Module descriptions of Master Microbiology (handbook)

Carl von Ossietzky University of Oldenburg
Institute for Chemistry and Biology of Marine Environment (ICBM)

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Content

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar500 Physiology and diversity of microorganisms (L1)**
2	Courses:	**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)
3	Semester:	1st and 2ndSemester
4	Coordinator:	Cypionka
5	Teacher:	Teaching staff involved in the program
6	Language:	English (some optional broadening lectures might be in German)
7	Facultative or obligatory:	obligatory
8	Form of study/semester periods per week:	Lectures (6 SPPW); Exercises (2 SPPW); Excursion (1 CP)
9	Work load:	Presence: 136 hours, private study: 224 hours
10	Credit points:	12
11	Preconditions:	None
12	Learning target/competences:	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.
13	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: - 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 (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: – 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: Cypionka, Engelen, Vandieken; Work load: Presence: 30 hours, 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
14	Examinations:	Two written tests about the contents of the lectures 'Physiology and life modes of prokaryotes' and Microbial Diversity.
15	Literature:	Brock. Microbiology
16	Passing criteria:	At least 50 % of the reachable points in written tests about the two lectures mentioned above.

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar510 Molecular Mechanisms and Interactions (L2)**
2	Courses:	**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)
3	Semester:	2nd Semester
4	Coordinator:	Rabus
5	Teacher:	Teaching staff involved in the program
6	Language:	English (some optional broadening lectures might be in German)
7	Facultative or obligatory:	obligatory
8	Form of study/semester periods per week:	Lectures (4 SPPW); Seminar (2 SPPW); Exercises (2 SPPW; Excursion (1 CP)
9	Work load:	Presence: 136 hours, private study: 224 hours
10	Credit points:	12
11	Preconditions:	None
12	Learning target/competences:	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. The have experience with the field study of microorganisms.
13	Contents:	**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
14	Examinations:	Two written tests about the contents of the lectures 'Molecular Microbiology' and 'Microbial Ecology'.
15	Literature:	**Molecular Microbiology :** Stryer – Biochemistry

		Voet – Biochemistry Knippers – Molekulare Genetik Snyder – Molecular Genetics of Bacteria Brock - Microbiology
16	Passing criteria:	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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar520 Main Module: Proteomics (MM1)**
2	Courses:	Seminar (2 CP), practical course (10 CP)
3	Semester:	2nd Semester
4	Responsible:	Rabus
5	Teacher:	Teaching staff involved in the program (Wöhlbrand, NN, Rabus)
6	Language:	English
7	Facultative or obligatory:	Obligatory, 2 modules have to be completed
8	Form of study/semester periods per week:	Seminar (2 SPPW); Practical course (8 SPPW)
9	Work load:	Presence: 192 hours, private study: 168 hours
10	Credit points:	24 CP (12 CP per course)
11	Preconditions:	Lecture: Physiology and diversity of prokaryotes Lecture: Molecular Microbiology
12	Learning target/competences:	The students are getting directly involved in actual scientific projects in the area of physiological and/or meta-proteomics (under guidance). They ▪ understand the scientific rational and design of the experiment(s), ▪ 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.
13	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: ▪ 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.
14	Examinations:	One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)
15	Literature:	Lottspeich – Bioanalytik
13	Passing criteria:	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

		supervisor.)
1	Module name:	**mar530 Main Module: Ecophysiology of anaerobes (MM2)**
2	Courses:	Seminar (2 CP), practical course (10 CP)
3	Semester:	1st Semester
4	Responsible:	Cypionka
5	Teacher:	Cypionka, Engelen, Vandieken
6	Language:	English
7	Facultative or obligatory:	Facultative, 2 modules have to be completed
8	Form of study/semester periods per week:	Block course, 4 weeks, seminar and laboratory work
9	Work load:	Presence: 192 hours, private study: 168 hours
10	Credit points:	12 CP
11	Preconditions:	Lecture: Microbial Physiology and Diversity, recommended: Sediment Microbiology
12	Learning target/competences:	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.
13	Contents:	**"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.
14	Examinations:	One assessments of examination: Portfolio: Written protocol and contribution to the seminar (seminar presentation)
15	Literature:	will be announced
16	Passing criteria:	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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar540 Main Module: Ecology of Marine Microbial Communities (MM3)**
2	Courses:	Seminar (2 CP), practical course (10 CP)
3	Semester:	2nd Semester
4	Responsible:	Simon
5	Teacher:	Brinkhoff, Simon
6	Language:	English (or German)
7	Facultative or obligatory:	Obligatory, 2 modules have to be completed
8	Form of study/semester periods per week:	Seminar (1 SPPW); Practical course (9 SPPW)
9	Work load:	Presence: 192 hours, private study: 168 hours
10	Credit points:	12 CP
11	Preconditions:	Lecture: Biological significance of suspended matter
12	Learning target/competences:	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.
13	Contents:	**"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.
14	Examinations:	Two assessments of examination: 1) Written protocol and / or contribution to the seminar (seminar presentation) 2) oral examination (30 min)
15	Literature:	will be announced
16	Passing criteria:	Seminar presentation (no mark), written protocol (75 %), Final oral examination (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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar550 Profile Module: Physiology of bacteria (PM1)**
2	Courses:	Seminar (2 CP), practical course (4 CP)
3	Semester:	1st or 3rd Semester
4	Coordinator:	Cypionka
5	Teacher:	Cypionka
6	Language:	English
7	Facultative or obligatory:	3 Profile Modules have to be completed
8	Form of study/semester periods per week:	Seminar (1 SPPW); practical course (4 SPPW)
9	Work load:	Presence: 100 hours, private study: 80 hours
10	Credit points:	6 CP (per course)
11	Preconditions:	Lecture: Physiology and diversity of prokaryotes
12	Learning target/competences:	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
13	Contents:	**"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.
14	Examinations:	One assessment of examination: Portfolio (seminar presentation, written protocol)
15	Literature:	
16	Passing criteria:	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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar560 Profile Module: Fermentation (PM2)**
2	Courses:	Seminar (2 CP), practical course (4 CP)
3	Semester:	2nd Semester
4	Coordinator:	Rabus
5	Teacher:	Teaching staff involved in the program (Maschmann, Trautwein)
6	Language:	English
7	Facultative or obligatory:	3 Profile Modules have to be completed
8	Form of study/semester periods per week:	Seminar (1 SPPW); practical course (4 SPPW)
9	Work load:	Presence: 100 hours, private study: 80 hours
10	Credit points:	6 CP (per course)
11	Preconditions:	Lecture: Physiology and diversity of prokaryotes (successfully completed) Lecture: Molecular Microbiology
12	Learning target/competences:	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 process-controlled cultivation and growth balancing, know how to write concise scientific protocols, know how to present/discuss their results in public.
13	Contents:	**"Fermentation":** Daily lectures introduce the students to theory and concepts of process-controlled cultivation: (i) growth physiology and balancing, (ii) design and operating mode of laboratory fermenters, (iii) pH / pO_2 electrodes and k_La-determination of O_2-supply, (iv) *on-line* gas analysis (O_2, CO_2, etc.) by mass spectrometry. 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 as inoculum for actual "fermenter"-cultures ▪ determination of optical density, the live count and dry weight of cells during cultivation in fermenter ▪ (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 ▪ quantitative determination and calculation growth balances
14	Examinations:	One assessment of examination: Portfolio (seminar presentation, written protocol)
15	Literature:	
16	Passing criteria:	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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar570 Profile Module: Introduction into DNA-sequencing and sequence analysis (PM3)**
2	Courses:	Seminar (2 CP), practical course (4 CP)
3	Semester:	1st or 3rd Semester
4	Coordinator:	Brinkhoff
5	Teacher:	Brinkhoff
6	Language:	English
7	Facultative or obligatory:	3 Profile Modules have to be completed
8	Form of study/semester periods per week:	Seminar (1 SPPW); practical course (4 SPPW)
9	Work load:	Presence: 100 hours, private study: 80 hours
10	Credit points:	6 CP (per course)
11	Preconditions:	Lecture during the course
12	Learning target/competences:	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 ARB, databases and literature data to create ▪ phylogenetic trees ▪ design primers and probes ▪ present and discuss scientific results ▪ - write a scientific protocol
13	Contents:	**"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 and the phylogeny program ARB will be demonstrated by individual use of laptops of the institute.
14	Examinations:	One assessment of examination: Portfolio (seminar presentation, written protocol)
15	Literature:	
16	Passing criteria:	**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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar580 Profile Module: Microbial ecology of marine sediments (PM4)**
2	Courses:	Seminar (2 CP), practical course (4 CP)
3	Semester:	2nd Semester
4	Coordinator:	Engelen, Vandieken
5	Teacher:	Engelen, Vandieken
6	Language:	English
7	Facultative or obligatory:	Facultative, 3 Profile Modules have to be completed
8	Form of study/semester periods per week:	Block course, 2 weeks, seminar and laboratory work
9	Work load:	Presence: 100 hours, private study: 80 hours
10	Credit points:	6 CP (per course)
11	Preconditions:	Lecture: Microbial ecology
12	Learning target/competences:	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
13	Contents:	**"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.
14	Examinations:	One assessment of examination: Portfolio (seminar presentation, written protocol)
15	Literature:	

16	Passing criteria:	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.)

1	Module name:	**mar600 Profile Module: Methods in Aquatic Microbial Ecology (PM5)**
2	Courses:	Lecture, seminar (2 CP), practical course (4 CP)
3	Semester:	1st or 3rd Semester
4	Coordinator:	Simon
5	Teacher:	Simon, Brinkhoff
6	Language:	English
7	Facultative or obligatory:	3 Profile Modules have to be completed
8	Form of study/semester periods per week:	Seminar (1 SPPW); practical course (4 SPPW)
9	Work load:	Presence: 100 hours, private study: 80 hours
10	Credit points:	6 CP (per course)
11	Preconditions:	For the practical course lecture: Methods in Aquatic Microbial Ecology
12	Learning target/competences:	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.
13	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: ▪ 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.
14	Examinations:	One assessment of examination: Portfolio (seminar presentation, written protocol)
15	Literature:	Lecture notes, available on Stud.IP
16	Passing criteria:	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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar610 Profile Module: Isolation and characterization of microorganisms (PM6)**
2	Courses:	Seminar (2 CP), practical course (4 CP)
3	Semester:	1st or 3rd Semester
4	Coordinator:	Cypionka
5	Teacher:	Cypionka
6	Language:	English
7	Facultative or obligatory:	3 Profile Modules have to be completed
8	Form of study/semester periods per week:	Seminar and laboratory work, twice per week, half a day each
9	Work load:	Presence: 100 hours, private study: 80 hours
10	Credit points:	6 CP
11	Preconditions:	Microbial Physiology and diversity (M1)
12	Learning target/competences:	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.
13	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 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.
14	Examinations:	One assessment of examination: Portfolio (seminar presentation, written protocol)
15	Literature:	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
16	Passing criteria:	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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar620 Profile Module: Marine Chemical Ecology (PM7)**
2	Courses:	Seminar (2 CP), practical course (4 CP)
3	Semester:	1st or 3rd Semester
4	Coordinator:	Schupp
5	Teacher:	Schupp, Rohde
6	Language:	English
7	Facultative or obligatory:	3 Profile Modules have to be completed
8	Form of study/semester periods per week:	Compact Course
9	Work load:	Presence: 100 hours, private study: 80 hours
10	Credit points:	6 CP
11	Preconditions:	Lecture: Organic chemistry
12	Learning target/competences:	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 isolates 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.
13	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.
14	Examinations:	One assessment of examination: Portfolio (seminar presentation, written protocol)
15	Literature:	Marine Chemical Ecology, McClintock, Baker
16	Passing criteria:	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.)

1	Module name:	**mar621 Profile Module: Techniques in light microscopy and electron microscopy (PM8)**
2	Courses:	Lecture (1 CP), seminar (1 CP) & practical course (4 CP)
3	Semester:	1st / 3rd Semester
4	Coordinator:	Rhiel
5	Teacher:	Rhiel
6	Language:	English
7	Facultative or obligatory:	facultative (3 Profile Modules have to be completed)
8	Form of study/semester periods per week:	Seminar and laboratory work, at three days for three weeks
9	Work load:	Presence: 72 hours, private study: 108 hours
10	Credit points:	6
11	Preconditions:	None
12	Learning target/competences:	The students will learn ▪ 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
13	Contents:	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.
14	Examinations:	One assessment of examination: (seminar presentation, poster)
15	Literature:	will be announced
16	Passing criteria:	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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar622 Profile Module: R programming for (meta)-genomic sequence analysis (PM9)** *(Start: March 2018)*
2	Courses:	Seminar (2 CP), practical course (4 CP)
3	Semester:	1st / 3rd Semester
4	Coordinator:	Dr. Cristina Moraru
5	Teacher:	Dr. Cristina Moraru
6	Language:	English
7	Facultative or obligatory:	3 Profile Modules have to be completed
8	Form of study/semester periods per week:	Seminar and laboratory work, at three days for three weeks
9	Work load:	
10	Credit points:	6
11	Preconditions:	None
12	Learning target/competences:	
13	Contents:	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 programing languages most used for this purpose is R. The course will cover the following topics: I. programming in R using an integrated development environment (RStudio) II. working with strings (stringr package) III. working with lists and data frames (readr and dplyr package) IV. sequence analysis (seqinr, Bioconductor packages: Biostrings, GenomicRanges, Decipher) V. (meta)-genomic and data visualization (ggplot2, Gviz) VI. building web applications using R (Shiny, DT and Shinyjs packages) VII. reporting in R (Rmarkdown and Knitr packages) VIII. managing code (Roxygen2 package) Prerequisites: the „Introduction in sequencing and sequence analysis" course. Previous programming experience is not required.
14	Examinations:	Seminar presentation, written protocol, Portfolio
15	Literature:	will be announced
16	Passing criteria:	Protocol (75 %), seminar presentation (25 %)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar630 Research Project (RP 1)**
2	Courses:	Practical work (10 CP), Seminar (2 CP)
3	Semester:	2nd and 3rd Semester
4	Coordinator:	Cypionka
5	Teacher:	Teaching staff of the program
6	Language:	English
7	Facultative or obligatory:	Obligatory(2 Research Projects have to be completed)
8	Form of study/semester periods per week:	Seminar (2 SPPW); Practical work (4 SPPW)
9	Work load:	Presence: 250 hours, private study: 110 hours
10	Credit points:	12 CP (per course)
11	Preconditions:	1 main and 1 profile module
12	Learning target/competences:	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.
13	Contents:	The contents concern variable recent scientific questions on a high scientific level.
14	Examinations:	Two assessments of examination: Written protocol and / or written English thesis, presentation
15	Literature:	project-specific, will be announced
16	Passing criteria:	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.)

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mar640 Research Project (RP 2)**
2	Courses:	Practical work (10 CP), Seminar (2 CP)
3	Semester:	2nd and 3rd Semester
4	Coordinator:	Cypionka
5	Teacher:	Teaching staff of the program
6	Language:	English
7	Facultative or obligatory:	Obligatory (2 Research Projects have to be completed)
8	Form of study/semester periods per week:	Seminar (2 SPPW); Practical work (4 SPPW)
9	Work load:	Presence: 250 hours, private study: 110 hours
10	Credit points:	12 CP (per course)
11	Preconditions:	1 main and 1 profile module
12	Learning target/competences:	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.
13	Contents:	The contents concern variable recent scientific questions on a high scientific level.
14	Examinations:	Two assessments of examination: Written protocol and / or written English thesis, presentation
15	Literature:	project-specific, will be announced
16	Passing criteria:	Quality of the scientific performance and thesis (75 %), Final seminar and public defense (25 %).

Study Programme: Master of Science in Microbiology - module descriptions

1	Module name:	**mam Master Thesis (MT)**
2	Courses:	Practical work (28 CP), Seminar (2 CP)
3	Semester:	4th Semester
4	Coordinator:	Cypionka
5	Teacher:	Teaching staff of the program
6	Language:	English
7	Facultative or obligatory:	Obligatory
8	Form of study/semester periods per week:	Seminar (2 SPPW); Practical work (28 SPPW)
9	Work load:	Presence: 28 hours, private study: 872 hours
10	Credit points:	30
11	Preconditions:	According to the examination regulations
12	Learning target/competences:	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.
13	Contents:	The contents concern variable recent scientific questions on a high scientific level
14	Examinations:	Written English thesis, seminar with public discussion in English
15	Literature:	
16	Passing criteria:	According to the examination regulations; quality of the scientific performance and thesis (83.3 %), final seminar and public defense (16.7 %)

Information and Student Support

International applicants
International Student Office
Campus Haarentor, A5 1-147
26129 Oldenburg
Telefon: 0441-798-2478
E-Mail: iso@uni-oldenburg.de
Internet: www.uni-oldenburg.de/iso

For questions regarding your course of studyStudent advice centre
ZentraleStudienberatung
Campus Haarentor, A3 1-110 bis 1-117
26129 Oldenburg
Phone: 0441-798-4405
E-Mail: studienberatung@uni-oldenburg.de
Internet: www.zsb.uni-oldenburg.de

For questions regarding application and enrolmentApplicants with German higher education entrance qualifications
Admissions Office
Immatrikulationsamt
Campus Haarentor (Mensafoyer), M 1-174 bis 1-181
26129 Oldenburg
Telefon: 0441-798-2728
Internet: www.uni-oldenburg.de/i-amt

For questions regarding your course of study
Academic Advisor
Prof. Dr. Heribert Cypionka
Phone: +49(0)441-798-5360
E-Mail: cypionka@icbm.de

Coordinator
Dr. Ferdinand Esser
Phone: +49(0)441-798-3171
E-Mail: ferdinand.esser@uni-oldenburg.de

Further Information
Homepage Microbiology: www.mikrobiologie-studieren.de
Available courses: www.studium.uni-oldenburg.de/studienangebot
Funding: www.studium.uni-oldenburg.de/finanzierung