#### **Modules for Microbiology**

## Mastermodule

## mar500 - Physiology and diversity of microorganisms

Module name	Physiology and diversity of microorganisms
Module code	mar500
ECTS credit points	12.0 KP
Workload	360 h
Used in degree programmes	Master Microbiology > Mastermodule
Contact person	Modulverantwortung
	<ul> <li>Heribert Cypionka</li> <li>Prüfungsberechtigt</li> </ul>
	<ul> <li>Alle hier genannten</li> <li>Modulberatung</li> </ul>
	• Lehrende der Mikrobiologie
Prerequisites	none
Skills to be acquired in this module	The students know the cells of pro- und eukaryotes. They understand the basic mechanisms of microbial metabolism. They know the physiological and phylogenetic groups of prokaryotes, eukaryotic microorganisms and viruses. They have an overview over applied aspects of microbiology.
Module contents	Lecture + Exercises: Physiology and Life modes of Prokaryotes: Cellular and subcellular organization, assimilation and dissimilation, energy metabolism, transport, microbial growth, respiration, chemiosmotic theory, fermentation, anaerobic respiration, lithotrophy, photosynthesis, prokaryotic diversity, systematics and taxonomy, Archaea, Bacteria, Eukarya, pathogenic prokaryotes, evolution, microbiological techniques
	Lecture + Exercises: Microbial Diversity The eukaryotic cell, diversity, systematics and taxonomy of prokaryotes and eukaryotic microorganisms, algae, protozoa, fungi, slime molds, phagocytosis, symbioses, pathogenic eukaryotes, diversity of eukaryotic microbes, components of viruses, virus reproduction, bacteriophages, diversity of viruses, virus diseases
	Broadening lectures, one out of the following lectures: - Biological significance of suspended matter) - Sediment Microbiology This lecture presents state of the art knowledge about occurrence, life and activities of microorganisms in these environments. Physiological issues are addressed as well as evolutionary and applied aspects. Topics are:
	<ul> <li>Formation, diagenesis and special features of sediments</li> <li>physico-chemical conditions and geological records</li> <li>interpretation of gradients</li> <li>microbes and biological processes in sediments</li> <li>methods for cultivation of sediment organisms</li> <li>molecular methods</li> <li>biogeochemical methods</li> <li>quantification of prokaryotes and viruses</li> </ul>
	(Teacher: Cypionka, Engelen, Vandieken; Form of study/semester periods per week: 4 week block, 2 lectures per week, Presence: 16 hours, private study: 74 hours; Credits: 3; 2nd Semester, Learning target/competences Physico-chemical conditions, microbial processes and methods of studying these processes in sediments)
	Broadening Seminar: Scientific writing and presentation The students know the importance and structure of scientific publications. They have learned to critically read those, and know the requirements of different parts. They are trained to to give oral presentations and know how to produce scientific reports and posters. The know how to use the library and how to find relevant literature on the internet, and how to use data banks like Endnote. They have learned how to present themselves for an application. Seminar Scientific writing and presentation:
	<ul> <li>Types and relevance of scientific publications</li> <li>Parts of scientific publications step by step:</li> <li>Abstract, Introduction, Results, Discussion</li> <li>University facilities for literature search</li> <li>Oral presentation</li> <li>How to prepare posters</li> </ul>
	<ul> <li>Tips for using PowerPoint, Word and Endnote</li> <li>Job application</li> <li>(Courses: Seminar (2 SPPW, 3 CP); Teachers: Cypionka, Engelen, Vandieken; Work load: Presence: 30 hours</li> </ul>

Date 27.10.2017

private study: 60 hours; Passing criteria: Oral presentation or discussion of parts of scientific papers ) - alternative lectures of the MSc MUWI or Biology program (see current online schedule) Excursions to companies and scientific institutions

Recommended reading	Brock. Microbiology			
Links				
Language of instruction	Englisch			
Duration (semesters)	2 semester			
Module frequency	jährlich			
Module capacity	unlimited			
Modullevel	MM (Mastermodul)			
Modulart	Pflicht			
	1 broadening lecture	r: Scientific writing and p	1 SPPW, 3 CP) ignificance of suspended matter / Sec resentation) (2 SPPW, 3 CP)	diment microbiology /
	Excursions (1 CP)			
Vorkenntnisse / Previous knowledge Examination			Type of examination	
U	Excursions (1 CP)		Type of examination Two written tests about 'Physiology and life mod Microbial Diversity. At least 50 % of the read	les of prokaryotes' and
Examination			Two written tests about 'Physiology and life mod Microbial Diversity.	chable points in written
Examination			Two written tests about 'Physiology and life mod Microbial Diversity. At least 50 % of the read	les of prokaryotes' and chable points in written ures mentioned above.
Examination	examination p	eriods	Two written tests about 'Physiology and life mod Microbial Diversity. At least 50 % of the read tests about the two lectu	tes of prokaryotes' and chable points in written ures mentioned above. Workload attendance
Examination Final exam of module	examination p	eriods	Two written tests about 'Physiology and life mod Microbial Diversity. At least 50 % of the read tests about the two lectu	tes of prokaryotes' and chable points in written ures mentioned above. Workload attendance 84 I
Examination Final exam of module Course type Vorlesung	examination p	eriods SWS 6	Two written tests about 'Physiology and life mod Microbial Diversity. At least 50 % of the read tests about the two lectu	les of prokaryotes' and chable points in written

#### mar510 - Molecular Mechanisms and Interactions

Module name	Molecular Mechanisms and Interactions	
Module code	mar510	
ECTS credit points	12.0 KP	
Workload	360 h	
Used in degree programmes	Master Microbiology > Mastermodule	
Contact person	- Master Microsiology > Mastermodule	
Contact person	Modulverantwortung	
	<ul> <li>Ralf Andreas Rabus</li> </ul>	
	Modulberatung	
	• Lehrende der Mikrobiologie	
Prerequisites	none	
Skills to be acquired in this module	mechanisms on the molecular level and feedback n	netabolism, genetics and evolution. They know regulatory nechanisms between organisms. They know the basics of rtant microbial habitats. They know molecular and chemical- rience with the field study of microorganisms.
Module contents	plasmids and DNA-exchange Part II on gene expression: transcription, regulation Part III on enzymes: protein structures, basic conce Part IV on regulatory networks: diauxie and catabol Lecture + exercises: Microbial Ecology Principles of biogeochemistry, global element cycle habitats, terrestrial habitats, deep subsurface biosp methods in microbial ecology, isotope fractionation, Broadening Lecture: Scientific writing and presenta	epts and kinetics, catalytic and regulatory strategies lite repression, oxygen regulation, chemotaxis es, mineralization of organic substances, chemotaxis, aquatic where, syntrophy and symbiosis, microbes in earth history, , applied microbiology, bioremediation
Recommended reading	Molecular Microbiology : Stryer – Biochemistry Voet – Biochemistry Knippers – Molekulare Genetik Snyder – Molecular Genetics of Bacteria Brock - Microbiology	
Links		
Language of instruction	Englisch	
Duration (semesters)	1 semester	
Module frequency	jährlich	
Module capacity	unlimited	
Information	12 CP   VL; Ü; KO; EX   2. FS   Rabus	
Modullevel	MM (Mastermodul)	
Modulart	Pflicht	
Lern-/Lehrform / Type of program	Lecture + Exercises: Molecular microbiology, (2 +1 Lecture + Exercises: Microbial ecology (2 + 1 SPPV Broadening lecture: Scientific writing and presentat Excursion (1 CP) Microbiological + ICBM Colloquium (2 CP)	N, 3 CP)
Vorkenntnisse / Previous knowledge		
Examination	examination periods	Type of examination
Final exam of module		Two written tests about the contents of the lectures 'Molecular Microbiology' and 'Microbial Ecology'.
		At least 50 % of the reachable points in written tests about the two lectures mentioned above.

At least 50 % of the reachable points in written tests about the two lectures mentioned above. Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report or seminar presentations according to the advice ot

amination	examination per	iods	Type of examination	
			the course supervisor.)	
Course type	Comment	SWS	Offer rhythm	Workload attendance
Vorlesung		4		56 h
Übung		2		28 h
Seminar		2		28 h
Exkursion		1		14 h

#### mar520 - Main Module Proteomics

Module name	Main Module Proteomics
Module code	mar520
ECTS credit points	12.0 KP
Workload	360 h
Used in degree programmes	Master Microbiology > Mastermodule
Contact person	Modulverantwortung ○ Ralf Andreas Rabus
	Modulberatung
	<ul> <li>Lars Wöhlbrand</li> <li>N. N.</li> </ul>
Prerequisites	Lecture: Physiology and diversity of prokaryotes Lecture: Molecular Microbiology
Skills to be acquired in this module	The students are getting directly involved in actual scientific projects in the area of physiological and/or meta- proteomics (under guidance). They
	<ul> <li>get acquainted with state-of-the-art proteomic concepts and technologies,</li> <li>know how to write concise scientific protocols,</li> <li>know how to present/discuss their results in public.</li> </ul>
Module contents	Functional proteomics: Daily lectures introduce the students to theory and concepts of modern proteomics: (i) separation of cellular compartments and protein extraction, (ii) gel-based and -free protein separation, (iii) gel-staining, protein detection and quantification by image analysis, (iv) integrative mass spectrometry-based protein identification, (v) meta-proteomics, and (vi) focused genomic analysis. Each student will prepare a seminar presentation on selected publications relevant for the actual scientific project. The following sequence of experiments will be conducted:
	<ul> <li>extraction and quantification of total protein from prepared cell samples (incl. separation of compartments),</li> <li>protein separation by SDS-PAGE and staining with Coomassie, silver and/or fluorescent dyes,</li> <li>digital image acquisition and analysis,</li> <li>manual and/or automated band excision,</li> <li>protein identification by nanoLC-ESI-MS/MS,</li> <li>nanoLC-MALDI-coupling and protein identification by MALDI-TOF-MS/MS,</li> <li>Physiological interpretation of predicted protein functions and relevant genomic context.</li> </ul>
Recommended reading	Lottspeich - Bioanalytik
Links	
Language of instruction	Englisch
Duration (semesters)	1 semester
Module frequency	jährlich
Module capacity	unlimited
Information	12 CP   SE; PR   2. FS   Rabus

Examination	examination periods	Type of examination	
Vorkenntnisse / Previous knowledge			
Lern-/Lehrform / Type of program	Seminar (2 CP ), practical course (10 CP)		
Modulart	Wahlpflicht		
Modullevel	MM (Mastermodul)		
Information	12 CP   SE; PR   2. FS   Rabus		

Final exam of module

One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)

Seminar presentation (25%), written protocol (75%). Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report or

amination	examination per	iods	Type of examination	
			seminar presentations a the course	ccording to the advice or
Course type	Comment	SWS	Offer rhythm	Workload attendance
Seminar		2		28 h
Praktikum		8		112 h
Total attendance time of module	•			140 h

#### mar530 - Main Module Ecophysiology of anaerobes

CTS readit points       12.0 KP         Vorkload       300 h         State in degree programmes       • Master Microbiology > Mastermodule         State in the interpret of the	Module name	Main Module Ecophysiology of anaerobes	
torokoad         960 h           Sead in degree programmes <ul> <li>Master Microbiology &gt; Mastermodule</li> <li>Sead in degree programmes</li> <li>Modulverantwortung</li> <li>Intelect Cybionka</li> <li>Profungsberechtigt</li> <li>Alle hiar genannten</li> <li>Modulberatung</li> <li>Bert Engelen</li> <li>N.</li> <li>The students can contribute to current scientific projects (under guidance). They know modern analytical techniques. They know and understand recent scientific iterature. They can write scientific reports, present their results and docus them in the public.</li> </ul> Ideals contents         "Ecotypicalogy of programmes" are carried out, typically in groups of visuades and docus them in the public.         - Anaenabic processes           - Anaenabic processes         - Senter Engelen <li>- Anaenabic processes</li> <li>- Microscopic analysis of chemotaxis in the exact PM studeent The results are summarized and discussed in a protocol fulfiling scientific tovel requirements.</li> <li>- Englisch</li> <ul> <li>- The results are summarized and discussed in a protocol fulfiling scientific tovel requirements.</li> <li>- Microscopic analysis of themotaxis</li> <li>- Anaenabic protocal anaenabic processes</li> <li>- Anaenabic processes</li></ul>	Module code	mar530	
seed in degree programmes <ul> <li>Master Microbiology &gt; Mastermodule</li> <li>Sentact person</li> <li>Modulverantwortung</li> <li>Heribert Cypionka</li> <li>Profungsberechtigi</li> <li>Alle hier genannten</li> <li>Modulberatung</li> <li>Sentact person</li> <li>Alle hier genannten</li> <li>Modulberatung</li> <li>Senta Engelen</li> <li>N.N.</li> </ul> <li>The students can contribute to current scientific projects (under guidance). They know moder analytical techniques: Projects derived from turrent scientific reports, present their results and discuss them in the public.</li> <li>Module contents</li> <li>Te cophysiology of prokarynet? Projects derived from current scientific programs are carted out, typically in <i>analysis of incorbail communities</i> <ul> <li>Project derived from turrent scientific reports, present their evalues and discuss them in the public.</li> </ul> </li> <li>Module contents</li> <li>Te cophysical projects and dividy measurements international journals are presented by the student. Typical project deal with: Analysis in the accompanying seminar, recent scientific studies in international journals are presented by the student The results are summarized and discussed in a protocol fulfilling scientific level requirements.</li> <li>Hord companying and instruction</li> <li>Englisch</li> <li>Module analysis of chemotaxis in the accompanying seminar, recent scientific studies in international journals are presented by the student The results are summarized and discussed in a protocol fulfilling scientific level requirements.</li> <li>Mord Mittermoduli</li> <li>Cophysical are summarized and discussed in a protocol fulfilling scientific level requirements.</li>	ECTS credit points	12.0 KP	
Addukterantwortung <ul> <li>Hariber Cypionka</li> <li>Privilungsberrechtigt</li> <li>Alle hier genannten</li> <li>Modulteratung</li> <li>Bert Engelen</li> <li>N.N.</li> </ul> Prerequisites       Lecture: Kinochial Physiology and Diversity, recommended: Sediment Microbiology         Kittls to be acquired in this module       The students can contribute to current acientific projects (under guidance). They how modern analytical techniques. They know modern analytical tech	Workload	360 h	
Modulerantwortung <ul> <li>Herlbert Cypionka</li> <li>Privilengeberechtigt</li> <li>Alle hier genannten</li> <li>Modulesatung</li> <li>Bert Engelen</li> <li>Nn.</li> </ul> Terequisites       Lecture: Microbial Physiology and Diversity, recommended: Sediment Microbiology         Kills to be acquired in this module       The students can contribute to current scientific projects (under guidance). They know modern analytical techniques. They know and understand recent scientific iterature. They can write scientific reports, present their results and decoss them in the public.         Kodule contents       "Ecosysticality of prokarytes". Projects derived from current scientific programs are carried out, typically in groups of two students guided by a selien scientific program are carried to t, typically in groups of two students guided by a selien scientific revol requirements.         • Macrobic processes       • Macrobic processes         • Mille analysis of chemotaxis       in the accompanying seminar, recent scientific studies in international journals are presented by the student The results are summarized and discussed in a protocol fulfiling scientific tereal requirements.         In the accompanying seminar, recent scientific studies in international journals are presented by the student The results are summarized and discussed in a protocol fulfiling scientific tereal requirements. <li>Mille announced</li>	Used in degree programmes	Master Microbiology > Mastermodule	3
Prüfungsberechtigt <ul> <li>Alle hier genannten koduberstung</li></ul>	Contact person	Modulverantwortung	
Modulberatung <ul> <li>Bert Engelen</li> <li>N.N.</li> </ul> **rerequisites       Lecture: Microbial Physiology and Diversity, recommended: Sediment Microbiology         *this to be acquired in this module       The students can contribute to current scientific projects (under guidance). They know modern analytical their results and discuss them in the public.        Module contents      The students can contribute to current scientific traterue. They can write scientific project deal write: students guided by a senior scientist or PhD student. Typical project deal write: scientific studies in international journals are presented by the student microbiology - Physiological experiments and activity measurements - Microscopic analysis of reicrobial communities - Microscopic analysis of dimensatis in the mational journals are presented by the student The results are summarized and discussed in a protocol fulfilling scientific level requirements.        Adequare matyles of the announced <ul> <li>Here accompanying sominar, recert scientific studies in international journals are presented by the student The results are summarized and discussed in a protocol fulfilling scientific level requirements.</li> <li>Microscopic analysis of the microbial experiments.</li> </ul> Adequare matyles of the microbial experiments. <ul> <li>Microscopic analysis of the microbial experiments.</li> <li>Microscopic analysis of the microbial experestexperements.<!--</th--><th></th><th></th><th></th></li></ul>			
* NN.       NN.         trerequisites       Lecture: Microbial Physiology and Diversity, recomment Scientific Projects (under guidance). They know modern analytical techniques. They know and understand recent scientific Iterature. They can write scientific reports, present their results and discuss them in the public.         todule contents       "Ecophysiology of prokaryotes": Projects derived from current scientific Iterature. They can write scientific reports, present techniques. They know students guided by a senior scientific or PDD student. Typical project deal with: <ul> <li>Anaeobic processes</li> <li>Molecular analysis of microbial communities</li> <li>Sediment incrobiology</li> <li>Physiologial experiments and activity measurements</li> <li>Microscopic analysis of chemotaxis</li> <li>In the accompanying seminar, recent scientific studies in international journals are presented by the student The results are summarized and discussed in a protocol fulfilling scientific level requirements.</li> </ul> tecture: Microscopic analysis of chemotaxis           Int be announced           inks           anguage of instruction         Englisch           torration         12 CP [ SE; PR   1. FS   Cypionka           todule requirements         Frequency           idodule requirements         Ecomponendul           errot.herdform / Type of program         examination periods         Type of examination:           reference.         Frequency         Biock course, 4 weeks, seminar and lisboratory work         <		-	
iskills to be acquired in this module       The students can contribute to current scientific projects (under guidance). They know modern analytical techniques. They know and understand recent scientific iterature. They can write scientific reports, present tire results and discuss them in the public.         Rodule contents       "Ecophysiology of prokaynotes". Projects derived from current scientific projects end with: - Anaerobic processes         • Miceular analysis of microbial scientific studies in international journals are presented by the student. Typical project deal with: - Anaerobic processes         • Microscopic analysis of therrobaxis         In the accompanying seminar, recent scientific studies in international journals are presented by the student. The results are summarized and discussed in a protocol fulfiling scientific level requirements.         Anaerobic processes			
techniques       They know and understand recent scientific literature. They can write scientific reports, present their results and accuss them in the public.         techniques       "Ecophysiology of prokaryotes". Projects derived from current scientific programs are carried out, typically in groups of two students guided by a senior scientist of PhD student. Typical project deal with: <ul> <li>anaerobic processes</li> <li>Molecular analysis of chicrobial communities</li> <li>Sediment microbiology</li> <li>Physiological experiments and activity measurements</li> <li>In the accompanying seminar, recent scientific studies in international journals are presented by the student The results are summarized and discussed in a protocol fulfilling scientific level requirements.</li> </ul> anguage of instruction     Englisch           Jurration (semesters)         1 semester           lockulart         With Matemodu)           Modulart         With Matemodu)           Moreacopit         Seminar (2CP), practical course (10 CP)           Block course, 4 weeks, seminar and laboratory work         One assessments of examination:           Portolic: Writer protocol and cournibulies         Seminar presentation (no mark), writen protocol fulfilling alter protocol fulfilling and presentation (seminar presentation)           lockulart         Wahipflicht         Seminar (2CP), practical course (10 CP)           Block course, 4 weeks, seminar and laboratory work         One assessments of examination:           Portolic: Writen	Prerequisites	Lecture: Microbial Physiology and Diversity, r	ecommended: Sediment Microbiology
groups of two students guided by a senior scientist or PhD student. Typical project deal with:       Anaerobic processes         Molecular analysis of incrobial communities       Sediment microbial communities         Sediment microbial communities       Intrococcipic analysis of chemotaxis         In the accompanying seminar, recent scientific studies in international journals are presented by the student The results are summarized and discussed in a protocol fulfilling scientific level requirements.         anguage of Instruction       Englisch         anguage of Instruction       Englisch         foodule requency       jährlich         Molecular       Valvastermodul)         Koduler       Seminar (CP ) program         Remnarized for the examination periods       Type of examination:         er.mr.Lehrform / Type of program       Seminar (2 P ) practical course (10 CP)         Block course, 4 weeks, seminar and laboratory work       Portfolio: Written protocol and contribution to the seminar (seminar presentation)         rinal exam of module       examination periods       Type of examination:         Portfolio: Written protocol and course (10 CP)       Berniar presentation (no mark), written protocol (100%)         Seminar (seminari on module       Examination periods       Type of examination:         er.mr.Lehrform / Type of program       Seminar presentation (no mark), written protocol (100%)         Seminar present	Skills to be acquired in this module	techniques. They know and understand recer	
inks       Englisch         anguage of instruction       Englisch         buration (semesters)       1 semester         Aodule frequency       jährlich         Module capacity       unlimited         Information       12 CP   SE; PR   1. FS   Cypionka         Modulerel       MM (Mastermodul)         Modulart       Wahlpflicht         .ern-/Lehrform / Type of program       Seminar (2 CP ), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work         forkenntnisse / Previous knowledge       Examination periods       Type of examination: Portolic: Written protocol and contribution to the seminar (seminar presentation)         Final exam of module       Seminar presentation (Active and documented 	Module contents	groups of two students guided by a senior sci - Anaerobic processes - Molecular analysis of microbial communities - Sediment microbiology - Physiological experiments and activity meas - Impact of viruses - Microscopic analysis of chemotaxis In the accompanying seminar, recent scientifi	entist or PhD student. Typical project deal with: surements c studies in international journals are presented by the students
anguage of instruction       Englisch         buration (semesters)       1 semester         fodule frequency       jährlich         fodule capacity       unlimited         formation       12 CP   SE; PR   1. FS   Cypionka         fodulatr       VMM (Mastermodul)         fodulatr       Vahlpflicht         seminar (2 CP ), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work       Seminar (2 CP ), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work         forkenntnisse / Previous knowledge       Examination periods       Type of examination: Portfolic: Written protocol and contribution to the seminar (seminar presentation)         inal exam of module       Seminar presentation (no mark), written protocol (100%)       Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report seminar presentations cocording to the advice or the course supervisor.         course type       Comment       SWS       Offer rhythm       Workload attendand Seminar	Recommended reading	will be announced	
Jammation (semesters)       1 semester         fodule frequency       jährlich         fodule capacity       unlimited         formation       12 CP   SE; PR   1. FS   Cypionka         fodulate       MM (Mastermodul)         fodulate       Wahlpflicht         seminar (2 CP ), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work         forkenntnisse / Previous knowledge         ixamination       examination periods         Type of examination:         Portolici: Written protocol and contribution to the seminar presentation)         Seminar (seminar presentation)         Seminar presentation (no mark), written protocol and courses (100%)         Active participation (no mark), written protocol (100%)         Active participation in practical courses (10 CP)         Block course, 4 weeks, seminar and laboratory work         forkenntnisse / Previous knowledge         image: transmation         examination         examination (a course)         inal exam of module         One assessments of examination:         Portolici: Written protocol and courses (labs, exercises, seminar presentation)         Seminar presentation (a courses, writing a lab report seminar presentation)         Seminar presentation saccording to the advice or the course supervisor.)         cou	_inks		
Module frequency       jährlich         Module capacity       unlimited         Information       12 CP   SE; PR   1. FS   Cypionka         Modulevel       MM (Mastermodul)         Modulart       Wahlpflicht         seminar (2 CP), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work         Korkenntnisse / Previous knowledge         Examination       examination periods         Tinal exam of module       One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)         Seminar presentation (no mark), written protocol (100%)       Seminar presentation (no mark), written protocol (100%)         Seminar presentation (no mark), written protocol (100%)       Cotive participation (Active and documented participation in practical courses (labs, exercises, seminar, field trips) and courses. These include e.g. the delivery of exercises, seminar presentations according to the advice or the course supervisor.)         course type       Comment       SWS       Offer rhythm       Workload attendand Workload attendand         Seminar       12       28	anguage of instruction	Englisch	
Module capacity       unlimited         Information       12 CP   SE; PR   1. FS   Cypionka         Modulevel       MM (Mastermodul)         Modulart       Wahlpflicht         semr/Lehrform / Type of program       Seminar (2 CP), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work         Korkenntnisse / Previous knowledge       Type of examination         Examination       examination periods       Type of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)         Seminar presentation (no mark), written protocol (100%)       Seminar presentation (no mark), written protocol (100%)         Course type       Comment       SWS       Offer rhythm       Workload attendand Workload attendand         Seminar       2       28	Duration (semesters)	1 semester	
12 CP   SE; PR   1. FS   Cypionka         Modullevel       MM (Mastermodul)         Modulart       Wahlpflicht         sem-r/Lehrform / Type of program       Seminar (2 CP ), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work         /orkenntnisse / Previous knowledge       Examination         Examination       examination periods         Type of examination:       Portfolio: Written protocol and contribution to the seminar (seminar presentation)         Seminar presentation (no mark), written protocol (100%)       Active participation (no mark), written protocol (100%)         Active participation in practical courses (labs, exercises, seminar presentation)       Seminar presentation (no mark), written protocol (100%)         Active participation in practical courses (labs, exercises, seminar presentation)       Seminar presentation (active and documented participation in practical courses (labs, exercises, seminar presentations according to the advice or the course supervisor.)         Course type       Comment       SWS       Offer rhythm       Workload attendance or the course supervisor.)         Seminar       2       28	Nodule frequency	jährlich	
Modullevel       MM (Mastermodul)         Modulart       Wahlpflicht         Modulart       Wahlpflicht         Modulart       Seminar (2 CP), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work         /orkenntnisse / Previous knowledge       Examination periods         Examination       examination periods         Final exam of module       One assessments of examination: Portfolio: Written protocol and contribution to the seminar presentation (no mark), written protocol (100%) Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report seminar presentations according to the advice or the course supervisor.)         Course type       Comment       SWS       Offer rhythm       Workload attendand seminar (2 CM)         Seminar       2       28	Nodule capacity	unlimited	
Modulart       Wahlpflicht         seminar (2 CP), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work         /orkenntnisse / Previous knowledge         Examination       examination periods       Type of examination: Portfolic: Written protocol and contribution to the seminar (seminar presentation)         Final exam of module       Seminar presentation (no mark), written protocol (100%)       Seminar presentation (no mark), written protocol (100%)         Active participation (Active and documented participation (Active and documented participation in practical courses; These include e.g. the delivery of exercises, seminary presentations according to the advice or the course supervisor.)         course type       Comment       SWS       Offer rhythm       Workload attendand Workload attendand         Seminar       2       28	nformation	12 CP   SE; PR   1. FS   Cypionka	
Lerr-/Lehrform / Type of program       Seminar (2 CP), practical course (10 CP) Block course, 4 weeks, seminar and laboratory work         /orkenntnisse / Previous knowledge         Examination       examination periods       Type of examination         Final exam of module       One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)         Seminar presentation (no mark), written protocol (100%)       Seminar presentation (no mark), written protocol (100%)         Active participation (Active and documented participation in practical courses (labs, exercises, seminar; field trips) and courses. These include e.g. the delivery of exercises, writing a lab report seminar presentations according to the advice or the course supervisor.)         Course type       Comment       SWS       Offer rhythm       Workload attendance         2       28	Modullevel	MM (Mastermodul)	
Block course, 4 weeks, seminar and laboratory work         Arrive Corkennthisse / Previous knowledge         Examination       examination periods       Type of examination         Final exam of module       One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)         Seminar presentation (no mark), written protocol (100%)       Seminar presentation (no mark), written protocol (100%)         Active participation (Active and documented participation in practical courses (labs, exercises, seminar, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report seminar presentations according to the advice or the course supervisor.)         Course type       Comment       SWS       Offer rhythm       Workload attendand Workload attendand         Seminar       2       28	Modulart	Wahlpflicht	
Examination       examination periods       Type of examination         Final exam of module       One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)       Portfolio: Written protocol and contribution to the seminar presentation)         Seminar presentation       Seminar presentation (no mark), written protocol (100%)       Active participation (Active and documented participation in practical courses (labs, exercises, seminar, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report seminar presentations according to the advice or the course supervisor.)         Course type       Comment       SWS       Offer rhythm       Workload attendance 2	Lern-/Lehrform / Type of program		ry work
Final exam of moduleOne assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)Seminar presentationSeminar presentation (no mark), written protocol (100%) Active participation (Active and documented participation in practical courses (labs, exercises, seminar, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report seminar presentations according to the advice or the course supervisor.)Course typeCommentSWSOffer rhythmWorkload attendance 28	Vorkenntnisse / Previous knowledge		
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(100%)Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report seminar presentations according to the advice or the course supervisor.)Course typeCommentSWSOffer rhythmWorkload attendance 28Seminar228	Final exam of module		Portfolio: Written protocol and contribution to the
Seminar 2 28			(100%) Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report of seminar presentations according to the advice or
	Course type	Comment SWS	Offer rhythm Workload attendance
Praktikum 8 112	Seminar	2	28
	Praktikum	8	112

#### mar540 - Main Module Ecology of Marine Microbial communities

Module code         mar/540           ECTS cardit points         12.0 KP           Workload         360 h           Used in degree programmes         • Master Microbiology > Mastermodule           Contact person         Module contents           * Module content person         • Master Microbiology > Mastermodule           Contact person         Module content person           * Module content person         • Master Microbiology > Mastermodule           Perequisities         - Male integrammeter           * Thorsten Henning Brinkhoff         Perequisities           Skills to be acquired in this module         Contact person           Skills to be acquired in this module         Contact person on the ecology of passion on the ecology of passion and to carry out experimental and/or field work in accompt data datase specific researchers and PhD students. The projects are designed in the contact of orgoning research on the ecology of passion on the ecology of passion on the ecology of passion and dataset specific researchers in aquatic microbial ecology and to choose appropriate methods. They obtain project-tar reported in methods and on the validity of scientific reports are designed in the accompanying sequent dataset accompanying sequent dataset with a module cology.           Module contents         Thesis work and of the content of the art methods and on the validity of scientific reports are designed in the accompanying sequence three designed in the accompanying sequence three designed in the accompanying sequence three designed in the accothopsis and the accompan	Module name	Main Module Ecology	of Marine Microbial o	communities		
CTS credit points         12.0 KP           Workload         360 h           Used in degree programmes         • Master Microbiology > Mastermodule           Contact person         Module ranktworkung           • Maihard Simon         Prifungsberechtigt           • Maihard Simon         Prifungsberechtigt           • Maihard Simon         Prifungsberechtigt           • Maihard Simon         Prifungsberechtigt           • Thorstan Herning Brinkhoff         Percequisites           Skills to be acquired in this module         Torstan Herning Brinkhoft           Prerequisites         Lacture: Biological significance of suppended matter           Skills to be acquired in this module         Torstan Herning Brinkhoft           Statistica be acquired in this module         Torstan Herning Brinkhoft           Skills to be acquired in this module         Torstan Herning Brinkhoft           Skills to be acquired in this module         Torstan Herning Brinkhoft           Skills to be acquired in this module         Torstan Herning Brinkhoft           Skills to be acquired in this module         Torstan Herning Brinkhoft           Skills to be acquired in this module         Torstan Herning Brinkhoft           Torstan Herning Brinkhoft         Torstan Herning Brinkhoft           Torstachart in the accoprophere herbafts. Thre students and realits of						
Workload       360 h         Used in degree programmes       • Master Microbiology > Mastermodule         Contact person       Modulverantwortung         • Meinhard Simon       Préfungsboechtigt         • Alle hier genannten       Modulverantwortung         • Alle hier genannten       Modulverantwortung         • Alle hier genannten       Modulverantwortung         • Thorsten Henning Brinkhoff       -         Perequisites       Lectus: Eliological significance of suspended matter         Skills to be acquired in this module       Steudents lams how to address sociatific questions and to carry out experimental and/or field work in associated to eukaryotic progeing guidely assignificance for suspended matter         Skills to be acquired in this module       Steudents lams how to address sociatific questions and to carry out experiments and address specific research designed in the cortext of droging research on results and reference studes to an associated to eukaryotic progeins microbial ecology and how to interpret data and results of the erimetal students lams how and address specific research questions in aquate microbial ecology and to ohoose appropriate methods. The obtain a more citical view on the application of these and other methods and on the validity of scientific investigations in aquate microbial coulds and on the validity of scientific investigations in aquate microbial ecology and to ohoose appropriate methods. The obtain a more citical view on the application of these and other methods and on the validity of scientific investigations in aquate microbial ecology.         Module contents<						
Used in degree programmes       • Master Microbiology > Mastermodule         Contact person       Modulverantwortung         • Meinhard Simon Profungsberechtigt       • Alle hier genannten Modulberatung         • Thorsten Henning Brinkhoff         Person       Letture: Biological significance of suspended mater         Skills to be acquired in this module       Scientific project significance of suspended mater         Skills to be acquired in this module       Scientific project significance of suspended mater         Skills to be acquired in this module       Scientific project significance of suspended mater         Skills to be acquired in this module       Scientific project significance of suspended mater         Skills to be acquired in this module       Context of organ present on the devise of paterial commutation in the valer organizes and the organ present on the scientific papers and to present own results and the methods and approachases in aquater microball ecclosing and to to inserper present own results and reference studies to an audience.         The students gain competences in how to design experiments and address specific research project transet de application of taste of the art methods. This enables them to obtain practical Superince in project transet de application of taste of the art methods. The subtent is and accompanying seminar, methods sudden ther methods. The subtent is and ecclosy.         Module contents       "Ecology of marine microbers". The students gain competences in how to design experiments.         Module contents       English, Deuts	-					
Contact person       Modulvariantwortung <ul> <li>Meinhard Simon</li> <li>Profungsberechtigt</li> <li>Alle hier genannten</li> <li>Modulvariantwortung</li> <li>Thorsten Henning Brinkhoff</li> </ul> Prerequisites     Lecture: Biological significance of suspended matter           Skills to be acquired in this module         The students learn how to address scientific questions and to carry out experimental and/or field work in sature of the students learn how to address scientific questions and to the students. The projects are designed in the context of ongoing research on the ecology of bactenial communities in the wetter column, oxic sediments and associated to eukaryot cognains. The students learn how to address scientific questions and to carry out experiments and adress students on the ongoing research on the valuent students being ongoing research on the valuent students of the projects. They learn to write projects the students and on the valuent wetter column, oxic sediments and other methods and on the valuent students. The projects they learn to appreate more forgain and the research students to an anne critical view on the application of these and other methods. This enables them to obain a more critical view on the application of these and other methods. This enables them to obain a more critical view on the application of these and other methods. The voltaring research of PhD Theses work and other carrent research the working group. Tryctally a group of two of three students is a protocol fulfilling scientific levestignents in the students. The results are written down and discussed in a protocol fulfilling scientific levesting scientific levesting scientific levesting scientific levesting scientific levesting scientific levesting scientis is a published in limenational journals are presented			biology > Mastermod	ule		
Modulverantwortung         • Meinhard Simon         Prüfungsberechtigt         • Alle hier genannten         Modulveratung         • Thorsten Henning Brinkhoff         Perequisites       Lettre: Biological significance of suspended matter         Skills to be acquired in this module       The students leam how to address scientific questions and to carry out experimental and/or field work in scientific projects guided by experienced researchers and PhD students. The projects are designed in the content of ongoin greeserch on the ecology of abtecidal communities in the water columo. oxic sediments and associated to eukaryotic organisms. The studentis leam to apply various state of the art methods and associated to eukaryotic organisms. The studentis leam to apply various state of the art methods and associated to eukaryotic organisms. The studentis leam to apply various state of the art methods and associated to eukaryotic organisms. The studentis leam to apply various state of the art methods and associated to eukaryotic organisms. The studentis leam to apply various state of the art methods. The projects are designed in the content is more critical wave on the projects. The project are designed in the content is more critical wave on the application of these and obter methods and on the validity of scientific investigations in aquatic microbial ecology.         Module contents       "Ecology of marine microbes": The students carry out small projects coming out of ongoing research of the art methods. The results and results of the art methods. The results are results and results of the art methods. The results are results and results of the art methods. The results are results and results of the art methods. The results are results and results or apr			biology > Masternioe	uic		
Prüfungsberechtigt <ul> <li>Alle hiergenannten Modubleratumg</li> <li>- Torsten Henning Brinknoff</li> </ul> Prerequisites       Lecture: Biological significance of suspended matter         Skills to be acquired in this module       The students learn how to address scientific questions and to carried the art methods. This is the vater column, oxis cediments and arcinetific projects are designed in the projects are designed in the context of ongoing research on the ecology of bacterial communities in the water column, oxis cediments and arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects.         Module contents              "Ecology of marine microbes". The students arm yout small projects are dependent on and siccussed arroteorial utilities scientific learner and/or a PhD student. In the accompanying seminar, recent scientific experiments arroteorial utilities scientific learner are dependent on the scientific experiments.         Interior (semsetres)              interinteresearch experiments of the worinhegratics	Contact person	Modulverantwortung				
Prüfungsberechtigt <ul> <li>Alle hiergenannten Modubleratumg</li> <li>- Torsten Henning Brinknoff</li> </ul> Prerequisites       Lecture: Biological significance of suspended matter         Skills to be acquired in this module       The students learn how to address scientific questions and to carried the art methods. This is the vater column, oxis cediments and arcinetific projects are designed in the projects are designed in the context of ongoing research on the ecology of bacterial communities in the water column, oxis cediments and arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects. They learn is arguiter microbale ecology and how to interpret data are results of the projects.         Module contents              "Ecology of marine microbes". The students arm yout small projects are dependent on and siccussed arroteorial utilities scientific learner and/or a PhD student. In the accompanying seminar, recent scientific experiments arroteorial utilities scientific learner are dependent on the scientific experiments.         Interior (semsetres)              interinteresearch experiments of the worinhegratics		∘ Mein	hard Simon			
Modulberatung       • Thorsten Henning Brinkhoff         Prerequisites       Lecture: Biological significance of suspended matter         Skills to be acquired in this module       The students learn how to address scientific questions and to carry out experimental and/or field work in scientific projects guided by experienced researchers and PhD students. The projects are designed in the context of orgonize presearch on the collogy and how to inderess and exposure of the and result communities in the water column, oxis data of the art methods and associated to eukaryotic organisms. The students learn to apply values state of the art methods and associated to eukaryotic organisms. The students learn to apply values state of the art methods and associated to eukaryotic organisms. The students learn to apply values state of the art methods in a more critical view on the valid experiments and address specific research questions in aquatic microbial ecology and how to badging experiments and address specific research questions in aquatic microbial ecology and how to be students. They obtain the obtain a more critical view on the esitivation of state of the art methods. This enables them to obtain a more critical view on the signification of these of the art methods. This enables them to obtain a more critical view of the esitivation is aquatic microbial ecology and how to the students. The results are written down ad discussed in a protocol fulfiling scientific level requirements.         Recommended reading       will be announced       Image: Ima						
Increase         Exercise           Prerequisites         Lecture: Biological significance of suspended mater           Skills to be acquired in this module         The students learn how to address scientific questions and to carry out experimental and/or field work in scientific projects guided by aspendenced researches and PDD students. The project are designed in the context of ongoing research on the ecology of bacterial commuties in the water column, oxis sediments and aspociate in aquatic microbial ecology and how to interprit data and results of the projects. They lean to audience.           The students gain competences in how to dotigin experiments and address specific research questions in aquatie microbial ecology and how to interprit data and results of research questions in aquatie microbial ecology and to choose appropriate methods. This enables them to obtain practical experience in project- targeted application of these and other methods. This enables them to obtain a more critical view on the application of these and other methods. This enables them to obtain a more critical view on the application of these and other methods. They obtain practical experience is not the subject of on poing research of PDD Thesis work and other current research and the working group. Typically a group of two of three students is protocol fulfilling scientific level requirements.           Recommended reading         Will be announced         The secule working aroup. Typically a group of two of three students is protocol fulfilling scientific level requirements.           Recommended reading         Indirect Fill Fill Fill Fill Fill Fill Fill Fil		• Alle I	hier genannten			
Prerequisites         Lecture: Biological significance of suspended matter           Skills to be acquired in this module         The students learn how to address scientific questions and to carry out experimental and/or field work in scientific projects guided by experienced researchers and PhD students. The projects are designed in the context of orgging research on the ecology of hacterial communities in the water column, oxis sediments and associated to eukaryotic organisms. The students learn to apply various state of the art methods and approaches in aquatic microbial ecology and how to interpret data and reference studies to an audience. The students gain competences in how to design experiments and address specific research questions in a quatic microbial ecology of how to horse partorabing in ractical experience in project-targeted application of these and other methods. This orbital practical experience in project-targeted application of state of the art methods. They obtain a more critical view on the application of these and other methods. This orbital practical experience in project-targeted application of these and other current research of the working group. Typically agroup of two of three students is guided by a senior researcher and/or a PND student. The results are written down and discussed in a protocol fulfilling scientific level requirements.           Recommended reading         will be announced         Image: Senitific level requirements.           Links         Languages of instruction         Englisch, Deutsch         Image: Senitific level requirements.           Module craceity         Milling scientific level requirements.         Senitific studies: Senitific level requirements.           Recommended reading         Unifified <t< th=""><th></th><th>Modulberatung</th><th>C C</th><th></th><th></th><th></th></t<>		Modulberatung	C C			
Skills to be acquired in this module       The students learn how to address scientific questions and to carry out experimental and/or field work in scientific projects guided by experienced researchers and PD students. The projects are designed in the context of ongoing research on the ecology of bacterial communities in the water column, oxis sediments and associated to eukaryotic organisms. The students learn to apply various state of the art methods and approaches in aquatic microbial ecology and how to interpret data and results of the projects. They learn to write protocols in the structure of scientific papers and to present own results and reference studies to an audience.         The students gain competences in how to design experiments and address specific research questions in aquatic microbial ecology and to choose appropriate methods. This evolution protecture application of state of the art methods. This enables them to obtain a more critical view on the application of state of the art methods. The working group. Typically a group of two of three students is guided by a senior research of and of the corm provides are designed in the companying seminar, recent scientific studies published in international journals are presented by the students. The results are written down and discussed in a protocol fulfilling scientific level requirements.         Recommended reading       will be announced       Intersecure to the students is guided by a senior research of the students. The results are written down and discussed in a protocol fulfilling scientific level requirements.         Recommended reading       will be announced       Intersecure to the students. The results are written down and discussed in a protocol fulfilling scientific level requirements.         Module frequency       jahrlich       Inter		• Thor	sten Henning Brinkho	off		
scientific projects guided by experienced researchers and PDs buidents. The projects are designed in the context of ongoing research on the ecology of bacterial communities in the water column, oxis sediments and associated to eukayotic organisms. The students learn to apply various state of the art methods and usero collegy and how to interpret data and results of the projects. They learn to write protocols in the structure of scientific pargets and to present own results and reference studies to an audience.Module contents"Ecology of marine microbes": The students learn to obtain a more critical view on obtain andore critical view on other state and view of the structure.Module contentsEcology of marine microbes': The students carry out and bicrusted of the structure.Innese	Prerequisites	Lecture: Biological sig	nificance of suspend	ed matter		
Thesis work and other current researcher and/or a PhD student. In the accompanying seminar, recent scientific studies published in international journals are presented by the students. The results are written down and discussed in a protocol fulfilling scientific level requirements.         Recommended reading       will be announced         Links       Image: State Stat	Skills to be acquired in this module	scientific projects guided by experienced researchers and PhD students. The projects are designed in the context of ongoing research on the ecology of bacterial communities in the water column, oxic sediments and associated to eukaryotic organisms. The students learn to apply various state of the art methods and approaches in aquatic microbial ecology and how to interpret data and results of the projects. They learn to write protocols in the structure of scientific papers and to present own results and reference studies to an audience. The students gain competences in how to design experiments and address specific research questions in aquatic microbial ecology and to choose appropriate methods. They obtain practical experience in project-targeted application of state of the art methods and on the validity of scientific investigations in aquatic microbial		cts are designed in the olumn, oxic sediments and e art methods and e projects. They learn to eference studies to an c research questions in al experience in project- e critical view on the		
Links Languages of instruction Englisch, Deutsch Duration (semesters) 1 semester Module frequency jährlich Information 12 C P J SE; PR   2. FS   Simon I 2 C P J SE; PR   2. FS   Simon Modullevel MM (Mastermodul) MM (Mastermodul) Modulart Vahlpflicht Lenn-/Lehrform / Type of program Seminar (2 C P, 1 SP PW), practical course (10 C P, 9 SP PW) Vorkenntnisse / Previous knowledge Examination periods forget fo	Module contents	Thesis work and other guided by a senior res published in internatio	r current research of searcher and/or a Phl mal journals are pres	the working group. D student. In the ad ented by the stude	Typically a group of t ccompanying seminar	wo of three students is , recent scientific studies
Languages of instruction       Englisch, Deutsch         Duration (semesters)       1 semester         Module frequency       jährlich         Module capacity       unlimited         Information       12 CP   SE; PR   2. FS   Simon         Modullevel       MM (Mastermodul)         Modulart       Wahlpflicht         Lern-/Lehrform / Type of program       Seminar (2 CP, 1 SP EW ), practical course (10 CP, 9 SP EW)         Vorkenntnisse / Previous knowledge          Examination       examination periods       Type of examination         Final exam of module        1       14 h         Seminar       1       9       126 h	Recommended reading	will be announced				
Duration (semesters)       1 semester         Duration (semesters)       1 semester         Module frequency       jährlich         Module capacity       unlimited         Information       12 CP   SE; PR   2. FS   Simon         Modulevel       MM (Mastermodul)         Modulart       Wahlpflicht         Lern-/Lehrform / Type of program       Seminar (2 CP, 1 SPPW ), practical course (10 CP, 9 SPPW)         Vorkenntnisse / Previous knowledge       Type of examination         Examination       examination periods       Type of examination         Final exam of module       Comment       SWS       Offer rhythm       Workload attendance         Seminar       1       14 h         Practikum       9       126 h	Links					
Module frequency       jährlich         Module capacity       unlimited         Information       12 CP   SE; PR   2. FS   Simon         Modullevel       MM (Mastermodul)         Modulart       Wahlpflicht         Lern-/Lehrform / Type of program       Seminar (2 CP, 1 SPPW), practical course (10 CP, 9 SPPW)         Vorkenntnisse / Previous knowledge       Type of examination         Final exam of module       Vorkenter         Course type       Comment       SWS       Offer rhythm       Workload attendance         Seminar       1       9       9       126 h	Languages of instruction	Englisch, Deutsch				
Module capacity     unlimited       Information     12 CP   SE; PR   2. FS   Simon       Modullevel     MM (Mastermodul)       Modulart     Wahlpflicht       Lern-/Lehrform / Type of program     Seminar (2 CP, 1 SPPW ), practical course (10 CP, 9 SPPW)       Vorkenntnisse / Previous knowledge     Examination periods       Final exam of module     Comment       Seminar     SWS       Offer rhythm     Workload attendance       Seminar     1       9     126 h	Duration (semesters)	1 semester				
Information 12 CP   SE; PR   2. FS   Simon Modullevel MM (Mastermodul) Modulart Wahlpflicht Lern-/Lehrform / Type of program Seminar (2 CP, 1 SPPW ), practical course (10 CP, 9 SPPW) Vorkenntnisse / Previous knowledge Examination eriods examination periods Type of examination Final exam of module Course type Comment SWS Offer rhythm Workload attendance Seminar 1 1 14 h Praktikum 9 12 CP   SE; PR   2. FS   Simon	Module frequency	jährlich				
Modullevel     MM (Mastermodul)       Modullart     Wahlpflicht       Lern-/Lehrform / Type of program     Seminar (2 CP, 1 SPPW ), practical course (10 CP, 9 SPPW)       Vorkenntnisse / Previous knowledge     Examination periods       Examination     examination periods     Type of examination       Final exam of module     Comment     SWS     Offer rhythm       Seminar     1     14 h       Praktikum     9     126 h	Module capacity	unlimited				
Modulart     Wahlpflicht       Lern-/Lehrform / Type of program     Seminar (2 CP, 1 SPPW ), practical course (10 CP, 9 SPPW)       Vorkenntnisse / Previous knowledge     Examination periods     Type of examination       Examination     examination periods     Type of examination       Final exam of module     Comment     SWS     Offer rhythm     Workload attendance       Seminar     1     14 h       Praktikum     9     126 h	Information	12 CP   SE; PR   2. F	S   Simon			
Lern-/Lehrform / Type of program     Seminar (2 CP, 1 SPPW ), practical course (10 CP, 9 SPPW)       Vorkenntnisse / Previous knowledge       Examination     examination periods       Final exam of module       Course type     Comment     SWS     Offer rhythm     Workload attendance       Seminar     1     14 h       Praktikum     9     126 h	Modullevel	MM (Mastermodul)				
Vorkenntnisse / Previous knowledge       Examination     examination periods     Type of examination       Final exam of module     Comment     SWS     Offer rhythm     Workload attendance       Seminar     1     14 h       Praktikum     9     126 h	Modulart	Wahlpflicht				
Examinationexamination periodsType of examinationFinal exam of moduleCourse typeCommentSWSOffer rhythmWorkload attendanceSeminar114 hPraktikum9126 h	Lern-/Lehrform / Type of program	Seminar (2 CP, 1 SPF	PW ), practical course	(10 CP, 9 SPPW)	)	
Final exam of module       Course type     Comment     SWS     Offer rhythm     Workload attendance       Seminar     1     14 h       Praktikum     9     126 h	Vorkenntnisse / Previous knowledge					
Course typeCommentSWSOffer rhythmWorkload attendanceSeminar114 hPraktikum9126 h	Examination	examination per	riods	Ту	pe of examination	
Seminar114 hPraktikum9126 h	Final exam of module					
Praktikum 9 126 h	Course type	Comment	SWS		Offer rhythm	Workload attendance
	Seminar		1			14 h
	Praktikum		9			126 h
Total attendance time of module 140 h	Total attendance time of module					140 h

#### mar550 - Profile Module Physiology of bacteria

Module name	Profile Module Physiology of bacteria		
Module code	mar550		
ECTS credit points	6.0 KP		
Workload	180 h		
Used in degree programmes	Master Microbiology > Mastermodule		
Contact person	Modulverantwortung		
	<ul> <li>Heribert Cypionka</li> <li>Prüfungsberechtigt</li> </ul>		
	Heribert Cypionka		
Prerequisites	Lecture: Physiology and diversity of prokaryote	es	
Skills to be acquired in this module	The students know how to  cultivate bacteria and generate pure cu determine the live count prepare and use washed cell suspensi measure bacterial activity (respiration, use and understand the functioning ele use a microscope and take digital micr quantitatively rely growth, energy meta understand the action of inhibitors present and discuss scientific results write a scientific protocol	ons for experiments proton translocation, transport proce ectrodes (pH, O2) and photometers ophotographs	, ,
Nodule contents	Physiology of bacteria: The course starts with isolation experiment will be performed over 10 round robin. The following processes are analy complex and monomer substrates, respiration	days. Four physiological experiment yzed: Growth under oxic and anoxic	ts are done over two day's conditions, respiration with
Recommended reading			
inks			
anguage of instruction	Englisch		
Duration (semesters)	1 semester		
Module frequency	jährlich		
Module capacity	unlimited		
nformation	6 CP   SE; PR   1. or 3. FS   Cypionka		
Modullevel	MM (Mastermodul)		
Modulart	Wahlpflicht		
_ern-/Lehrform / Type of program	Seminar (2 CP, 1 SPPW ), practical course (4	CP,4 SPPW)	
Vorkenntnisse / Previous knowledge			
Examination	examination periods	Type of examination	
Final exam of module		One assessment of exar Portfolio (seminar preser	
		Active participation (Acti	ar presentation (no mark).
		seminars, field trips) and e.g. the delivery of exerc	courses (labs, exercises,
Course type	Comment SWS	seminars, field trips) and e.g. the delivery of exerc seminar presentations a	courses (labs, exercises, courses. These include ises, writing a lab report o
Course type Seminar	Comment SWS 1	seminars, field trips) and e.g. the delivery of exerc seminar presentations a the course supervisor.)	courses (labs, exercises, courses. These include ises, writing a lab report o ccording to the advice of
		seminars, field trips) and e.g. the delivery of exerc seminar presentations a the course supervisor.)	courses (labs, exercises, courses. These include ises, writing a lab report o ccording to the advice of Workload attendance

#### mar560 - Profile Module Fermentation

Module name	Profile Module Fermentation	
Module code	mar560	
ECTS credit points	6.0 KP	
Workload	180 h	
Used in degree programmes	Master Microbiology > Mastermodule	•
Contact person	Modulverantwortung	
	-	
	<ul> <li>Ralf Andreas Rabus</li> <li>Prüfungsberechtigt</li> </ul>	
	<ul> <li>Alle hier genannten Modulberatung</li> </ul>	
	<ul><li>Uwe Maschmann</li><li>Kathleen Trautwein</li></ul>	
Prerequisites	Lecture: Physiology and diversity of prokaryot Lecture: Molecular Microbiology	es (successfully completed)
Skills to be acquired in this module	guidance). They understand the scientific ratio	ctual scientific projects in the area of general physiology (under onal and design of the experiment(s), get acquainted with state-of -controlled cultivation and growth balancing, know how to write ent/discuss their results in public.
Module contents	growth physiology and balancing, (ii) design a electrodes and kLa-determination of O2-supp	udents to theory and concepts of process-controlled cultivation: (i ind operating mode of laboratory fermenters, (iii) pH / pO2 ly, (iv) on-line gas analysis (O2, CO2, etc.) by mass spectrometry tion on selected publications relevant for the actual scientific
	-determination of optical density, the live cour -(dis)assembly and sterilization of fermentatio -operate process-controlled fermenters (incl.	neyer flasks as inoculum for actual "fermenter"-cultures It and dry weight of cells during cultivation in fermenter n devices D2 and pH adjustments and sterile sampling) tion rates based on on-line GC-MS measurements
Recommended reading		
Links		
	Englisch	
Language of instruction	Englisch 1 semester	
Language of instruction Duration (semesters)		
Language of instruction Duration (semesters) Module frequency	1 semester	
Language of instruction Duration (semesters) Module frequency Module capacity	1 semester jährlich	
Language of instruction Duration (semesters) Module frequency Module capacity Information	1 semester jährlich unlimited	
Language of instruction Duration (semesters) Module frequency Module capacity Information Modullevel	1 semester jährlich unlimited 6 CP   SE; PR   2. FS   Rabus	
Links Language of instruction Duration (semesters) Module frequency Module capacity Information Modullevel Modulart Lern-/Lehrform / Type of program	1 semester jährlich unlimited 6 CP   SE; PR   2. FS   Rabus MM (Mastermodul)	CP, 4 SPPW)
Language of instruction Duration (semesters) Module frequency Module capacity Information Modullevel Modulart Lern-/Lehrform / Type of program	1 semester jährlich unlimited 6 CP   SE; PR   2. FS   Rabus MM (Mastermodul) Wahlpflicht	CP, 4 SPPW)
Language of instruction Duration (semesters) Module frequency Module capacity Information Modullevel Modulart	1 semester jährlich unlimited 6 CP   SE; PR   2. FS   Rabus MM (Mastermodul) Wahlpflicht	CP, 4 SPPW) Type of examination
Language of instruction Duration (semesters) Module frequency Module capacity Information Modullevel Modulart Lern-/Lehrform / Type of program Vorkenntnisse / Previous knowledge	1 semester jährlich unlimited 6 CP   SE; PR   2. FS   Rabus MM (Mastermodul) Wahlpflicht Seminar (2 CP, 1 SPPW), practical course (4	
Language of instruction Duration (semesters) Module frequency Module capacity Information Modullevel Modulart Lern-/Lehrform / Type of program Vorkenntnisse / Previous knowledge Examination	1 semester jährlich unlimited 6 CP   SE; PR   2. FS   Rabus MM (Mastermodul) Wahlpflicht Seminar (2 CP, 1 SPPW), practical course (4	Type of examination One assessment of examination:
Language of instruction Duration (semesters) Module frequency Module capacity Information Modullevel Modulart Lern-/Lehrform / Type of program Vorkenntnisse / Previous knowledge Examination	1 semester jährlich unlimited 6 CP   SE; PR   2. FS   Rabus MM (Mastermodul) Wahlpflicht Seminar (2 CP, 1 SPPW), practical course (4	Type of examination         One assessment of examination:         Portfolio (seminar presentation, written protocol)         Protocol (100 %), seminar presentation (no mark).         Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report or seminar presentations according to the advice of
Language of instruction Duration (semesters) Module frequency Module capacity Information Modullevel Modullart Lern-/Lehrform / Type of program Vorkenntnisse / Previous knowledge Examination Final exam of module	1 semester jährlich unlimited 6 CP   SE; PR   2. FS   Rabus MM (Mastermodul) Wahlpflicht Seminar (2 CP, 1 SPPW), practical course (4 examination periods	Type of examination         One assessment of examination:         Portfolio (seminar presentation, written protocol)         Protocol (100 %), seminar presentation (no mark).         Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report or seminar presentations according to the advice of the course supervisor.)

#### mar570 - Profile Module Introduction to DNA-sequencing and sequence analysis

Module name	Profile Module Introduction to DNA-sequencing and seq	wence analysis
Module code	mar570	
ECTS credit points	6.0 KP	
Workload	180 h	
Used in degree programmes	Master Microbiology > Mastermodule	
Contact person		
	Modulverantwortung	
	• Thorsten Henning Brinkhoff	
	Prüfungsberechtigt	
	<ul> <li>Thorsten Henning Brinkhoff</li> </ul>	
	<ul> <li>Liliana Cristina Moraru</li> <li>Modulberatung</li> </ul>	
	, and the second s	
	Liliana Cristina Moraru	
Prerequisites	Lecture during the course	
Skills to be acquired in this module	The students know how to	
	• equipped DNA by Concertainty	
	<ul> <li>sequence DNA by Sanger sequencing</li> <li>assemble DNA sequences</li> </ul>	
	use internet databases for sequence comparison	n
	<ul> <li>use the various facilities of the NCBI database</li> <li>analyze bacterial genomes for presence of spec</li> </ul>	ific genes
	<ul> <li>use ARB, databases and literature data to create</li> </ul>	
	phylogenetic trees	
	<ul> <li>design primers and probes</li> <li>present and discuss scientific results</li> </ul>	
	<ul> <li>write a scientific protocol</li> </ul>	
Module contents		abases and the phylogeny program ARB will be
Recommended reading		
Links		
Language of instruction	Englisch	
Duration (semesters)	1 semester	
Module frequency	jährlich	
Module capacity	unlimited	
Information	6 CP   SE; PR   1. or 3. FS   Brinkhoff	
Modullevel	MM (Mastermodul)	
Modulart	Wahlpflicht	
Lern-/Lehrform / Type of program	Seminar (2 CP, 1 SPPW), practical course (4 CP, 4 SPI	PW)
Vorkenntnisse / Previous knowledge		
Examination	examination periods	Type of examination
Final exam of module		One assessment of examination:
		Portfolio (seminar presentation, written protocol)
		Protocol (75 %), seminar presentation (25 %).
		Active participation (Active and documented
		participation in practical courses (labs, exercises, seminars, field trips) and courses. These include
		e.g. the delivery of exercises, writing a lab report or
		seminar presentations according to the advice of
		seminar presentations according to the advice of the course supervisor.)
Course type Seminar	Comment SWS	seminar presentations according to the advice of

Course type	Comment	SWS	Offer rhythm	Workload attendance
Praktikum		4		56 h

l otal	attendance	time of	module	

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70 h

#### mar580 - Profile Module Microbial ecology of marine sediments

Module name	Profile Module Microbial ecology of marine sedir	ments			
Module code	mar580				
ECTS credit points	6.0 KP				
Workload	180 h				
Used in degree programmes	Master Microbiology > Mastermodule				
Contact person					
	Modulverantwortung				
	Bert Engelen				
	Prüfungsberechtigt				
	<ul> <li>Alle hier genannten</li> </ul>				
Prerequisites	Lecture: Microbial ecology				
Skills to be acquired in this module	The students know how to				
	<ul> <li>sample marine sediments</li> <li>characterize the cores sedimentologicall</li> </ul>	v and biogeochemically			
	<ul> <li>collect and analyze porewater</li> </ul>	y and biogeochemically			
	determine total cell counts	historian			
	<ul> <li>quantify groups of organisms molecular l</li> <li>cultivate different physiological groups of</li> </ul>				
	<ul> <li>present and discuss scientific results</li> </ul>				
	<ul> <li>write a scientific protocol</li> </ul>				
Module contents		siological diversity of microorganisms and their spatial			
	distribution within marine sediments are demonstrated according to chemical and physical parameters. Different physiological groups are analysed along the sediment column of intertidal sandflat or beach. Sedimen				
	sampling is performed at the back barrier area of the island 'Spiekeroog' at the beginning of the course.				
	Oxygen penetration, porewater sulfate and methane concentrations are measured down to a depth of app. 5				
	meters. As microbiological parameters, total cell numbers are counted and the numbers of archaea and bacteria are calculated after quantitative PCR (qPCR). More specifically, the relative amounts of sulfate				
	reducers and methanogens are also determined by qPCR targeting key-genes for sulfate reduction and				
	methanogenesis. Furthermore, every single group of students will specifically enrich one physiological type of microorganisms from distinctive sediment layers. Microbial growth and activity are monitored over the whole				
	period of the course.				
	Accompanying the course, all participants will give a talk to introduce 'their' physiological group concerning its				
	ecology, physiology, and strategies for a specific enrichment. All the data and observations of the single groups will be combined at the end of the course to draw an overall picture of microbial diversity and the occurrence of				
	the different physiological groups corresponding				
Recommended reading					
Links					
Language of instruction	Englisch				
Duration (semesters)	1 semester				
Module frequency	jährlich				
Module capacity	unlimited				
Information	6 CP   SE; PR   2. FS   Engelen				
Modullevel	MM (Mastermodul)				
Modulart	Wahlpflicht				
Lern-/Lehrform / Type of program	Seminar (2 CP, 1SPPW ), practical course (4 CF	P, 4 SPPW)			
	Block course, 2 weeks, seminar and laboratory	work			
Vorkenntnisse / Previous knowledge					
Examination	examination periods	Type of examination			
Final exam of module		One assessment of examination:			
		Portfolio (seminar presentation, written protocol)			
		Protocol (100 %), seminar presentation (no mark).			
		Active participation (Active and documented			

amination	examination periods		Type of examination seminar presentations according to the advice of the course supervisor.)	
Course type	Comment	SWS	Offer rhythm	Workload attendance
Seminar		1		14 h
Praktikum		4		56 h
Total attendance time of module				70 h

### mar600 - Profile Module Methods in Aquatic Microbial Ecology

Module name	Profile Module Methods in Aquatic Microbial Ecology
Module code	mar600
ECTS credit points	6.0 KP
Workload	180 h
Used in degree programmes	Master Microbiology > Mastermodule
Contact person	Modulverantwortung
	Meinhard Simon
	Prüfungsberechtigt
	Alle hier genannten
	Modulberatung
	<ul> <li>Thorsten Henning Brinkhoff</li> </ul>
Prerequisites	For the practical course lecture: Methods in Aquatic Microbial Ecology
Skills to be acquired in this module	The students learn to:
	<ul> <li>Analyze bacterial substrates at ambient concentrations such as dissolved amino acids and carbohydrates by high performance liquid chromatography (HPLC), organic carbon by TOC and POC/PON analyser and the composition of the pool of dissolved organic matter by Fourier-Transform lon Cyclotron Resonance Mass spectrometry (FT-ICR-MS).</li> <li>Determine bacterial cell numbers by flow cytometry and epifluorescence microscopy and to analyse these data by image analysis.</li> <li>Extract bacterial DNA from water and sediment samples.</li> <li>to amplify bacterial genes by specific primers and PCR.</li> <li>Assess bacterial communities by culture-independent methods such as denaturing gradient gel electrophoresis.</li> <li>present and discuss scientific results</li> <li>write a scientific protocol</li> <li>The students gain competences in:</li> <li>Understanding how to analyse dissolved substrates of heterotrophic aquatic bacterial communities by state of the art approaches.</li> <li>How to assess the abundance of aquatic bacterial communities by State of the art approaches.</li> </ul>
Module contents	Methods in Aquatic Microbial Ecology: The course starts with a lecture introducing basic issues of aquatic microbial ecology with an emphasis on methodological aspects. This lecture is completed before the practical work starts. During the practical course of a block of two weeks the participants carry out analyses and experiments on:
	<ul> <li>determining the concentration of dissolved organic substrates (amino acids, carbohydrates, dissolved and particulate organic carbon),</li> <li>the abundance of bacterial communities in aquatic systems</li> <li>The composition of bacterial communities in environmental samples by denaturing gradient gel electrophoresis (DGGE) of 16S rRNA targeted gene fragments.</li> </ul>
Recommended reading	Lecture notes, available on Stud.IP
Links	
Language of instruction	Englisch
Duration (semesters)	1 semester
Module frequency	jährlich
Module capacity	unlimited
Information	6 CP   SE; PR   1. or 3. FS   Simon
Modullevel	MM (Mastermodul)
Modulart	Wahlpflicht
Lern-/Lehrform / Type of program	Lecture, seminar (2 CP, 1 SPPW), practical course (4 CP, 4 SPPW)
Vorkenntnisse / Previous knowledge	

Final exam of module			One assessment of exa Portfolio (seminar prese	mination: entation, written protocol)
			Protocol (100 %), seminar presentation (no mark). Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report or seminar presentations according to the advice of the course supervisor.)	
Course type	Comment	SWS	Offer rhythm	Workload attendance
Seminar		1		14 h
Praktikum		4		56 h
Total attendance time of module				70 h

#### mar610 - Profile Module Isolation and characterization of microorganisms

Module name	Profile Module Isolation and characterizati	on of microorganisms			
Module code	mar610				
ECTS credit points	6.0 KP				
Workload	180 h				
Used in degree programmes	Master Microbiology > Mastermo	dule			
Contact person	Modulverantwortung				
	Heribert Cypionka				
Prerequisites	Microbial Physiology and diversity (M1)				
Skills to be acquired in this module	microbiological techniques as enrichment	teria and other microorganisms. They will learn classical culture, aseptic work, preparation of liquid and solid media, cultivatior plates and in deep agar dilution, description of microbes by photography.			
Module contents	Isolation and characterization of microorganisms: Seminar Prior to the laboratory work the participants shall read literature about first isolation, description and current studies on their target organisms and present this and their isolation strategy in the seminar. During the cours and at the end, results and a possible molecular identification of isolates will be presented and discussed. Practical work: Every student prepares media and agar plates required for the isolation of the different target organisms. If pure cultures have been isolated, they should be transferred to long-term storage on agar and i liquid nitrogen. Sampling sites and different stages of the enrichment and isolation are documented by macro and microphotography and described in the report. Finally, tests to verify purity of the culture and its identification, as well as a phylogenetic analysis are requested.				
Recommended reading	Brock. Biology of Microorganisms / Cypionka, Grundlagen der Mikrobiologie / Drews, G. Mikrobiologisches Praktikum, 1974 / DSMZ catalogue (www.dsmz.de) / Dyer, B.D. A field guide to the bacteria. 2003 //Praktikumsskripte, Uni Göttingen, Uni Konstanz / Reddy, C.A. Methods for general and molecular Microbiology. 2007 / Steinbüchel et al. Mikrobiologisches Praktikum. 2012 / www.microbiogical-garden.net				
Links					
Language of instruction	Englisch				
Duration (semesters)	1 semester				
Module frequency	jährlich				
Module capacity	unlimited				
Information	6 CP   SE; PR   1. or 3. FS   Cypionka				
Modullevel	MM (Mastermodul)				
Modulart	Wahlpflicht				
Lern-/Lehrform / Type of program	Seminar (2 CP, 1 SPPW ), practical cours	e (4 CP, 4 SPPW)			
Vorkenntnisse / Previous knowledge					
Examination	examination periods	Type of examination			
Final exam of module		One assessment of examination: Portfolio (seminar presentation, written protocol)			
		Protocol (100 %), webpage, seminar presentation (no mark) Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report or seminar presentations according to the advice of the course supervisor.)			
Course type	Comment SWS	Offer rhythm Workload attendance			
Seminar	1	14 h			
Praktikum	4	56 h			
Total attendance time of module		70 h			

### mar620 - Profile Module Marine Chemical Ecology

		o					
Module name		ne Chemical Ecology					
Module code	mar620						
ECTS credit points	6.0 KP						
Workload	180 h	180 h					
Used in degree programmes	Master Mici	robiology > Mastermodule					
Contact person	Modulverantwortung	l ter Schupp					
	Modulberatung	ler ochupp					
	• Sve	en Rohde					
Prerequisites	Lecture: Organic che	emistry					
Skills to be acquired in this module	investigate the secon profiles, how to isola	ndary metabolites of mari ites compounds of interes rude extracts and potentia	ies and major ecological roles of secondary metabolites, how to ne invertebrates and algae, how to analyze secondary metabolite t and how to conduct various bioassays to assess potential ally isolated compounds. Students will also learn how to				
Module contents	Chemical Ecology: The course consists of lectures, followed by laboratory experiments. Students will research about various topics in marine chemical ecology. Laboratory work will include production of extracts from various invertebrates and algae. Extracts will be tested in various feeding assays to assess the chemical properties of extracts. Extracts will also be tested for antimicrobial activity with environmental strains. This includes the culture of test bacteria and antimicrobial assays. Final evaluation will be a laboratory report about the experiments. This will include statistical analysis of their experiments and discussion of their results in the framework of the lectures and seminars presented during the course.						
Recommended reading	Marine Chemical Ec	Marine Chemical Ecology, McClintock, Baker					
Links							
Language of instruction	Englisch						
Duration (semesters)	1 semester	1 semester					
Module frequency	jährlich						
Module capacity	unlimited						
Modullevel	Abschlussmodul (Ab	schlussmodul)					
Modulart	Wahlpflicht						
Lern-/Lehrform / Type of program	•	PPW ), practical course (4	CP, 4 SPPW)				
Vorkenntnisse / Previous knowledge							
Examination	examination p	eriods	Type of examination				
Final exam of module			One assessment of examination: Portfolio (seminar presentation, written protocol)				
			Portfolio (seminar presentation – no mark, written protocol 100%). Active participation (Active and documented participation in practical courses (labs, exercises, seminars, field trips) and courses. These include e.g. the delivery of exercises, writing a lab report or seminar presentations according to the advice of the course supervisor.)				
Course type	Comment	SWS	Offer rhythm Workload attendance				
Seminar		1	14 h				
Praktikum		4	56 h				
Total attendance time of module							

Total attendance time of module

Module name	Profile Medule Techniques in light	microscopy and electron	microscopy		
Module code	Profile Module Techniques in light microscopy and electron microscopy mar621				
ECTS credit points	6.0 KP				
Workload	180 h				
		atormodulo			
Used in degree programmes	<ul> <li>Master Microbiology &gt; Ma</li> </ul>	astermodule			
Contact person	Modulverantwortung				
<b>D</b> i	Erhard Rhiel				
Prerequisites	none				
Skills to be acquired in this module	The students will learn				
	<ul> <li>the basics/theory of scann</li> <li>different sample preparation</li> <li>to operate our scanning electron</li> <li>to operate our critical point</li> <li>to perform sputter coating</li> <li>to perform negative stainin</li> <li>to operate our transmission</li> <li>to perform immuno-labelling</li> </ul>	on methods for SEM ectron microscope drying device g TEM n electron microscope	SEM) and transmission	electron microscopy (TEM)	
Module contents	The profile module "Techniques in distributed over three weeks. On t remaining 9 days are for practice. and electron microscopes, sample staining TEM, and immuno-labellin	he first day, seminars will The main topics of the con preparation, fixation, low	introduce into the theor urse are: basic principle	y, i.e. of SEM and TEM. The s and functioning of light	
Recommended reading	will be announced				
Links					
Language of instruction	Englisch				
Duration (semesters)	1 semester				
Module frequency	jährlich				
Module capacity	unlimited				
Information	6 CP   SE; PR   1. or 3. FS   Rhiel				
Modullevel	MM (Mastermodul)				
Modulart	Wahlpflicht				
Lern-/Lehrform / Type of program	Lecture (1 CP), seminar (1 CP) & Seminar and laboratory work, at the				
Vorkenntnisse / Previous knowledge					
Examination	examination periods	T	ype of examination		
Final exam of module			ne assessment of exame minar presentation, po		
		pa se e. se	eminars, field trips) and g. the delivery of exerci	e and documented courses (labs, exercises, courses. These include ses, writing a lab report or cording to the advice of	
Course type	Comment SWS		Offer rhythm	Workload attendance	
Seminar	1			14 h	
Praktikum	4			56 h	

#### mar621 - Profile Module Techniques in light microscopy and electron microscopy

70 h

#### mar622 - Profile Module R programming for (meta)-genomic sequence analysis

Module name	Profile Module R programming for (meta)-	genomic sequence analysis					
Module code	mar622						
ECTS credit points	6.0 KP						
Workload	180 h						
Used in degree programmes	Master Microbiology > Mastermodule						
Contact person							
contact person	Modulverantwortung						
	<ul> <li>Liliana Cristina Moraru</li> </ul>						
	Prüfungsberechtigt						
	<ul> <li>Alle hier genannten</li> </ul>						
Prerequisites	The course "Introduction in sequencing an required.	d sequence analysis". Previous programming experience is not					
Skills to be acquired in this module	<ul> <li>DNA sequencing has become a routine method in microbiology research. Most of the times, sequence analyrequires knowledge of a programming language. One of the programing languages most used for this purporties R. The course will cover the following topics:         <ol> <li>programming in R using an integrated development environment (RStudio)</li> <li>working with strings (stringr package)</li> <li>working with lists and data frames (readr and dplyr package)</li> <li>sequence analysis (seqinr, Bioconductor packages: Biostrings, GenomicRanges, Decipher)</li> <li>sequence analysis (seqinr, Bioconductor packages: Biostrings, GenomicRanges, Decipher)</li> <li>(meta)-genomic and data visualization (ggplot2, Gviz)</li> <li>Accessing and mining sequence / metadata databases though R based web applications (Shiny, DT an Shinyjs packages)</li> <li>IV. metaoling in R (Rmarkdown and Knitr packages)</li> <li>X. managing code (Roxygen2 package)</li> <li>X. microbial genome annotation using R</li> </ol> </li> <li>R programming for (meta)-genomic sequence analysis will run over a two weeks period. A single, introductor lecture will be offered within the first day of the course. Then, the course will be structured in programming exercises which cover all topics at point 12. The exercises are designed to exemplify the use R programming within the framework of microbial queroge-log-genome analysis. In addition to the teacher –student sessions, the students will work on individual projects. Each student will receive a short microbial genome (e.g. viral genome), and will analyze it by building custom, self-programmed pipelines. The output from the individual</li> </ul>						
	genome), and will analyze it by building cu projects will consist in a analysis report pre	stom, self-programmed pipelines. The output from the individual pared in Rmarkdown and Knitr packages. The report will include					
Recommended reading	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis	stom, self-programmed pipelines. The output from the individual pared in Rmarkdown and Knitr packages. The report will include					
_	genome), and will analyze it by building cu projects will consist in a analysis report pre	stom, self-programmed pipelines. The output from the individual pared in Rmarkdown and Knitr packages. The report will include					
Links	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced	stom, self-programmed pipelines. The output from the individual pared in Rmarkdown and Knitr packages. The report will include					
Links Language of instruction	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch	stom, self-programmed pipelines. The output from the individual pared in Rmarkdown and Knitr packages. The report will include					
Links Language of instruction Duration (semesters)	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester	stom, self-programmed pipelines. The output from the individual pared in Rmarkdown and Knitr packages. The report will include					
Links Language of instruction Duration (semesters) Module frequency	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year	stom, self-programmed pipelines. The output from the individual pared in Rmarkdown and Knitr packages. The report will include					
Recommended reading Links Language of instruction Duration (semesters) Module frequency Module capacity	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year unlimited	stom, self-programmed pipelines. The output from the individual pared in Rmarkdown and Knitr packages. The report will include					
Links Language of instruction Duration (semesters) Module frequency Module capacity Modullevel	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year unlimited 	stom, self-programmed pipelines. The output from the individual pared in Rmarkdown and Knitr packages. The report will include					
Links Language of instruction Duration (semesters) Module frequency Module capacity Modullevel Modullart	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year unlimited  Wahlmodul / Opportunity	istom, self-programmed pipelines. The output from the individual apared in Rmarkdown and Knitr packages. The report will include results.					
Links Language of instruction Duration (semesters) Module frequency Module capacity Modullevel Modullart Lern-/Lehrform / Type of program	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year unlimited 	istom, self-programmed pipelines. The output from the individual apared in Rmarkdown and Knitr packages. The report will include results.					
Links Language of instruction Duration (semesters) Module frequency Module capacity Modullevel Modullevel Modulart Lern-/Lehrform / Type of program Vorkenntnisse / Previous knowledge	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year unlimited  Wahlmodul / Opportunity Seminar and computer lab, 2 continuous w	istom, self-programmed pipelines. The output from the individual epared in Rmarkdown and Knitr packages. The report will include results.					
Links Language of instruction Duration (semesters) Module frequency Module capacity Modullevel Modulart Lern-/Lehrform / Type of program Vorkenntnisse / Previous knowledge Examination	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year unlimited  Wahlmodul / Opportunity	istom, self-programmed pipelines. The output from the individual apared in Rmarkdown and Knitr packages. The report will include results.					
Links Language of instruction Duration (semesters) Module frequency Module capacity Modullevel Modulart Lern-/Lehrform / Type of program Vorkenntnisse / Previous knowledge Examination Final exam of module	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year unlimited  Wahlmodul / Opportunity Seminar and computer lab, 2 continuous w examination periods	Istom, self-programmed pipelines. The output from the individual epared in Rmarkdown and Knitr packages. The report will include results.					
Links Language of instruction Duration (semesters) Module frequency Module capacity Modullevel Modulart Lern-/Lehrform / Type of program Vorkenntnisse / Previous knowledge Examination Final exam of module Course type	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year unlimited  Wahlmodul / Opportunity Seminar and computer lab, 2 continuous w examination periods	Istom, self-programmed pipelines. The output from the individual epared in Rmarkdown and Knitr packages. The report will include results.					
Links Language of instruction Duration (semesters) Module frequency Module capacity Modullevel Modulart Lern-/Lehrform / Type of program Vorkenntnisse / Previous knowledge Examination Final exam of module	genome), and will analyze it by building cu projects will consist in a analysis report pre both the R code and the genome analysis will be announced Englisch 1 semester once a year unlimited  Wahlmodul / Opportunity Seminar and computer lab, 2 continuous w examination periods	Istom, self-programmed pipelines. The output from the individual epared in Rmarkdown and Knitr packages. The report will include results.					

#### mar630 - Research Project

Module name	Research Project			
Module code	mar630			
ECTS credit points	12.0 KP			
Workload	360 h			
Used in degree programmes		biology > Mastermodule		
Contact person				
	Modulverantwortung			
	∘ Herib	ert Cypionka		
	Modulberatung			
	• Lehre	ende der Mikrobiologie		
Prerequisites	1 main and 1 profile m	odule		
Skills to be acquired in this module		d can regard it for their own	on an ambitious research project. T n work. They can prepare, carry out,	
Module contents	The contents concern	variable recent scientific of	uestions on a high scientific level.	
Recommended reading	project-specific, will be	e announced		
Links				
Language of instruction	Englisch			
Duration (semesters)	2 semester			
Module frequency	halbjährlich			
Module capacity	unlimited			
Modullevel	MM (Mastermodul)			
Modulart	Wahlpflicht			
Lern-/Lehrform / Type of program	Practical work (10 CP)	), Seminar (2 CP)		
	Obligatory (2 Researc	h Projects have to be com	pleted)	
Vorkenntnisse / Previous knowledge				
Examination	examination per	iods	Type of examination	
Final exam of module			Two assessments of exar Written protocol and / or v presentation	
			Quality of the scientific pe %), Final seminar and public of participation (Active and c in practical courses (labs, trips) and courses. These of exercises, writing a lab presentations according to supervisor.)	lefense (25 %). Active locumented participation exercises, seminars, field include e.g. the delivery report or seminar
Course type	Comment	SWS	Offer rhythm	Workload attendance
Seminar		6		84 h
Praktikum		12		168 h
Total attendance time of module				252 h

#### mar640 - Research Project

Module name	Research Project		
Module code	mar640		
ECTS credit points	12.0 KP		
Workload	360 h		
Used in degree programmes	Master Micro	biology > Mastermodule	
Contact person	Modulverantwortung		
	• Herit Modulberatung	pert Cypionka	
	• Lehr	ende der Mikrobiologie	
Prerequisites	1 main and 1 profile m	nodule	
Skills to be acquired in this module		d can regard it for their o	e) on an ambitious research project. They understand recent wn work. They can prepare, carry out, write down, present and
Module contents	The contents concern	variable recent scientific	questions on a high scientific level.
Recommended reading	project-specific, will be	e announced	
Links			
Language of instruction	Englisch		
Duration (semesters)	2 semester		
Module frequency	halbjährlich		
Module capacity	unlimited		
Modullevel	MM (Mastermodul)		
Modulart	Wahlpflicht		
Lern-/Lehrform / Type of program	Practical work (10 CP	), Seminar (2 CP)	
Vorkenntnisse / Previous knowledge			
Examination	examination per	riods	Type of examination
Final exam of module			Two assessments of examination: Written protocol and / or written English thesis, presentation
			Quality of the scientific performance and thesis (75 %), Final seminar and public defense (25 %).
Course type	Comment	SWS	Offer rhythm Workload attendance
Seminar		6	84 h
Praktikum		12	168 h
Total attendance time of module			252 h

# Abschlussmodul

#### mam - Master's Thesis Module

Module name	Master's Thesis Module
Module code	mam
ECTS credit points	30.0 KP
Workload	900 h
Used in degree programmes	Master Microbiology > Abschlussmodul
	• Master Microbiology > Abschlussifiodul
Contact person	Modulverantwortung
	<ul> <li>Heribert Cypionka</li> </ul>
	Prüfungsberechtigt
	• Alle hier genannten
	Modulberatung
	• Lehrende der Mikrobiologie
Prerequisites	
Skills to be acquired in this module	The students are able to work (under guidance) on an extended research project. They understand recent
Skins to be acquired in this module	scientific literature and can regard it for their own work. They can prepare, carry out, write down, present and defend their work in the public.
Module contents	The contents concern variable recent scientific questions on a high scientific level
Recommended reading	
Links	
Language of instruction	Englisch
Duration (semesters)	1 semester
Module frequency	halbjährlich
Module capacity	unlimited
Modullevel	Abschlussmodul (Abschlussmodul)
Modulart	Pflicht
Lern-/Lehrform / Type of program	Seminar (2 CP, 2 SPPW); Practical work (28CP, 28 SPPW)
Vorkenntnisse / Previous knowledge	
Examination	examination periods Type of examination
Final exam of module	Written English thesis, seminar with public discussion in English
	According to the examination regulations; quality of the scientific performance and thesis (83.3 %), final seminar and public defense (16.7 %)