

Mastermodule

mar500 - Physiology and diversity of microorganisms

Modulbezeichnung	Physiology and diversity of microorganisms
Modulkürzel	mar500
Kreditpunkte	12.0 KP
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule
Zuständige Personen	<p>Engelen, Bert (Modulverantwortung)</p> <p>der Mikrobiologie, Lehrende (Modulberatung)</p>
Teilnahmevoraussetzungen	
Kompetenzziele	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.
Modulinhalte	<p>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</p> <p>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</p> <p>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:</p> <ul style="list-style-type: none"> • Formation, diagenesis and special features of sediments • physico-chemical conditions and geological records • interpretation of gradients • microbes and biological processes in sediments • methods for cultivation of sediment organisms • molecular methods • biogeochemical methods • quantification of prokaryotes and viruses <p>(Teacher: Engelen; 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)</p> <p>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. They 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: - Types and relevance of scientific publications - Parts of scientific publications step by step: - Abstract, Introduction, Results, Discussion - University facilities for literature search - Oral presentation - How to prepare posters - Tips for using PowerPoint, Word and Endnote - Job application (Courses: Seminar (2 SPPW, 3 CP); Teachers: Engelen; Work load: Presence: 30 hours, private study: 60 hours; Passing criteria: Oral presentation or</p>

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

Literaturempfehlungen	Brock. Microbiology			
Links				
Unterrichtssprache	Englisch			
Dauer in Semestern	2 Semester			
Angebotsrhythmus Modul	jährlich			
Aufnahmekapazität Modul	unbegrenzt			
Modullevel / module level	---			
Modulart / typ of module	je nach Studiengang Pflicht oder Wahlpflicht			
Lehr-/Lernform / Teaching/Learning method	Lecture + Exercises: Physiology and life modes of prokaryotes (2 + 1 semester periods per week [SPPW], 3 CP) Lecture + Exercises : Microbial Diversity (2 +1 SPPW, 3 CP) 1 broadening lecture or seminar (Biological significance of suspended matter / Sediment microbiology / Broadening Seminar: Scientific writing and presentation) (2 SPPW, 3 CP) Microbiological + ICBM Colloquium (2 CP) Excursions (1 CP)			
Vorkenntnisse / Previous knowledge				
Prüfung	Prüfungszeiten	Prüfungsform		
Gesamtmodul	At the end of the lecture period.	Two written tests about the contents of the lectures 'Physiology and life modes of prokaryotes' and Microbial Diversity.		
		At least 50 % of the reachable points in written tests about the two lectures mentioned above.		
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Vorlesung		6.00		
Übung		2.00		
Exkursion		1.00		
Präsenzzeit Modul insgesamt				0 h

mar510 - Molecular Mechanisms and Interactions

Modulbezeichnung	Molecular Mechanisms and Interactions	
Modulkürzel	mar510	
Kreditpunkte	12.0 KP	
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 	
Zuständige Personen	der Mikrobiologie, Lehrende (Modulberatung) Rabus, Ralf Andreas (Modulverantwortung)	
Teilnahmevoraussetzungen		
Kompetenzziele	The students know the molecular mechanisms of metabolism, genetics and evolution. They know regulatory mechanisms on the molecular level and feedback mechanisms between organisms. They know the basics of microbial ecology and the biogeochemistry of important microbial habitats. They know molecular and chemical-analytical methods of microbiology. They have experience with the field study of microorganisms.	
Modulinhalte	Lecture + exercises: Molecular Microbiology Part I on DNA: structure, DNA-proteins, DNA-replication, recombination, transposition, mutation, repair, plasmids and DNA-exchange Part II on gene expression: transcription, regulation of transcription, translation Part III on enzymes: protein structures, basic concepts and kinetics, catalytic and regulatory strategies Part IV on regulatory networks: diauxie and catabolite repression, oxygen regulation, chemotaxis Lecture + exercises: Microbial Ecology Principles of biogeochemistry, global element cycles, mineralization of organic substances, chemotaxis, aquatic habitats, terrestrial habitats, deep subsurface biosphere, syntrophy and symbiosis, microbes in earth history, methods in microbial ecology, isotope fractionation, applied microbiology, bioremediation Broadening Lecture: Scientific writing and presentation Presentation and analysis of structure und style of scientific publications, presentation and discussion of own written elaborations Excursions into the field	
Literaturempfehlungen	Molecular Microbiology : Stryer – Biochemistry Voet – Biochemistry Knippers – Molekulare Genetik Snyder – Molecular Genetics of Bacteria Brock - Microbiology	
Links		
Unterrichtssprache	Englisch	
Dauer in Semestern	1 Semester	
Angebotsrhythmus Modul	jährlich	
Aufnahmekapazität Modul	unbegrenzt	
Modullevel / module level	---	
Modulart / typ of module	Wahlpflicht / Elective	
Lehr-/Lernform / Teaching/Learning method	Lecture + Exercises: Molecular microbiology, (2 +1 SPPW, 3 CP) Lecture + Exercises: Microbial ecology (2 + 1 SPPW, 3 CP) Broadening lecture: Scientific writing and presentation (2 SPPW, 3 CP) Excursion (1 CP) Microbiological + ICBM Colloquium (2 CP)	
Vorkenntnisse / Previous knowledge	none	
Prüfung	Prüfungszeiten	Prüfungsform
Gesamtmodul	At the end of the lecture period, the exact date will be announced during the course.	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. 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.)

Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Vorlesung		4.00		
Übung		2.00		
Seminar		2.00		
Exkursion		1.00		
Präsenzzeit Modul insgesamt				0 h

mar520 - Main Module Proteomics

Modulbezeichnung	Main Module Proteomics			
Modulkürzel	mar520			
Kreditpunkte	12.0 KP			
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 			
Zuständige Personen	<p>Rabus, Ralf Andreas (Modulverantwortung)</p> <p>Wöhlbrand, Lars (Modulberatung)</p> <p>N., N. (Modulberatung)</p>			
Teilnahmevoraussetzungen	Lecture: Physiology and diversity of prokaryotes Lecture: Molecular Microbiology			
Kompetenzziele	The students are getting directly involved in actual scientific projects in the area of physiological and/or meta-proteomics (under guidance). They - get acquainted with state-of-the-art proteomic concepts and technologies, - know how to write concise scientific protocols, - know how to present/discuss their results in public.			
Modulinhalte	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: - extraction and quantification of total protein from prepared cell samples (incl. separation of compartments), - protein separation by SDS-PAGE and staining with Coomassie, silver and/or fluorescent dyes, - digital image acquisition and analysis, - manual and/or automated band excision, - protein identification by nanoLC-ESI-MS/MS, - nanoLC-MALDI-coupling and protein identification by MALDI-TOF-MS/MS, - Physiological interpretation of predicted protein functions and relevant genomic context.			
Literaturempfehlungen	Lottspeich - Bioanalytik			
Links				
Unterrichtssprache	Englisch			
Dauer in Semestern	1 Semester			
Angebotsrhythmus Modul	jährlich			
Aufnahmekapazität Modul	unbegrenzt			
Hinweise	12 CP SE; PR 2. FS Rabus			
Modullevel / module level				
Modulart / typ of module	je nach Studiengang Pflicht oder Wahlpflicht			
Lehr-/Lernform / Teaching/Learning method	Seminar (2 CP), practical course (10 CP)			
Vorkenntnisse / Previous knowledge				
Prüfung	Prüfungszeiten	Prüfungsform		
Gesamtmodul	Announced at the beginning of the course.	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 seminar presentations according to the advice or the course		
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Seminar		2.00		
Praktikum		8.00		
Präsenzzeit Modul insgesamt				0 h

mar530 - Main Module Ecophysiology of prokaryotes

Modulbezeichnung	Main Module Ecophysiology of prokaryotes		
Modulkürzel	mar530		
Kreditpunkte	12.0 KP		
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 		
Zuständige Personen	Engelen, Bert (Modulverantwortung) der Mikrobiologie, Lehrende (Prüfungsberechtigt)		
Teilnahmevoraussetzungen			
Kompetenzziele	The students can contribute to current scientific projects (under guidance). They know modern analytical techniques. They know and understand recent scientific literature. They can write scientific reports, present their results and discuss them in the public.		
Modulinhalte	"Ecophysiology of prokaryotes": Projects derived from current scientific programs are carried out, typically in groups of two students guided by a senior scientist or PhD student. Typical project deal with: - Anaerobic processes - Molecular analysis of microbial communities - Sediment microbiology - Physiological experiments and activity measurements - Impact of viruses - Microscopic analysis of chemotaxis In the accompanying seminar, recent scientific studies in international journals are presented by the students. The results are summarized and discussed in a protocol fulfilling scientific level requirements.		
Literaturempfehlungen	will be announced		
Links			
Unterrichtssprache	Englisch		
Dauer in Semestern	1 Semester		
Angebotsrhythmus Modul	jährlich		
Aufnahmekapazität Modul	unbegrenzt		
Modullevel / module level			
Modulart / typ of module	Wahlpflicht / Elective		
Lehr-/Lernform / Teaching/Learning method	Block course, 4 weeks, seminar and laboratory work		
Vorkenntnisse / Previous knowledge	Lecture: Physiology and diversity of prokaryotes; recommended: Sediment microbiology		
Prüfung	Prüfungszeiten	Prüfungsform	
Gesamtmodul	Announced during the course.	One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation) 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 or the course supervisor.)	
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus Workload Präsenz
Seminar		2.00	
Praktikum		8.00	
Präsenzzeit Modul insgesamt			0 h

mar540 - Main Module Ecology of Marine Microbial communities

Modulbezeichnung	Main Module Ecology of Marine Microbial communities		
Modulkürzel	mar540		
Kreditpunkte	12.0 KP		
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> • Master Microbiology (Master) > Mastermodule 		
Zuständige Personen	<p>Simon, Meinhard (Modulverantwortung)</p> <p>Brinkhoff, Thorsten Henning (Modulberatung)</p>		
Teilnahmevoraussetzungen	Lecture: Biological significance of suspended matter		
Kompetenzziele	<p>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 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. This enables them to obtain a more critical view on the application of these and other methods and on the validity of scientific investigations in aquatic microbial ecology.</p>		
Modulinhalte	<p>“Ecology of marine microbes”: The students carry out small projects coming out of ongoing research of PhD Thesis work and other current research of the working group. Typically a group of two of three students is guided by a senior 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.</p>		
Literaturempfehlungen	will be announced		
Links			
Unterrichtssprachen	Englisch, Deutsch		
Dauer in Semestern	1 Semester		
Angebotsrhythmus Modul	jährlich		
Aufnahmekapazität Modul	unbegrenzt		
Modullevel / module level			
Modulart / typ of module	Wahlpflicht / Elective		
Lehr-/Lernform / Teaching/Learning method			
Vorkenntnisse / Previous knowledge	Lecture: Biological significance of suspended matter		
Prüfung	Prüfungszeiten	Prüfungsform	
Gesamtmodul	to be announced during the course.	<p>One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation) Assessments of examination: Portfolio: Written protocol (75 %) and contribution to the seminar (seminar presentation 25%). Active participation in the course. This includes, e.g. specific exercises, writing a lab report and seminar presentation, according to the advice of the supervisors.</p>	
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus Workload Präsenz
Seminar		1.00	
Praktikum		9.00	
Präsenzzeit Modul insgesamt			0 h

mar550 - Profile Module Physiology of bacteria

Modulbezeichnung	Profile Module Physiology of bacteria			
Modulkürzel	mar550			
Kreditpunkte	6.0 KP			
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 			
Zuständige Personen	Engelen, Bert (Modulverantwortung) Cypionka, Heribert (Prüfungsberechtigt)			
Teilnahmevoraussetzungen	Lecture: Physiology and diversity of prokaryotes			
Kompetenzziele	The students know how to - cultivate bacteria and generate pure cultures - determine the live count - prepare and use washed cell suspensions for experiments - measure bacterial activity (respiration, proton translocation, transport processes) and growth - use and understand the functioning electrodes (pH, O ₂) and photometers - use a microscope and take digital microphotographs - quantitatively rely growth, energy metabolism and fundamental physiological processes - understand the action of inhibitors - present and discuss scientific results - write a scientific protocol			
Modulinhalte	"Physiology of bacteria": The course starts with an introductory seminar every morning. One enrichment and isolation experiment will be performed over 10 days. Four physiological experiments are done over two day's round robin. The following processes are analyzed: Growth under oxic and anoxic conditions, respiration with complex and monomer substrates, respiration-driven proton translocation, transport of ions.			
Literaturempfehlungen	will be announced			
Links				
Unterrichtssprache	Englisch			
Dauer in Semestern	1 Semester			
Angebotsrhythmus Modul	jährlich			
Aufnahmekapazität Modul	unbegrenzt			
Modullevel / module level	---			
Modulart / typ of module	Wahlpflicht / Elective			
Lehr-/Lernform / Teaching/Learning method				
Vorkenntnisse / Previous knowledge				
Prüfung	Prüfungszeiten	Prüfungsform		
Gesamtmodul	Announced during the course.	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.)		
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Seminar		1.00		
Praktikum		4.00		
Präsenzzeit Modul insgesamt				0 h

mar560 - Profile Module Fermentation

Modulbezeichnung	Profile Module Fermentation		
Modulkürzel	mar560		
Kreditpunkte	6.0 KP		
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 		
Zuständige Personen	Rabus, Ralf Andreas (Modulverantwortung) Wöhlbrand, Lars (Modulberatung)		
Teilnahmevoraussetzungen	Lecture: Physiology and diversity of prokaryotes (successfully completed); Lecture: Molecular Microbiology		
Kompetenzziele	The students are getting directly involved in actual scientific projects in the area of general physiology (under guidance). They understand the scientific rational and design of the experiment(s), get acquainted with state-of-the-art concepts and technologies for growth balancing (e.g. bioreactor), know how to write concise scientific protocols, know how to present/discuss their results in public.		
Modulinhalte	"Growth balancing": Daily lectures introduce the students to theory and concepts of growth stoichiometry: (i) aerobic or anaerobic growth experiments in glass vessels and/or bioreactors, (ii) experimental design, (iii) design and operating laboratory fermenters, (iv) HPLC, IC and GC-MS 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: - cultivation of bacterial pure cultures in Erlenmeyer flasks, glass bottles or controlled bioreactors - determination of optical density, the live count, dry weight of cells and microscopic inspection during cultivation - (dis)assembly and sterilization of fermentation devices - operate process-controlled fermenters (incl. O ₂ and pH adjustments and sterile sampling) - determine O ₂ -consumption and CO ₂ -production rates based on on-line GC-MS measurements - quantification of substrate consumption for HPLC and IC - quantitative determination and calculation growth balances and efficiencies		
Literaturempfehlungen			
Links			
Unterrichtssprache	Englisch		
Dauer in Semestern	1 Semester		
Angebotsrhythmus Modul	jährlich		
Aufnahmekapazität Modul	unbegrenzt		
Modullevel / module level			
Modulart / typ of module	Wahlpflicht / Elective		
Lehr-/Lernform / Teaching/Learning method	Seminar (1 SPPW); practical course (4 SPPW)		
Vorkenntnisse / Previous knowledge	Lecture: Physiology and diversity of prokaryotes (successfully completed); Lecture: Molecular Microbiology		
Prüfung	Prüfungszeiten	Prüfungsform	
Gesamtmodul	Announced at the beginning of the course.	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.)	
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus Workload Präsenz
Seminar		1.00	
Praktikum		4.00	
Präsenzzeit Modul insgesamt			0 h

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

Modulbezeichnung	Profile Module Introduction to DNA-sequencing and sequence analysis			
Modulkürzel	mar570			
Kreditpunkte	6.0 KP			
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 			
Zuständige Personen	Brinkhoff, Thorsten Henning (Prüfungsberechtigt) Moraru, Liliana Cristina (Modulberatung)			
Teilnahmevoraussetzungen	Lecture during the course			
Kompetenzziele	The students know how to - sequence DNA by Sanger sequencing - assemble DNA sequences - use internet databases for sequence comparison - use the various facilities of the NCBI database - analyze bacterial genomes for presence of specific genes - use Genious for genome analysis - use ARB, databases and literature data to create - phylogenetic trees - design primers and probes - present and discuss scientific results - write a scientific protocol			
Modulinhalte	"Introduction into DNA-sequencing and sequence analysis": The course starts with a lecture on the first two days. During the following days the participants will give seminar talks about different scientific studies for which DNA sequencing was highly relevant. DNA sequencing will be taught in the lab of the working group. Sequence analysis, introduction into the use of various internet databases, the sequence analysis program Genious and the phylogeny program ARB will be demonstrated by individual use of laptops of the institute.			
Literaturempfehlungen				
Links				
Unterrichtssprache	Englisch			
Dauer in Semestern	1 Semester			
Angebotsrhythmus Modul	jährlich			
Aufnahmekapazität Modul	unbegrenzt			
Modullevel / module level				
Modulart / typ of module	Wahlpflicht / Elective			
Lehr-/Lernform / Teaching/Learning method	Seminar (1 SPPW); practical course (4 SPPW)			
Vorkenntnisse / Previous knowledge	Lecture during the course			
Prüfung	Prüfungszeiten	Prüfungsform		
Gesamtmodul	Announced during the course.	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 the course supervisor.)		
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Seminar		1.00		
Praktikum		4.00		
Präsenzzeit Modul insgesamt				0 h

mar580 - Profile Module Microbial ecology of marine sediments

Modulbezeichnung	Profile Module Microbial ecology of marine sediments			
Modulkürzel	mar580			
Kreditpunkte	6.0 KP			
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> • Master Microbiology (Master) > Mastermodule 			
Zuständige Personen	Engelen, Bert (Modulverantwortung)			
Teilnahmevoraussetzungen	Lecture: Microbial ecology and Lecture: Sediment microbiology			
Kompetenzziele	The students know how to - sample marine sediments - characterize the cores sedimentologically and biogeochemically - collect and analyze porewater - determine total cell counts - quantify groups of organisms molecular biologically - cultivate different physiological groups of bacteria - present and discuss scientific results - write a scientific protocol			
Modulinhalte	<p>“Microbial ecology of marine sediments”: The physiological 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. Sediment 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 to relevant geochemical gradients.</p>			
Literaturempfehlungen				
Links				
Unterrichtssprache	Englisch			
Dauer in Semestern	1 Semester			
Angebotsrhythmus Modul	jährlich			
Aufnahmekapazität Modul	unbegrenzt			
Modullevel / module level				
Modulart / typ of module	je nach Studiengang Pflicht oder Wahlpflicht			
Lehr-/Lernform / Teaching/Learning method	Block course, 2 weeks, seminar and laboratory work			
Vorkenntnisse / Previous knowledge	Lecture: Microbial ecology and Lecture: Sediment microbiology			
Prüfung	Prüfungszeiten	Prüfungsform		
Gesamtmodul	Announced during the course.	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.)		
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Seminar		1.00		
Praktikum		4.00		
Präsenzzeit Modul insgesamt				0 h

mar600 - Profile Module Methods in Aquatic Microbial Ecology

Modulbezeichnung	Profile Module Methods in Aquatic Microbial Ecology			
Modulkürzel	mar600			
Kreditpunkte	6.0 KP			
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 			
Zuständige Personen	Brinkhoff, Thorsten Henning (Modulberatung) Simon, Meinhard (Modulverantwortung)			
Teilnahmevoraussetzungen	For the practical course lecture: Methods in Aquatic Microbial Ecology			
Kompetenzziele	<p>The students learn to: - 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 Ion Cyclotron Resonance Mass spectrometry (FT-ICR-MS). - Determine bacterial cell numbers by flow cytometry and epifluorescence microscopy and to analyse these data by image analysis. - Extract bacterial DNA from water and sediment samples. - to amplify bacterial genes by specific primers and PCR. - Assess bacterial communities by culture-independent methods such as denaturing gradient gel electrophoresis. - present and discuss scientific results - write a scientific protocol - The students gain competences in: - Understanding how to analyse dissolved substrates of heterotrophic aquatic bacterial communities by state of the art approaches. - How to assess the abundance of aquatic bacterial communities by state of the art approaches. - Analyzing the composition of bacterial communities by PCR-based culture-independent approaches.</p>			
Modulinhalte	<p>"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: - determining the concentration of dissolved organic substrates (amino acids, carbohydrates, dissolved and particulate organic carbon), - the abundance of bacterial communities in aquatic systems - The composition of bacterial communities in environmental samples by denaturing gradient gel electrophoresis (DGGE) of 16S rRNA targeted gene fragments. The main emphasis is on analyses and approaches of bacterial communities in the water column.</p>			
Literaturempfehlungen	Lecture notes, available on Stud.IP			
Links				
Unterrichtssprache	Englisch			
Dauer in Semestern	1 Semester			
Angebotsrhythmus Modul	jährlich			
Aufnahmekapazität Modul	unbegrenzt			
Modullevel / module level				
Modulart / typ of module	Wahlpflicht / Elective			
Lehr-/Lernform / Teaching/Learning method	Seminar (1 SPPW); practical course (4 SPPW)			
Vorkenntnisse / Previous knowledge	For the practical course lecture: Methods in Aquatic Microbial Ecology			
Prüfung	Prüfungszeiten	Prüfungsform		
Gesamtmodul	Will be announced during the course.	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.)		
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Seminar		1.00		
Praktikum		4.00		
Präsenzzeit Modul insgesamt				0 h

mar610 - Profile Module Isolation and characterization of microorganisms

Modulbezeichnung	Profile Module Isolation and characterization of microorganisms			
Modulkürzel	mar610			
Kreditpunkte	6.0 KP			
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 			
Zuständige Personen	Engelen, Bert (Modulverantwortung)			
Teilnahmevoraussetzungen	Microbial Physiology and diversity (M1)			
Kompetenzziele	In this course the students will isolate bacteria and other microorganisms. They will learn classical microbiological techniques as enrichment culture, aseptic work, preparation of liquid and solid media, cultivation under oxic and anoxic condition, on agar plates and in deep agar dilution, description of microbes by techniques as staining, microscopy, microphotography.			
Modulinhalte	"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 course 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 in 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.			
Literaturempfehlungen	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.microbiological-garden.net			
Links				
Unterrichtssprache	Englisch			
Dauer in Semestern	1 Semester			
Angebotsrhythmus Modul	jährlich			
Aufnahmekapazität Modul	unbegrenzt			
Modullevel / module level	MM (Mastermodul / Master module)			
Modulart / typ of module	Wahlpflicht / Elective			
Lehr-/Lernform / Teaching/Learning method	Seminar and laboratory work, twice per week, half a day each			
Vorkenntnisse / Previous knowledge	Module mar500 including lectures on "Physiology and life modes of prokaryotes" and "Microbial diversity"			
Prüfung	Prüfungszeiten	Prüfungsform		
Gesamtmodul	Announced during the course.	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.)		
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Seminar		1.00		
Praktikum		4.00		
Präsenzzeit Modul insgesamt				0 h

mar620 - Profile Module Marine Chemical Ecology

Modulbezeichnung	Profile Module Marine Chemical Ecology		
Modulkürzel	mar620		
Kreditpunkte	6.0 KP		
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 		
Zuständige Personen	Rohde, Sven (Modulberatung) Schupp, Peter (Modulverantwortung)		
Teilnahmevoraussetzungen	Lecture: Organic chemistry		
Kompetenzziele	Students will learn about the chemical properties and major ecological roles of secondary metabolites, how to investigate the secondary metabolites of marine invertebrates and algae, how to analyze secondary metabolite profiles, how to isolate compounds of interest and how to conduct various bioassays to assess potential ecological roles of crude extracts and potentially isolated compounds. Students will also learn how to statistically evaluate their results.		
Modulinhalte	"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.		
Literaturempfehlungen	Marine Chemical Ecology, McClintock, Baker		
Links			
Unterrichtssprache	Englisch		
Dauer in Semestern	1 Semester		
Angebotsrhythmus Modul	jährlich		
Aufnahmekapazität Modul	unbegrenzt		
Modullevel / module level	MM (Mastermodul / Master module)		
Modulart / typ of module	je nach Studiengang Pflicht oder Wahlpflicht		
Lehr-/Lernform / Teaching/Learning method	Compact Course, Seminar, Practical		
Vorkenntnisse / Previous knowledge	Lecture: Organic chemistry		
Prüfung	Prüfungszeiten	Prüfungsform	
Gesamtmodul	Will be announced during the course	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.)	
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus Workload Präsenz
Seminar		1.00	
Praktikum		4.00	
Präsenzzeit Modul insgesamt			0 h

mar621 - Profile Module Techniques in light microscopy and electron microscopy

Modulbezeichnung	Profile Module Techniques in light microscopy and electron microscopy		
Modulkürzel	mar621		
Kreditpunkte	6.0 KP		
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Mastermodule 		
Zuständige Personen	Rhiel, Erhard (Modulverantwortung)		
Teilnahmevoraussetzungen	none		
Kompetenzziele	<p>The students will learn</p> <ul style="list-style-type: none"> - the basics/theory of scanning electron microscopy (SEM) and transmission electron microscopy (TEM) - different sample preparation methods for SEM - to operate our scanning electron microscope - to operate our critical point drying device - to perform sputter coating - to perform negative staining TEM - to operate our transmission electron microscope - to perform immuno-labelling for light microscopy 		
Modulinhalte	<p>The profile module "Techniques in light microscopy and electron microscopy" runs over a period of 10 days, distributed over three weeks. On the first day, seminars will introduce into the theory, i.e. of SEM and TEM. The remaining 9 days are for practice. The main topics of the course are: basic principles and functioning of light and electron microscopes, sample preparation, fixation, low temperature SEM, low vacuum SEM, negative staining TEM, and immuno-labelling for light microscopy.</p>		
Literaturempfehlungen	will be announced		
Links			
Unterrichtssprache	Englisch		
Dauer in Semestern	1 Semester		
Angebotsrhythmus Modul	jährlich		
Aufnahmekapazität Modul	unbegrenzt		
Modullevel / module level	MM (Mastermodul / Master module)		
Modulart / typ of module	je nach Studiengang Pflicht oder Wahlpflicht		
Lehr-/Lernform / Teaching/Learning method	Seminar and laboratory work, at three days for three weeks		
Vorkenntnisse / Previous knowledge			
Prüfung	Prüfungszeiten	Prüfungsform	
Gesamtmodul	after delivery of the two course assessments	<p>One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)</p> <p>One assessment of examination: (seminar presentation, poster). 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.)</p>	
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus Workload Präsenz
Seminar		1.00	
Praktikum		4.00	
Präsenzzeit Modul insgesamt			0 h

mar630 - Research Project

Modulbezeichnung	Research Project			
Modulkürzel	mar630			
Kreditpunkte	12.0 KP			
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> • Master Microbiology (Master) > Mastermodule 			
Zuständige Personen	Engelen, Bert (Modulverantwortung) der Mikrobiologie, Lehrende (Modulberatung)			
Teilnahmevoraussetzungen	1 main module and 1 profile module			
Kompetenzziele	The students are able to work (under guidance) on an ambitious research project. They understand recent 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.			
Modulinhalte	The contents concern variable recent scientific questions on a high scientific level.			
Literaturempfehlungen	project-specific, will be announced			
Links				
Unterrichtssprache	Englisch			
Dauer in Semestern	2 Semester			
Angebotsrhythmus Modul	halbjährlich			
Aufnahmekapazität Modul	unbegrenzt			
Modullevel / module level	MM (Mastermodul / Master module)			
Modulart / typ of module	Pflicht / Mandatory			
Lehr-/Lernform / Teaching/Learning method	Seminar (2 SPPW); Practical work (4 SPPW)			
Vorkenntnisse / Previous knowledge	1 main module and 1 profile module			
Prüfung	Prüfungszeiten	Prüfungsform		
Gesamtmodul	Announced during the course.	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 %). 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.)		
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Seminar		6.00		
Praktikum		12.00		
Präsenzzeit Modul insgesamt				0 h

mar640 - Research Project

Modulbezeichnung	Research Project		
Modulkürzel	mar640		
Kreditpunkte	12.0 KP		
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> • Master Microbiology (Master) > Mastermodule 		
Zuständige Personen	Engelen, Bert (Modulverantwortung) der Mikrobiologie, Lehrende (Modulberatung)		
Teilnahmevoraussetzungen	1 main and 1 profile module		
Kompetenzziele	The students are able to work (under guidance) on an ambitious research project. They understand recent 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.		
Modulinhalte	The contents concern variable recent scientific questions on a high scientific level.		
Literaturempfehlungen	project-specific, will be announced		
Links			
Unterrichtssprache	Englisch		
Dauer in Semestern	2 Semester		
Angebotsrhythmus Modul	halbjährlich		
Aufnahmekapazität Modul	unbegrenzt		
Modullevel / module level	MM (Mastermodul / Master module)		
Modulart / typ of module	Pflicht / Mandatory		
Lehr-/Lernform / Teaching/Learning method	Seminar (2 SPPW); Practical work (4 SPPW)		
Vorkenntnisse / Previous knowledge			
Prüfung	Prüfungszeiten	Prüfungsform	
Gesamtmodul	Announced during the course.	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 %).	
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus Workload Präsenz
Seminar		6.00	
Praktikum		12.00	
Präsenzzeit Modul insgesamt			0 h

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

Modulbezeichnung	Profile Module R programming for (meta)-genomic sequence analysis
Modulkürzel	mar622
Kreditpunkte	6.0 KP
Verwendbarkeit des Moduls	<ul style="list-style-type: none">• Master Microbiology (Master) > Mastermodule
Zuständige Personen	Moraru, Liliana Cristina (Prüfungsberechtigt)
Teilnahmevoraussetzungen	Participation in the course „Introduction in sequencing and sequence analysis“. Previous programming experience is not required.
Kompetenzziele	DNA sequencing has become a routine method in microbiology research. Most of the times, sequence analysis requires knowledge of a programming language. One of the programming languages most used for this purpose is R. After successful participation the students will have the competence to understand, interpret and carry out simple genome sequence analyses. They will acquire transferable skills in using R
Modulinhalte	<p>A single, introductory lecture will be offered within the first day of the course. Then, the course will be structured in programming exercises which cover all topics listed below. The exercises are designed to exemplify the use R programming within the framework of microbial (meta)-genome analysis.</p> <p>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 projects will consist in an analysis report prepared in Rmarkdown and Knitr packages. The report will include both the R code and the genome analysis results.</p> <p>The course will cover the following topics:</p> <ul style="list-style-type: none">• programming in R using an integrated development environment (RStudio)• working with strings (stringr package)• working with lists and data frames (readr and dplyr package)• sequence analysis (seqinr, Bioconductor packages: Biostrings, GenomicRanges, Decipher)• (meta)-genomic and data visualization (ggplot2, Gviz)• Creating sequence / metadata databases• Accessing and mining sequence / metadata databases though R based web applications (Shiny, DT and Shinyjs packages)• reporting in R (Rmarkdown and Knitr packages)• managing code (Roxygen2 package) <p>microbial genome annotation using R.</p>
Literatureempfehlungen	will be announced
Links	
Unterrichtssprache	Englisch
Dauer in Semestern	1 Semester
Angebotsrhythmus Modul	jährlich
Aufnahmekapazität Modul	15 (Proportionale Aufteilung zwischen Master MUWI und Master Microbiology)
Modullevel / module level	AC (Aufbaucurriculum / Composition)
Modulart / typ of module	Wahlpflicht / Elective
Lehr-/Lernform / Teaching/Learning method	Seminar (2 SWS), Practical (2 SWS)

Vorkenntnisse / Previous knowledge

Participation in the course „Introduction in sequencing and sequence analysis“. Previous programming experience is not required.

Prüfung	Prüfungszeiten	Prüfungsform		
Gesamtmodul	Will be announced during the course	Written protocol (80%) and class participation (20%)		
Lehrveranstaltungsform	Kommentar	SWS	Angebotsrhythmus	Workload Präsenz
Seminar		2.00	SoSe	0
Praktikum		2.00	SoSe	0
Präsenzzeit Modul insgesamt				0 h

Abschlussmodul

mam - Master Thesis Module

Modulbezeichnung	Master Thesis Module	
Modulkürzel	mam	
Kreditpunkte	30.0 KP	
Verwendbarkeit des Moduls	<ul style="list-style-type: none"> Master Microbiology (Master) > Abschlussmodul 	
Zuständige Personen	Engelen, Bert (Modulverantwortung) der Mikrobiologie, Lehrende (Modulberatung)	
Teilnahmevoraussetzungen	1 research project	
Kompetenzziele	The students are able to work (under guidance) on an extended research project. They understand recent 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.	
Modulinhalte	The contents concern variable recent scientific questions on a high scientific level	
Literaturempfehlungen	project-specific, will be announced	
Links		
Unterrichtssprache	Englisch	
Dauer in Semestern	1 Semester	
Angebotsrhythmus Modul	halbjährlich	
Aufnahmekapazität Modul	unbegrenzt	
Modullevel / module level		
Modulart / typ of module	je nach Studiengang Pflicht oder Wahlpflicht	
Lehr-/Lernform / Teaching/Learning method	Seminar (2 SPPW); Practical work (28 SPPW)	
Vorkenntnisse / Previous knowledge		
Prüfung	Prüfungszeiten	Prüfungsform
Gesamtmodul		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 %)
Lehrveranstaltungsform	Seminar	
SWS	2.00	
Angebotsrhythmus		
Workload Präsenzzeit	28 h	

