LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Module Catalogue
Master's Programme:
Geobiology and Paleobiology
(Master of Science, M.Sc.)

(120 ECTS credits)

Based on the *Prüfungs- und Studienordnung* of 01 June 2018

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Abbreviations and annotations

CP	Credit Points, ECTS credits
ECTS	European Credit Transfer and Accumulation System
h	hours
SoSe	summer semester
SWS	contact hours
WiSe	winter semester
WP	compulsory elective course/module
P	mandatory course/module

1. The ECTS credits assigned in the Module Catalogue are designated as follows: Credit Points not listed in parentheses are awarded when the pertinent examination of the module or module parts have/has been completed successfully. Credit Points in parentheses are listed for calculatory purposes only.

2. The semester for taking a module can either be binding or may be considered as a recommendation, depending on the applicable data in Anlage 2 of the Prüfungs- und Studienordnung for your Programme. In this Module catalogue, the options are indicated as „scheduled semester“ and „recommended semester“.

3. Please note: The Module Catalogue is merely intended to serve as an orientation whereas the provisions of the applicable version of the Prüfungs- und Studienordnung (in German only) of your Programme are legally binding. See: www.lmu.de/studienangebot and select your Programme.

Module: P 1 Paleobiology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	P 1.1 Evolution of Life: Lecture	WiSe	30 h (2 SWS)	60 h	(3)
Exercise	P 1.2 Evolution of Life: Tutorial	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other Programmes	Master's Programme Geology
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	The module includes an interactive teaching program on the evolution of life in the seas and on land during the Phanerozoic. In addition, the program comprises principles of chronostratigraphy. In detail, the courses include the following contents: • P 1.1 Evolution of Life: Lecture The interactive program of the lectures illustrates the state of the art with regard to the evolution of life and principles of chronostratigraphy. • P 1.2 Evolution of Life: Tutorial The exercises include analysis of fossils in the context of the lectures and selected papers published in international journals.
Learning outcomes	Students will be able to understand basic processes governing the evolution of life, palaeoclimate, palaeogeography and extinction events: By attending the lecture and the tutorial, they will gain insight in contemporary research on interactions between processes of evolution and global or regional patterns.
Type of examination	Written exam and presentation
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential

	elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bettina Reichenbacher
Language(s)	English
Additional information	None

Module: P 2 Evolutionary Geobiology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	P 2.1 Systematics and Phylogenetics	WiSe	30 h (2 SWS)	60 h	(3)
Exercise	P 2.2 Phylogenetic Analysis of Morphological and Molecular Data	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other Programmes	Master's Programme Evolution, Ecology and Systematics (as WP 8.0.69 & WP 8.0.70)
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	Basics concepts of evolution, systematics, phylogenetics. In detail, the courses include the following contents: • P 2.1 Systematics and Phylogenetics Basic concepts of classification and taxonomy, systematic and phylogenetic concepts, character evolution. • P 2.2 Phylogenetic analyses of molecular and morphological data The exercises include creation of phylogenetic character matrices, phylogenetic reconstructions, and interpretation of phylogenetic data and hypotheses. Relevant software will be introduced and applied by the students
Learning outcomes	At the end of the module students are able to understand basic concepts of classification, taxonomy, systematics, phylogenetic principles, and the assessment of character evolution. Students will be able to analyse phylogenetic data and interpret the results. The practical methods taught allow students to apply the gained background in the analyses or re-analyses of published or own data.
Type of examination	Written exam or scientific report
Type of assessment	The successful completion of the module will be graded.

Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Dirk Erpenbeck
Language(s)	English
Additional information	None

Module: P 3 Environmental Geobiology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	P 3.1 Global Cycles: Lecture	WiSe	30 h (2 SWS)	60 h	(3)
Ecercise	P 3.2 Global Cycles: Tutorial	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other Programmes	Master's Programme Geology
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	Introduction to biogeochemical global cycles and methods to acquire and analyse geobiological data in this context. In detail, the courses include the following contents: • P 3.1 Global Cycles: Lecture Theoretical background on biogeochemical global cycles of relevant elements like carbon, nitrogen, phosphorous, , iron, and sulfur • P 3.2 Global Cycles: Tutorial • Each week, one student gives a 15 minute presentation on either a review article or original research article dealing with one of the biogeochemical processes discussed in class the week before, followed by a group discussion. Articles are assigned by the instructor but can also be suggested by the students.
Learning outcomes	At the end of the module students are familiar with the most recent reviews on the global cycles of carbon, nitrogen, , iron, phosphorous and sulfur. They are able to discuss the role of biology in controlling ecologically relevant geochemical cycles of important elements. Furthermore, students will be able to apply theoretical background to understand complex connections between the biosphere and geosphere in geobiology. This enables them to apply this understanding in the future and to

	critically understand and evaluate related scientific publications.
Type of examination	Written exam or scientific report
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. William Orsi
Language(s)	English
Additional information	None

Module: WP 1 Basic Concepts in Geology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 1.1 Basic Concepts in Geology: Lecture	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Modules with a total value of 6 ECTS credits have to be taken from the compulsary elective modules WP 1 – WP 4.
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	The module includes an introduction to basic concepts in geology such as plate tectonics, sedimentology, global geochemical cycles, stratigraphy, fossil record, marine thermohaline circulation, and paleoclimate. The description and identification of rocks is also also part of the course.
Learning outcomes	At the end of this module students should have complemented and expanded their knowledge about basic concepts, terminologies, and hypotheses in geology. The student should be capable to understand and interpret fundamental geological knowledge.
Type of examination	Written exam
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Evelyn Kustatscher
Language(s)	English
Additional information	None

Module: WP 2 Basic Concepts in Biology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 2.1 Basic Concepts in Biology: Lecture	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Modules with a total value of 6 ECTS credits have to be taken from the compulsary elective modules WP 1 – WP 4.
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	Introduction to basic concepts in biology, for example: Origin and evolution of biological diversity, fundamentals of ecology, genetics, general physiology and cell biology.
Learning outcomes	At the end of this module students should have complemented and expanded their knowledge about basic concepts, terminologies, and theories in biology. The student should be capable to understand and interpret fundamental biological observations.
Type of examination	Written exam
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Oliver Voigt
Language(s)	English
Additional information	This course should be attended to obtain or refresh basic biological concepts for students with little

biological background in their former academic education.

Module: WP 3 Basic Concepts in Molecular Paleobiology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 3.1 Basic Concepts in Molecular Paleobiology: Lecture	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Modules with a total value of 6 ECTS credits have to be taken from the compulsary elective modules WP 1 – WP 4.
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	Methods in molecular and cell biological research, ecology, genetics, physiology and biochemistry.
Learning outcomes	At the end of this module students should have expanded their knowledge about molecular biological concepts, theories and methodologies, and should be capable of applying them to the analysis of empirical data to critically evaluate published results in the field.
Type of examination	Written exam
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Dirk Erpenbeck
Language(s)	English
Additional information	None

Module: WP 4 Systematic Data and Evidence

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 4.1 Systematic Data and Evidence: Lecture	WiSe	60 h (4 SWS)	60 h	(4)
Exercise	WP 4.2 Systematic Data and Evidence: Tutorial	WiSe	15 h (1 SWS)	45 h	(2)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 5 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Compulsory elective module with mandatory courses
Usability of the module in other Programmes	Master's Programme Evolution, Ecology and Systematics
Elective guidelines	Modules with a total value of 6 ECTS credits have to be taken from the compulsary elective modules WP 1 – WP 4.
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	Students will be introduced to the main topics of Systematics. In this lecture, a choice of the following topics will be discussed: paleontological and biogeographical data; the kinds of data used in primatology; speciation and radiations (diversity hotspots); principles of phylogenetics tree inference; introduction to biological collecting and collections (including visits to the Bavarian Natural History collections); taxon-specific approaches and problems (e.g., species concepts in bacteria vs. species concepts in higher organisms); role of organismic interactions in the evolution of adaptation; role of Systematics in Evolutionary Biology. Students receive questions and tasks, which must be answered in small teams. This requires literature search and further reading in textbooks and publications. The results are presented and discussed in the tutorial.
Learning outcomes	Students receive background knowledge in Systematics; they are familiar with important terminology and important theory. Participants acquire a firm understanding of the kinds of data with which phylogenetic relationships and macroevolution can be inferred. They also understand and are able to discuss some problems in Systematics. They know the role of Systematics in Evolutionary Biology.

Type of examination	Written exam
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Susanne Renner
Language(s)	English
Additional information	This module is offered by the faculty of Biology and part of the Master's Programme Evolution, Ecology and Systematics. It can only be recommended to students with a biological background

Module: WP 5 Basic Invertebrate Geobiology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Exercise	WP 5.1 Basic Invertebrate Geobiology: Tutorial	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Two of the compulsory elective modules WP 5 – WP 7 must be taken.
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	Evolution, comparative morphology and phylogeny of selected groups of invertebrate animals
Learning outcomes	Students will remember, apply and connect knowledge from previous courses (P 1, P 2) to gain advanced knowledge on the morphology and evolution of invertebrate animals. Upon successful completion of this module students will combine this knowledge to understand the morphological adaptations in different invertebrate bauplans
Type of examination	Written exam or drawing portfolio
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Dirk Erpenbeck
Language(s)	English
Additional information	Recommended textbook: On the Origin of Phyla, Valentine 2004, University of Chicago Press, 614 pp.

Module: WP 6 Concepts of Biomineralization

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 6.1 Concepts of Biomineralization: Lecture	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Two of the compulsory elective modules WP 5 – WP 7 must be taken.
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	Concepts of Biomineralization is an interdisciplinary lecture run jointly by lecturers from geobiology/paleontology, and geomaterials/geochemistry. Fundamentals and current research on biomineralization are highlighted from paleontological, molecular-biological, geochemical, crystallographic, and biomedical points of view. The lecture covers the most important biominerals (i.e., calcium carbonate, calcium phosphate, and silica mineral-organic composites) and their function in various organisms, structure-function relationships, the physiology of biomineralization processes, recording of environmental signatures in biominerals, biocompatible, bioactive or biomimetic materials, including those of medical relevance (e.g., prostheses, bone replacements), the evolution of biomineralization throughout geological time, feedback between mineralizing organisms (populations) and environmental changes, genetic and genomic aspects of biomineralization processes in deep time.
Learning outcomes	Understanding the interconnection of the world of organisms and the inorganic "mineral" world in geosystems, and the related feedback processes between genomes, organisms, the biomineral products they produce and global change, all related to earth processes and their analytical reconstruction, as well as to biomechanical/biochemical/biomedical issues. Learning of critical thinking and preparation for independent research in a modern, highly interdisciplinary and active field.
Type of examination	Written exam

Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Gert Wörheide
Language(s)	English
Additional information	None

Module: WP 7 Marine Biology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 7.1 Marine Biology: Lecture	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Two of the compulsory elective modules WP 5 – WP 7 must be taken.
Entry requirements	None
Semester	Recommended semester: 1
Duration	The completion of the module takes 1 semester.
Content	- Basic oceanography (geography, geomorphology, plate tectonics and water circulation systems of oceans) - Physical and chemical factors in marine ecosystems - Adaptations of marine organisms - Geobiology of marine communities - Interaction of abiotic and biotic factors in different marine ecosystems - Marine biomes and marine biogeography
Learning outcomes	Students will develop an advanced understanding on the physical, geochemical and biological interactions in marine environments to be able to critically read technical and scientific publications on the topic
Type of examination	Klausur
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Gert Wörheide
Language(s)	English
Additional information	Recommended textbook: Marine Biology: An Ecological Approach (6th Edition), Nybakken and Bertness, 2004, Benjamin Cummings.

Module: P 4 Laboratory Methods

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	P 4.1 Methods in Geobiology and Paleobiology: Lecture	SoSe	30 h (2 SWS)	60 h	(3)
Exercise	P 4.2 Methods in Geobiology and Paleobiology: Tutorial	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other Programmes	None
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 2
Duration	The completion of the module takes 1 semester.
Content	Theoretical and practical introduction to laboratory methods in Geobiology and Palaeobiology. In detail, the courses include the following contents: • P 4.1 Methods in Geobiology and Paleobiology The students are introduced to laboratory methods in the field of Geobiology and Paleobiology. The theoretical background of the methods are explained and their application demonstrated with the help of exemplary studies. • P 4.2 Methods in Geobiology and Paleobiology: Tutorial Practical application of some of the methods presented in P 4.1 in the laboratories of the department.
Learning outcomes	At the end of the module the students are familiar with a range of methods applied in Geobiology and Paleobiology and know about the available equipment of the laboratories in the department. • P 4.1 Methods in Paleobiology: Lecture The students will be familiar with the principles of the taught laboratory methods and can use this knowledge in their further studies.

	• P 4.2 Methods in Paleobiology: Tutorial The students can apply methods they learned in the practical part of the module and have a basic understanding of laboratory work.
Type of examination	Scientific report or poster
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Dirk Erpenbeck
Language(s)	English
Additional information	None

Module: P 5 Data Analysis

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	P 5.1 Statistics for Geobiology and Paleobiology: Lecture	SoSe	30 h (2 SWS)	60 h	(3)
Exercise	P 5.2 Statistics for Geobiology and Paleobiology: Tutorial	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other Programmes	None
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 2
Duration	The completion of the module takes 1 semester
Content	Theoretical and practical background and application of different statistical analyses to geobiological and paleobiological data matrices. In detail, the courses include the following contents: P 5.1 Statistics for Geobiology and Paleobiology: Lecture Formulating and testing statistical hypotheses, analysis of data using linear models and multivariate statistical methods, introduction into experimental design. P 5.2 Statistics for Geobiology and Paleobiology: Practical Introduction to the statistical programming environments (e.g. R) for data analysis and data visualization in Geobiology and Paleobiology.
Learning outcomes	At the end of the module students will be able to understand and apply statistical methods to geobiological and paleobiological datasets. They will be able to design experiments in an adequate manner and to analyse the data derived from them. Students will be capable of using a statistical programming environment (e.g. R) to analyse data matrices and produce publication quality graphics describing these data. In addition, they will be capable of creating repositories to store data and scripts, and to use advanced typesetting systems (e.g. markdown, latex) to present their results.

Type of examination	Portfolio of exercises
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Dr. Sergio Vargas
Language(s)	English
Additional information	None

Module: P 6 Field Practical I

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Field exercise	P 6.1 Geobiology: Field Practical	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other Programmes	None
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 2
Duration	The completion of the module takes 1 semester.
Content	Methods of fieldwork in geobiology of exemplary geological settings; e.g.: Studying interactions of geological and biological systems, geological history and landscape development of the study area and its influence on the biological systems and analytical field methods.
Learning outcomes	Students will remember geological and biological knowledge from previous lectures, recognize and combine concepts of geology and biology in examples in the field and apply them to an exemplary geobiological setting. After the module, students will be able to understand and apply field methods for own research questions, e.g., in the Research Project (P 9) and their Master Thesis (P 11).
Type of examination	Presentation oder written exam or field report
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Alexander Nützel
Language(s)	English
Additional information	Moderate costs for travelling, board and lodging will have to be covered by the student.

Module: P 7 Field Practical II

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Field exercise	P 7.1 Paleobiology: Field Practical	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Mandatory module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 2
Duration	The completion of the module takes 1 semester.
Content	Geological-palaeontological history of the study area and outcrops; fieldwork and methods of fieldwork in exemplary geological settings, e.g. description and interpretation of litho- and biofacies, analytical field methods, mapping, profile logging, sampling, collecting fossils.
Learning outcomes	Students will remember geological, paleontological and biological knowledge from previous lectures. Students will be able to recognize and combine concepts of geology, paleontology and biology in the field. After the module, students will be able to understand and apply field methods for own research questions, e.g., in the research project (P 9) and the Master Thesis (P 11).
Type of examination	Presentation or written exam or field report
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bettina Reichenbacher
Language(s)	English
Additional information	Moderate costs for travelling, board and lodging will have to be covered by the student.

Module: P 8 Scientific Presentation and Communication

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Seminar	P 8.1 Presentation and Communication Skills	SoSe	30 h (2 SWS)	60 h	(3)
Seminar	P 8.2 Seminar on Current Topics in Geobiology and Paleobiology	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other Programmes	None
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 2
Duration	The completion of the module takes 1 semester(s).
Content	The module comprises a practical guideline for the preparation of various types of scientific communications and introduces novel concepts of geobiological and paleobiological research.
Learning outcomes	Students will learn how to design and interpret research, review current knowledge, prepare presentations including oral communications. They will know the principles of writing a scientific paper and are able to conduct literature searches.
Type of examination	Written exam or presentation
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bettina Reichenbacher
Language(s)	English
Additional information	None

Module: WP 8 Molecular Methods in Geobiology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Exercise	WP 8.1 Molecular Methods in Geobiology: Tutorial	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Two of the compulsory elective modules WP 8 – WP 11 must be taken.
Entry requirements	None
Semester	Recommended semester: 2
Duration	The completion of the module takes 1 semester.
Content	Molecular methods in Geobiology: Laboratory methods for the analysis and manipulation of nucleic acids and proteins relevant for geobiological questions. A small research question is addressed within the course work.
Learning outcomes	Students will learn routine molecular biology methods and critically analyse the results and communicate the results in a report or poster. After this module students should be able to perform molecular experiments to test their own hypotheses in their Research Project (P 9).
Type of examination	Report or poster
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Oliver Voigt
Language(s)	English
Additional information	None

Module: WP 9 Vertebrate Paleobiology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Exercise	WP 9.1 Vertebrate Paleobiology: Tutorial	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Two of the compulsory elective modules WP 8 – WP 11 must be taken.
Entry requirements	None
Semester	Recommended semester: 2
Duration	The completion of the module takes 1 semester.
Content	Basics and concepts of vertebrate form and function are introduced, under consideration of phylogenetic and ecological constraints.
Learning outcomes	Students will understand vertebrate morphology and its relation to function, ecology, and the evolutionary history of the respective clade.
Type of examination	Written exam or drawing portfolio
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bettina Reichenbacher
Language(s)	English
Additional information	None

Module: WP 10 Vertebrate Evolution

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Exercise	WP 10.1 Vertebrate Evolution: Tutorial	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Two of the compulsory elective modules WP 8 – WP 11 must be taken.
Entry requirements	None
Semester	Recommended semester: 2
Duration	The completion of the module takes 1 semester.
Content	In the module the link between form and function of selected vertebrate groups, their fossil record, and evolutionary history are investigated. Eco-morphological and physiological adaptations, character evolution, systematics, and palaeobiogeography are taught.
Learning outcomes	The students will be familiar with current knowledge on evolutionary history in selected vertebrate groups that have not been investigated in WP 9.
Type of examination	Presentation
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Gertrud Rößner
Language(s)	English
Additional information	None

Module: WP 11 Micropaleontology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Exercise	WP 11.1 Micropaleontology: Tutorial	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory courses
Usability of the module in other Programmes	None
Elective guidelines	Two of the compulsory elective modules WP 8 – WP 11 must be taken.
Entry requirements	None
Semester	Recommended semester: 2
Duration	The completion of the module takes 1 semester.
Content	The aim of this module is to provide students with key theoretical and practical issues concerning micropaleontology. This involves the study of major microfossil groups, their paleoecological, biostratigraphical, and paleobiological potential. An overview of the most common micropaleontological extraction techniques is presented. Additionally, an introduction to state-of-the-art documentation techniques (digital microscopy and X-ray CT) is also included within this module.
Learning outcomes	Students will be able to identify all main microfossil groups, and to understand modern methods in micropaleontology, and their application in paleodiversity, paleoecology, biostratigraphy, paleogeography, and paleobiology.
Type of examination	Written exam
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Mike Reich
Language(s)	English

Additional information

Recommended literature:
Haq, B.U. & Boersma, A. 1998. Introduction to Marine Micropaleontology. (2nd ed.). Amsterdam: Elsevier professional.
Armstrong, H. & Brasier, M. 2009. Microfossils. (2nd ed.). Hoboken: Blackwell Publishing.
Wissing, F.-N., Herrig, E. & Reich, M. 1999. Arbeitstechniken der Mikropaläontologie: Eine Einführung. Stuttgart: Enke.

Module: P 9 Research Project

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Seminar	P 9.1 Research Project Design	WiSe	30 h (2 SWS)	30 h	(2)
Research Project	P 9.2 Individual Research Project	WiSe	90 h (6 SWS)	210 h	(10)

For successful completion of the module, 12 ECTS credits have to be acquired. Class attendance averages about 8 contact hours. Including time for self-study, 360 hours have to be invested.

Module type	Mandatory module with mandatory courses.
Usability of the module in other Programmes	None
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 3
Duration	The completion of the module takes 1 semester.
Content	Students design and subsequently conduct a larger (semester-long) independent empirical research project, write a manuscript and present results. Projects will usually be suggested by the advisor but should be developed further by the student.
Learning outcomes	Students learn to independently formulate a research question or hypothesis, design their research projects considering aspects of time, financial budget, methodology and feasibility. Students will have acquired expertise in independently conducting a research project by collecting, generating, analysing, and evaluating their data, and in interpreting their results. They will be able to present their project outcomes to their peers, for example in the form of a paper or poster. After having completed the module, students will be able to plan, conduct and analyse the results in the Master Thesis (P 11).
Type of examination	Manuscript and presentation
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.

Responsible contact	Prof. Dr. Bettina Reichenbacher
Language(s)	English
Additional information	None

Module: P 10 Evolution and Ecology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	P 10.1 Mechanism of Evolution	WiSe	30 h (2 SWS)	60 h	(3)
Lecture	P 10.2 Paleoecology	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other Programmes	None
Elective guidelines	None
Entry requirements	None
Semester	Recommended semester: 3
Duration	The completion of the module takes 1 semester.
Content	Evolution and ecology of organisms in present and past ecosystems: physical and biological factors, natural selection and adaptation, speciation, extinction, dynamics and patterns of biodiversity in space and time.
Learning outcomes	In the module, the student should remember knowledge from previous modules (P 1, P 2, P 3). After the completion of the module they will be able to understand comprehensive concepts and processes of evolution and paleoecology that cause evolution and shaped present day and past ecosystems. This will enable them to critically interpret relevant scientific literature in the field.
Type of examination	Written exam
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Dr. Sergio Vargas
Language(s)	English
Additional information	None

Module: WP 12 Geobiological Field Exercises

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Field exercise	WP 12.1 Geobiological Field Exercises: Field Practical	WiSe	60 h (4 SWS)	30 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Four of the compulsory elective modules WP 12 – WP 17 must be taken.
Entry requirements	None
Semester	Recommended semester: 3
Duration	The completion of the module takes 1 semester.
Content	Introduction into marine biodiversity and environments. Advanced methods of fieldwork in geobiology of exemplary marine habitats.
Learning outcomes	Students will apply previously acquired knowledge on marine biology (for example from the lecture of WP 7) to own observations and research in the field.
Type of examination	Written exam
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Gert Wörheide
Language(s)	English
Additional information	Costs for their travelling, board and lodging will have to be covered by the students.

Module: WP 13 Geomicrobiology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Exercise	WP 13.1 Geomicrobiology: Tutorial	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Four of the compulsory elective modules WP 12 – WP 17 must be taken.
Entry requirements	None
Semester	Recommended semester: 3
Duration	The completion of the module takes 1 semester.
Content	Geomicrobiology: Laboratory methods for the analysis of geobiologically relevant communities of microorganisms.
Learning outcomes	Students will learn molecular biology methods commonly used for the study of microbial communities: DNA extraction, qPCR, gel electrophoresis, high-throughput Illumina DNA sequencing, and bioinformatic analysis of microbial communities. Upon completion of this module students should be able to analyse experimental data from microbial communities of geobiological importance and communicate their results.
Type of examination	Report
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. William Orsi
Language(s)	English
Additional information	None

Module: WP 14 Advanced Topics in Geosciences

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 14.1 Advanced Topics in Geosciences: Lecture	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Four of the compulsory elective modules WP 12 – WP 17 must be taken.
Entry requirements	None
Semester	Recommended semester: 3
Duration	The completion of the module takes 1 semester.
Content	Evolution and ecology of organisms in present and past ecosystems: physical and biological factors, natural selection and adaptation, speciation, extinction, dynamics and patterns of biodiversity in space and time.
Learning outcomes	In the module, the student should remember knowledge from previous modules (P 1, P 2, P 3). After the completion of the module they will be able to understand comprehensive concepts and processes of evolution and paleoecology that cause evolution and shaped present day and past ecosystems. This will enable them to critically interpret relevant scientific literature in the field.
Type of examination	Written exam or report
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Oliver Voigt
Language(s)	English
Additional information	None

Module: WP 15 Special Topics in Geosciences

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 15.1 Special Topics in Geosciences: Lecture	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Four of the compulsory elective modules WP 12 – WP 17 must be taken.
Entry requirements	None
Semester	Recommended semester: 3
Duration	The completion of the module takes 1 semester.
Content	This module focuses on one particular topic in geosciences and covers current developments in that area.
Learning outcomes	Upon successful completion of this module students will have complemented and expand their knowledge about current research methodologies.
Type of examination	Written exam or report
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Oliver Voigt
Language(s)	English
Additional information	None

Module: WP 16 Advanced Invertebrate Geobiology

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Exercise	WP 16.1 Advanced Invertebrate Geobiology: Tutorial	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Four of the compulsory elective modules WP 12 – WP 17 must be taken.
Entry requirements	None
Semester	Scheduled semester: 3
Duration	The completion of the module takes 1 semester.
Content	Systematics, evolution, comparative morphology, ecology and phylogeny of invertebrate animals.
Learning outcomes	Students will remember, apply and connect knowledge from previous courses (P 1, P 2, WP 5) to gain advanced understanding on the evolution of invertebrate animal phyla not covered in WP 5. Upon successful completion of the module students will have learned to observe and document morphological details of different animal bauplans.
Type of examination	Written exam or drawing portfolio
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Dirk Erpenbeck
Language(s)	English
Additional information	None

Module: WP 17 Collections Management and Research

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Exercise	WP 17.1 Collections Management and Research: Tutorial	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other Programmes	None
Elective guidelines	Four of the compulsory elective modules WP 12 – WP 17 must be taken.
Entry requirements	None
Semester	Recommended semester: 3
Duration	The completion of the module takes 1 semester.
Content	In this module students will learn the importance, maintenance, management and research options of scientific collections.
Learning outcomes	After the module students will be able to work with scientific collections, to understand the collection methodology and to establish collections under scientific principles.
Type of examination	Written exam or presentation
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	PD Dr. Gertrud Rößner
Language(s)	English
Additional information	None

Module: P 11 Final Module

Programme	Master's Programme: Geobiology and Paleobiology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Master Thesis	P 11.1 Master Thesis	SoSe	-	810 h	(27)
Disputation	P 11.2 Disputation	SoSe	-	90 h	(3)

For successful completion of the module, 30 ECTS credits have to be acquired and 900 hours have to be invested.

Module type	Mandatory module
Usability of the module in other Programmes	None
Elective guidelines	None
Entry requirements	Succesful completion of the modules P 1 – P 3
Semester	Recommended semester: 4
Duration	The completion of the module takes 1 semester.
Content	This final module of the Master's programme consists of the Master thesis, an one hour lab group seminar to discuss progress, and the Master thesis defence. The Master thesis is an independent research project conducted by the student. The student writes a report (Master thesis) and presents his/her work in a 30-minute public talk (defense).
Learning outcomes	The students carry out a comprehensive individual research project, write a report and give a talk about their work. Throughout the Master project, they use and extend the knowledge they have gathered in the Master's programme. They gather valuable research experience.
Type of examination	Master thesis and disuputation
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Gert Wörheide
Language(s)	English
Additional information	None