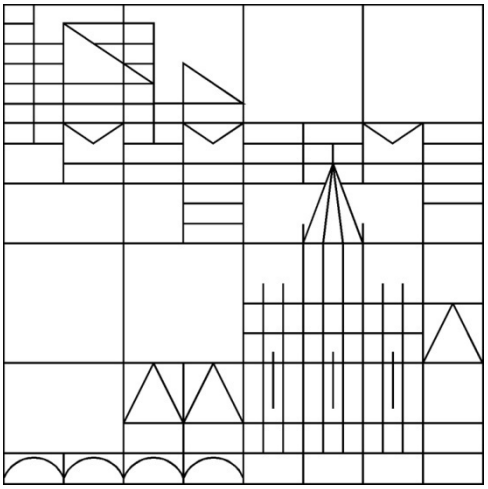
University of Konstanz

Faculty of Sciences

Department of Biology



Module manual

M. Sc. Biological Sciences

June 2015

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QUALIFICATION AIMS OF THE M.SC. “BIOLOGICAL SCIENCES”

General

The course of studies “M.Sc. Biological Sciences” imparts professional qualification in the areas of organismic as well as molecular biology.

The Masters-course provides a natural extension to the studies that builds upon the foundations laid as part of the bachelors-coursework. The theoretical, experimental and analytical abilities that the students acquired in their bachelors studies are to be extended upon and expanded to impart a specialization in one of the specified research foci of the Department of Biology (it should be stated that these research foci are not to be regarded as separate from one-another, but rather as intermeshing parts of the overall research pursued in the department). Aim of the masters-level course is to prepare the students for an academic or non-academic career pursuing basic science (i.e. Doctoral research/ Ph.D.), the pursuit of applied research in a biotechnology or industrial setting as well as the ability to work for service providers (e.g. “consulting firms” or 'environmental agencies”) requiring a solid expertise in biological topics and the general natural sciences. For each student, the course of studies is individually adapted so as to best match their specific interests while also taking into account advice provided by the lecturers of the Department of Biology. In addition to extending their subject-specific theoretical and experimental knowledge, the students are also expected to expand and refine their abilities in other areas, such as developing additional competences in methods, communication or socially relevant topics. To this effect, the Department of Biology and other departments of the University of Konstanz offer a variety of elective modules the student can select from.

<table>
<tr><td colspan="4">Study program/Usability
Master Biological Sciences
Master Life Science</td><td colspan="2"><u>Module Title: Preference Module</u></td></tr>
<tr><td>Credits</td><td>8</td><td>Duration</td><td>1 Semester
4 SWS</td><td>Part of module of the total rating</td><td>20 %</td></tr>
<tr><td colspan="4">Module grade</td><td colspan="2">In case of a compulsory course the module mark is composed of the arithmetic average of two selected courses within this module unit.
In case of an optional course the module is not graded.</td></tr>
<tr><td colspan="4">Module units</td><td colspan="2">a. Disease Biology I
b. Disease Biology II
c. Pharmacology and Toxicology II
d. Biochemistry III
e. Methods in Biology
f. Evolutionary Organismal Biology
g. Concepts in Ecology</td></tr>
<tr><td colspan="4">Qualification aims</td><td colspan="2">After successful completion of two of courses offered as alternatives within this module the students will have acquired the following capabilities:
- To give an account of the specific basics and important concepts of the fields chosen and to explain the current state-of-the art of science by using examples
- To explain the relevant methodology and to give a critical evaluation thereof
- To identify, collect, evaluate and correctly interpret scientific information relevant for a certain field, and to develop their own process of learning
- To come up with further research questions in the field, based on current concepts and research data, and to select appropriate methodology
- To find out where their own scientific interest lies and to critically evaluate it; assess if the knowledge and skills they have acquired in the field is going to contribute to their own qualification they aspire to.</td></tr>
<tr><td colspan="4">Educational objectives</td><td colspan="2">a-d. The objective is to give the students insight, at an advanced level, into major topics in the field of Biomedicine, as a basis for the full understanding of the current literature and for their own future experimental</td></tr>
</table>

	work in the field of Biomedicine. e. Get to know your possibilities: An overview on methods, techniques, and facilities available to you for your future (Master) research work at University of Konstanz. f. A wide overview of research in ecology and evolution at the University of Konstanz. g. The aim of the lecture is to introduce the students to basic conceptual approaches in ecology. Theoretical and modeling issues are presented at the integrative levels of behavioral, population and community ecology.
Module unit	**a. Disease Biology I**
Coordinator	Prof. Dr. Bürkle
Teaching content	The topics covered deal with the pathology, pathogenesis, clinical picture, therapy and prevention of specific human diseases or disease groups; animal and in vitro models of human disease; and specific microbial pathogens, at the organismal, tissue, cellular and molecular level. Infectious Diseases (INF)/Specific Organs (ORG)/Cancer (CAN) • Introduction / Model systems in Disease Biology • INF I: Viral infections • INF II: Fungal infections • INF III: Bacterial infections • INF IV: Protozoan infections • INF V: Inflammation / sepsis • ORG I: Autoimmune diseases and their therapy • ORG II: Pathogenesis of renal disease • ORG III: Chronic obstructive pulmonary disease • CAN I: Molecular pathogenesis of cancer: human colon cancer as an example • CAN II: Mitosis-Aneuploidy-Cancer: how mitotic checkpoints control chromosome segregation • CAN III: Oncogenes and transgenic models • CAN IV: Molecular Targets of current cancer chemotherapy • Epidemiological studies and clinical trials
Forms of teaching/Amount of SWS	Lecture/2 SWS
Work load	30 h Attendance time 60 h Preparation and post-processing

	30 h Exam preparation
Credits for this unit	4
Examination and unit completion	Written exam (2 h; questions in English, answers in English or German)
Prerequisites	Bachelor degree in Biological Sciences, Life Science or similar study courses
Language	English
Time slot and frequency of the module	Winter term
Module unit	**b. Disease Biology II**
Coordinator	Prof. Dr. Bürkle
Teaching content	The topics covered deal with the pathology, pathogenesis, clinical picture, therapy and prevention of specific human diseases or disease groups; animal and in vitro models of human disease; and specific microbial pathogens, at the organismal, tissue, cellular and molecular level. Metabolic and cardiovascular disorders (MCD) / Modern approaches to therapy (MAT) / Nervous system disorders (NSD) MCD-1: Adiposity / neuroendocrinology / diabetes MCD-2: Hereditary diseases and disorders of imprinting MCD-3: Cardiac dysrhythmias MCD-4: Atherosclerosis and ischemic disease MCD-5: Inflammatory bowel disease MCD-6: Gout and rheumatoid arthritis MAT-1: Gene therapy MAT-2: Transplantation medicine MAT-3: Regenerative medicine NSD-1: Dementias NSD-2: Addiction NSD-3: Channelopathies NSD-4: Schizophrenia
Forms of teaching/Amount of SWS	Lecture/2 SWS
Work load	30 h Attendance time 60 h Preparation and post-processing 30 h Exam preparation
Credits for this unit	4
Examination and unit completion	Written exam (2 h; questions in English, answers in English or

	German)
Prerequisites	Bachelor degree in Biological Sciences, Life Science or similar study courses
Language	English
Time slot and frequency of the module	Summer term
Module unit	**c. Pharmacology and Toxicology II**
Coordinator	Prof. Dr. Bürkle
Teaching content	The topics covered deal with current methodology in the field, including in vitro Toxicology, major molecular mechanisms involved in the cellular and organismal response to xenobiotics, in-depth discussion of major classes of natural or man-made hazardous substances, the pharmacology of selected disease groups and the interface between Toxicology and legislation (Regulatory Toxicology). The following specific topics are included: • Basics of Toxicology / molecular targets of toxic substances/assessment of toxic effects • Pharmacology of hematopoiesis and blood coagulation • In vitro Toxicology • Cell death, necrosis, apoptosis • Neurotoxicology • Toxicokinetics and xenobiotic metabolism • Toxic industrial compounds • Chemical carcinogenesis • Toxic gasses and dusts • Pharmacogenomics and toxicogenomics • Nanotoxicology • Toxins from animals or plants / chemical warfare agents • Regulatory Toxicology • Pharmacology of water and electrolyte disturbances
Forms of teaching/Amount of SWS	Lecture/2 SWS
Work load	30 h Attendance time 60 h Preparation and post-processing 30 h Exam preparation
Credits for this unit	4
Examination and unit completion	Written exam (2 h; questions in English, answers in English or

	German)
Prerequisites	Bachelor degree in Biological Sciences, Life Science or similar study courses
Language	English
Time slot and frequency of the module	Winter term
Module unit	**d. Biochemistry III**
Coordinator	Prof. Dr. Bürkle
Teaching content	The topics covered deal with fundamental cellular mechanisms like nucleotide synthesis, oxidative stress, inflammation, cell death, cellular and organismal ageing, cell cycle regulation and post-translational modification.
Forms of teaching/Amount of SWS	Lecture/2 SWS
Work load	30 h Attendance time 60 h Preparation and post-processing 30 h Exam preparation
Credits for this unit	4
Examination and unit completion	Written exam (2 h; questions in English, answers in English or German)
Prerequisites	Bachelor degree in Biological Sciences, Life Science or similar study courses
Language	English
Time slot and frequency of the module	Summer term
Module unit	**e. Methods in Biology**
Coordinator	Dr. Schleheck
Teaching content	A selection of seminars on current methods and techniques in use at the Department of Biology at University of Konstanz, presented by Postdocs of various groups and by members of the particular research facilities (Proteomics, Genomics, Microscopy units).
Forms of teaching/Amount of SWS	Lecture/2 SWS
Work load	30 h Attendance time 60 h Preparation and post-processing 30 h Exam preparation
Credits for this unit	4

Examination and unit completion	Exam
Prerequisites	n/a
Language	English
Time slot and frequency of the module	Winter term
Module unit	**f. Evolutionary Organismal Biology**
Coordinator	Dr. Robert Kraus
Teaching content	"Evolutionary Organismal Biology" is a lecture series that gives a wide overview of research in ecology and evolution at the University of Konstanz. Each lecture presents a general theme of one active researcher, with particular focus on ecological and evolutionary context. The lecture series is integrative and includes a wide range of contributions, e.g., from physiologists, limnologists and developmental and behavioural biologists. It is specifically intended for MA students who chose "Ecology and Evolution" as emphasis area but it is also open to other interested persons.
Forms of teaching/Amount of SWS	Lecture/2 SWS
Work load	30 h Attendance time 60 h Preparation and post-processing 30 h Exam preparation
Credits for this unit	4
Examination and unit completion	written examination
Prerequisites	none
Language	English
Time slot and frequency of the module	summer term
Module unit	**g. Concepts in Ecology**
Coordinator	Prof. Dr. Rothhaupt, Prof. Dr. Peeters
Teaching content	optimal foraging, ecological stoichiometry versus essential biochemicals, chemical communication, life histories, population growth and demography, predator-prey models, intra- and interspecific facilitation, theory of food chains and food webs, spatial ecology,

	biological invasions, patterns and functional aspects of biodiversity
Forms of teaching/Amount of SWS	Lecture/2 SWS
Work load	30 h Attendance time 60 h Preparation and post-processing 30 h Exam preparation
Credits for this unit	4
Examination and unit completion	Written exam, 90 minutes.
Prerequisites	Basic class/lecture in ecology.
Language	English
Time slot and frequency of the module	Winter term

Study program/Usability **Master Biological Sciences** **Master Life Science**				**Module Title: Advanced Courses:** **Applied Bioinformatics**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				Imparting a theoretical and practical working knowledge of a range of computational biology/bioinformatics approaches with a focus on biological sequence analysis.
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Frickey
Teaching content				Theoretical groundwork and computational approaches employed in biological sequence analysis
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				Students should have a good understanding of the english language and have to bring their own laptops and be able to install software on these machines. Being able to program is NOT a prerequisite.
Language				English
Time slot and frequency of the course				Winter term, 1. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Frickey
Teaching content				Practical application of the concepts learned in the theoretical lectures and pursuit of a self-defined research project.
Forms of teaching/Amount of SWS				10
Work load				200 h Attendance time 100 h Preparation and post-processing
Credits for this unit				10
Examination and unit completion				Colloquium and written report

Language	English
Time slot and frequency of the course	Winter term, 1. Half

Study program/Usability Master Biological Sciences Master Life Science				**Module Title: Advanced Courses: Behavioral Neurobiology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of a lecture, a seminar and an internship with individual projects.
Educational objectives				The lecture will cover basic principles of Behavioral Neurobiology with special emphasis on olfaction
Module unit				**a. Lecture and Seminar**
Coordinator				PD Dr. Kleineidam, Dr. Szyszka, Dr. Kreissl, PD Dr. Thum
Teaching content				The lecture covers both, contemporary techniques used in Neuroscience and an overview of classic topics in Behavioral Neurobiology. For further reading, we recommend the textbook: 'Behavioral Neurobiology' by Tom Carew. The lecture also includes a number of presentations by invited speakers, which gives the students the opportunity to learn more about different exciting research topics currently investigated. In addition, a paper seminar is held during one of the first weekends (usually the second weekend) where we discuss related publications at a retreat in the Alps. Here, the students present a publication, and the supervisors introduce their own field of research.
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				EOB and SIS or comparable backgroun required. In case you did not attend one of the before mentioned classes, please contact Chr. Kleineidam
Language				English
Time slot and frequency of the course				Summer term, 1. or 2. Half
Module unit				**b. Internship**

Coordinator	PD Dr. Kleineidam, Dr. Szyszka, Dr. Kreissl, PD Dr. Thum
Teaching content	students in this course will join one of our current research projects; either as single individuals or in pairs of two. Our main interest is Olfaction in Insects, Learning and Memory, and the proximate mechanisms for Social Organization in ants, bees and *Drosophila* flies and larvae. In order to study how insects acquire and process odor information, we use a variety of different physiological techniques such as Calcium Imaging of the first olfactory neuropil, the antennal lobe, and electrophysiological approaches such as Single Neuron Recordings and Electroantennography. The connectivity of the olfactory pathway and modulation of information processing, e.g. during learning is investigated with neuroanatomical techniques such as Immunohistochemistry and subsequent Confocal Microscopy. The neuroanatomy of the insect brain is reconstructed by a detailed visualization based on image stacks using advanced 3D-software (AMIRA). Experimental setups that analyse the naïve responses of insects towards odors or even learning and memory on a behavioral level are used to test, how the insect brain organizes a particular insect behavioral. We address our questions in different insect species ranging from the model organism Drosophila, mosquitoes, bees and various ant species.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Summer term, 1. or 2. Half

Study program/Usability Master Biological Sciences Master Life Science				**Module Title: Advanced Courses: Biochemical Pharmacology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				The participants of the course should learn about the various molecular, biochemical and cellular processes underlying cell death induction and regulation and their consequences for health and disease. Furthermore, they should get a deeper insight into molecular mechanisms of immune regulation and immunopathological disorders of the liver, intestine, and lung, and their pharmacological control. Students will also present and discuss a scientific publication in the field.
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Brunner
Teaching content				Regulation of cell death (apoptosis, necrosis, autophagy), cell biology, immunology, immunopathology, signal transduction, steroid synthesis, general pharmacology, in vitro and in vivo models, method applications
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Colloquium
Prerequisites				Successful completion of basic modules
Language				English
Time slot and frequency of the course				Summer term, 1. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Brunner
Teaching content				In the practical lab work participants should get familiar with various methods and techniques while working on current projects and scientific questions in the lab under the supervision of lab members. They will learn to summarize their

	data in scientific protocols and present their projects in internal seminars
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Report
Language	English
Time slot and frequency of the course	Summer term, 1. Half

Study program/Usability Master Biological Sciences Master Life Science				**Module Title: Advanced Courses: Bioinformatics and X-Ray Structure Analysis**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				The advanced course consists of a theoretical part with lecture and seminar and an internship with individual projects.
Educational objectives				Insight into theory and experimental work of macromolecular structure determination by X-ray crystallography. Understanding the impact of macromolecular structures at atomic resolution for modern molecular biology.
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Welte, Prof. Dr. Diederichs
Teaching content				Techniques for protein overexpression, purification, solubilization of membrane proteins, physicochemical analysis of protein solutions, macromolecular crystallization, oral reporting of scientific publications on from macromolecular structures at atomic resolution.
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Seminar
Prerequisites				Interest in molecular genetics, biology, wet lab work, some basic mathematics, computer work.
Language				English
Time slot and frequency of the course				Winter term, 2. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Welte, Prof. Dr. Diederichs
Teaching content				Techniques for protein overexpression, purification, solubilization of membrane proteins, physicochemical analysis of protein solutions, macromolecular crystallization, data collection, experimental phase determination, crystallographic computing, model building, structure refinement, oral reporting of scientific work done during the course and of scientific

	publications on from macromolecular structures at atomic resolution.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Winter term, 2. Half

Study program/Usability Master Biological Sciences Master Life Science				**Module Title: Advanced Courses: Cell Biology - Cell Adhesion and Signal Transduction**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				The advanced course consists of a theoretical part with lecture and seminar and an internship with individual projects.
Educational objectives				The students will be exposed to current conceptual and methodological approaches in cell biology with a particular emphasis on cell adhesion and signal transduction processes in animal cells. In the theoretical part a) of the module the students learn the current state of the art by focussed lectures. From this detailed theoretical background the students should be able to frame a hypothesis together with their supervisor. Furthermore, in part a) the students present and discuss original publications and seminal contributions to the field in the form of a seminar to understand how to deconstruct published information. Thereby, they will acquire the knowledge to analyse key experiments and to integrate such approaches in their own practical project. In the practical part b) the students experimentally address current research questions with state-of-the-art equipment in a one-to-one interaction with their supervisor. Based on their hypotheses, the students will learn to plan and conduct different experiments including proper experimental controls. They will learn to critically analyse the raw data, summarize results, and present their data to peers. Finally, they will have the opportunity to refine or reformulate their starting hypothesis. The students should understand that this iterative process is key to scientific discovery
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Hauck
Teaching content				The lectures cover the following areas of cell biology : adhesion molecules: integrins, IgCAMs; focal adhesions, protein and lipid phosphorylation: kinases/ phosphatases, adapter proteins/ protein-protein-interaction domains/ SH3-domains/ SH2- domains / ITAMs/ITIMs, endocytosis – autophagocytosis, lipid rafts, vesicle trafficking, dynamics of

	the actin cytoskeleton, regulation of cell migration, phagocytosis, innate immunity, cellular microbiology. Selected pathogenic bacteria will be presented (e.g. Neisseria, Haemophilus, Staphylococci) and medical aspects and their biology will be discussed. Furthermore, the second part of the lecture series addresses common experimental strategies, and the principles, application and pitfalls of the used methodology will be discussed. In particular we talk about: i) cell biological and genetic methods, e.g. cell culture, hybridoma cells, monoclonal antibodies, manipulation of cells – transfection, transduction, RNA-interference (RNAi), microRNAs, siRNA, shRNA, generation of viral particles, transgenic and knock-out mice, fluorescence labeling and –detection, flow cytometry, next-generation sequencing. ii) microscopy, electron microscopy and advanced light microscopy including confocal microscopy, TIRF, FRAP, FRET, FLIM iii) protein biochemistry, e.g. protein detection, epitope-tagging, affinity purification, Western Blotting, detection of protein-protein-interactions, protein-arrays, and identification of novel protein-protein-interactions The seminar focusses on current publications and breakthrough findings in the above mentioned areas, which will be discussed in detail. Each student presents one original paper.
Forms of teaching/Amount of SWS	5
Work load	60 h Attendance time 90 h Preparation and post-processing
Credits for this unit	5
Examination and unit completion	Seminar
Prerequisites	The lectures Cell Biology I and II, Biochemistry II, and Immunology (BA Life Science or BA Biological sciences) or equivalents to these lectures must have been followed and passed. Attending the lecture Disease Biology I (especially the series on infectious diseases) is an asset. A specific introduction into laboratory safety is mandatory and will be given on the first day of the course

Language	English
Time slot and frequency of the course	Winter term, 2. Half
Module unit	**b. Internship**
Coordinator	Prof. Dr. Hauck
Teaching content	Individual projects will be conducted alongside existing lines of investigation in the field of cell adhesion receptors and address the following topics: CEACAMs, Integrins & pathogenic microbes / Regulation of cell adhesion / Advanced Methodology in Microscopy Examples of recent projects: CEACAM3 initiated signalling in granulocytes / The adapter molecule Nck is involved in phagocytosis / CEACAM1 localization to membrane microdomains / The role of Pyk2 in complement-mediated phagocytosis / Role of Vinculin in the Internalization of Staphylococcus aureus / Influence of CD105 on subcelluar localization of zyxin / Role of Focal Adhesion Kinase (FAK) in cell migration
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Winter term, 2. Half

Study program/Usability Master Biological Sciences Master Life Science				**Module Title: Advanced Courses: Cellular Biochemistry**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				Introduction to the biochemistry and (patho-)physiology of the ubiquitin-conjugation system to prepare students for a future career in academia or industry
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Scheffner
Teaching content				(1) Ubiquitin-conjugation system: history, current research concepts and activities, role in human disorders (2) Methods used in ubiquitin research including yeast genetics, mass spectrometry, unnatural amino acids (3) Cancer: "classical" and current concepts, DNA tumor viruses
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				B.Sc. degree
Language				English
Time slot and frequency of the course				Summer term, 2. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Scheffner
Teaching content				The students will participate in current research projects and, depending on the individual project, will be acquainted with various biochemical/cell and molecular biological methods including PCR mutagenesis and cloning, protein expression and purification, enyzme assays, yeast and mammalian cell culture, mass spectrometry, etc.
Forms of teaching/Amount of SWS				10

Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Summer term, 2. Half

Study program/Usability **Master Biological Sciences** **Master Life Science** **Credits** 15 **Duration** 6 weeks	**Module Title: Advanced Courses: Chemical Ecology**
Module grade	The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units	Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives	The students should realise that most aspects in Chemical Ecology are mediated by chemical processes. In order to successfully address biological questions it is often crucial to appreciate their (bio)chemical basis. In interdisciplinary research it is necessary to be open minded and to include diverse methodologies in the experimental design. A broad knowledge in different techniques is communicated. The students should learn to design experiments, perform experiments independantly, to critically evaluate obtained experimental data and to present their results in a concise report.
Module unit	**a. Lecture and Seminar**
Coordinator	Prof. Dr. Spiteller
Teaching content	Chemical ecology, microbial chemical ecology, natural products chemisty and biochemistry, chemistry of microbial symbionts, microbiology, secondary metabolites: Presentation of own research topics and current topics in microbial chemical ecology. Presentation of analytical techniques such as chromatography, HPLC, gas chromatography, mass spectrometry, MS Imaging, and NMR). Discussion of microbiology and molecular biology techniques techniques (isolation, cultivation, bioassays, cloning techniques, analysis of gene clusters, phylogeny). General topics: experimental design, how to write a paper, how to give an oral presentation, bibliography. Short oral presentation of a research topic by each student.

Forms of teaching/Amount of SWS	5
Work load	60 h Attendance time 90 h Preparation and post-processing
Credits for this unit	5
Examination and unit completion	Journal club / seminar
Prerequisites	Solid knowledge in organic chemistry, analytical chemistry, biochemistry, and microbiology/molecular biology. Attendance of the lectures Bioorganic Chemistry and the lecture Chemical Ecology as basis for the practical course is expected.
Language	English
Time slot and frequency of the course	Winter term, 2. Half
Module unit	**b. Internship**
Coordinator	Prof. Dr. Spiteller
Teaching content	Interdisciplinary course: Depending on the interests of the students the focus of the experiments can be microbiology/molecular biology or biochemistry and analytical chemistry. Microbiology and molecular biology techniques: isolation, cultivation, phylogeny, bioassays, gene cluster analysis, mutagenesis, heterologous expression of enzymes. Chemistry: biosynthetic studies, feeding studies, isolation of bioactive compounds, structure elucidation (mass spectrometry, NMR), functional analysis of secondary metabolite gene clusters, enzymology. Ecology: Bioassays, function of natural products.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Winter term, 2. Half

Study program/Usability Master Biological Sciences Master Life Science				**Module Title: Advanced Courses: Developmental Neurobiology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				theoretical and practical training in neural development in vivo and in tissue culture
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Stürmer
Teaching content				molecular mechanisms of axon growth and guidance, axon regeneration, synaptogenesis, activity, plasticity
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				neurophysiology
Language				English
Time slot and frequency of the course				Summer term, 1. or 2. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Stürmer
Teaching content				practical work on neurons in brains and tissue culture, neuroanatomy, biochemistry and molecular biology of neurons
Forms of teaching/Amount of SWS				10
Work load				200 h Attendance time 100 h Preparation and post-processing
Credits for this unit				10
Examination and unit completion				Colloquium and written report
Language				English
Time slot and frequency of the course				Summer term, 1. or 2. Half

Study program/Usability **Master Biological Sciences** **Master Life Science** **Credits** 15 **Duration** 6 weeks	**Module Title: Advanced Courses: Dynamics of Aquatic Ecosystems**
Module grade	The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units	Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives	The students learn that the investigation of ecological processes and their interactions in aquatic systems requires an interdisciplinary approach. They will acquire basic knowledge about physical limnology and oceanography, abiotic-biotic interactions, ecological modelling and implications of climate change on aquatic systems. The course communicates theoretical concepts and field methods that enable the students to independently conduct a process oriented research project. The main focus is on the interaction between ecological and physical processes in aquatic systems. The students learn how to design and conduct field experiments for the investigation of ecological processes. They learn how to analyse their data, and to critically evaluate the results of their work with respect to existing knowledge. They learn to communicate scientific results in form of oral presentations and scientific manuscripts.
Module unit	**a. Lecture and Seminar**
Coordinator	Prof. Dr. Peeters
Teaching content	Basic principles in physical limnology (exchange and transport processes, tracer techniques), relevance and release of methane, utilization of acoustic techniques in aquatic systems, plankton patchiness, waves and their ecological relevance, basic ocean dynamics, climate change, introduction to ecological modelling, case studies from specific lakes. The lectures not only present basic principles but will also show recent results from the current projects of the research group. We will have additional presentations from invited guests addressing specific research topics. Seminar:

	In the seminar the participants present selected articles relevant for their projects.
Forms of teaching/Amount of SWS	5
Work load	60 h Attendance time 90 h Preparation and post-processing
Credits for this unit	5
Examination and unit completion	Journal club / seminar
Prerequisites	none
Language	English
Time slot and frequency of the course	Summer term, 2. Half
Module unit	**b. Internship**
Coordinator	Prof. Dr. Peeters
Teaching content	Introduction to field techniques in lake research (water sampling, in-situ techniques from a boat on Lake Constance), water sample analyses (e.g. zooplankton, methane, toxins) and data analysis using MATLAB (hands-on tutorial). Conduction of a research project according to the current focus of the group (e.g. temporal and spatial distribution patterns of plankton or methane). Typically this include 2 weeks of field work at a specific site (e.g. Lake Ammer, Illmensee, Untersee, Obersee). Projects focussing on modelling may also be possible if desired. The students work in groups of two. They develop a work plan for their project, conduct the field work and analyse the data with the support of a project supervisor. All projects are integrated part of our current research. After three weeks intermediate results are presented by the research groups and discussed with the other participants and supervisors of the course to adjust the remaining research program based on the information gained so far. At the end of the course the project results will be presented by the research groups in a poster session. Each group compiles and documents their data to make them available for further use in our research group. After the course the students provide a summary of their project work in the format of a scientific manuscript consisting of an abstract, an introduction providing the motivation of the project, a methods section, a section on the main results and

	a discussion.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Summer term, 2. Half

Study program/Usability **Master Biological Sciences** **Master Life Science**				**Module Title: Advanced Courses: Fish Ecology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				Aquire a deeper understanding of fish ecology theory and analytical approaches. Exercise verbal and written presentation of scientific experiments.
Module unit				**a. Lecture and Seminar**
Coordinator				Dr. Behrmann-Godel
Teaching content				Selected aspects of fish ecology
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				Einführung in die Limnologie At least one lecture given by the fish ecology group for BSc students.
Language				English
Time slot and frequency of the course				Summer term, 2. Half
Module unit				**b. Internship**
Coordinator				Dr. Behrmann-Godel
Teaching content				Planning of ecological experiments. Basic techniques of fish ecological studies. Actual topics in basic and applied fish ecological research.
Forms of teaching/Amount of SWS				10
Work load				200 h Attendance time 100 h Preparation and post-processing
Credits for this unit				10
Examination and unit completion				Colloquium and written report
Language				English
Time slot and frequency of the course				Summer term, 2. Half

Study program/Usability **Master Biological Sciences** **Master Life Science** **Credits** 15 **Duration** 6 weeks	**Module Title: Advanced Courses:** **Human and Environmental Toxicology**
Module grade	The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units	Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives	Interconnective thinking, holistic views of toxicological problems, evaluation of data, detailed understanding of experimental approaches, design and interpretation, extrapolation of datasets for toxicological risk assessment
Module unit	**a. Lecture and Seminar**
Coordinator	Prof. Dr. Dietrich
Teaching content	Toxicology of natural toxins (cyanobacteria and mycotoxins), intrinsic mechanisms of acute and chronic toxicity including carcinogenicity
Forms of teaching/Amount of SWS	5
Work load	60 h Attendance time 90 h Preparation and post-processing
Credits for this unit	5
Examination and unit completion	Journal club / seminar
Prerequisites	As a minimum the BS course in Ecotoxicology, preferably the 2 advanced courses in Human and Environmental Toxicology by Prof. Dietrich, or similar Toxicology courses provided by Profs. Bürkle, Leist, Hartung and Brunner
Language	English
Time slot and frequency of the course	Winter term, 1. Half
Module unit	**b. Internship**
Coordinator	Prof. Dr. Dietrich
Teaching content	Labwork on specific research topics associated or direct part of ongoing research projects in the area of renal toxicology or natural toxins
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time

	100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Winter term, 1. Half

Study program/Usability Master Biological Sciences Master Life Science				**Module Title: Advanced Courses: Immunology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				Presentation of research publications in the field of immunology. Understanding of how and when immunological techiques are applied in research in immunology. Overview of latest concepts in immunobiology.
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Groettrup, PD Dr. Schmidtke
Teaching content				Antiviral response, T helper cell differentiation, lineage commitment, thymic T cell selection, antigen processing pathways, ubiquitin-proteasome system, T cell vaccination, tumor immunology.
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				Lecture on Immunology in the fourth semester with written exam at Konstanz University or equivalent education at external universities.
Language				English
Time slot and frequency of the course				Winter term, 1. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Groettrup, PD Dr. Schmidtke
Teaching content				Practical application of research methods in immunology like intracellular cytokine staining, ELISA, ELISPOT, proliferation assay, flow cytometry, cell sorting, immunization of mice, virus plaque assays, tumor imaging.
Forms of teaching/Amount of SWS				10
Work load				200 h Attendance time

	100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Winter term, 1. Half

Study program/Usability **Master Biological Sciences** **Master Life Science**				**Module Title: Advanced Courses: Limnic Microbiology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				Understanding the activities of micro¬organisms in aquatic environments, how they influence the transformation of matter and use these processes for covering their energy needs
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Schink
Teaching content				Chemical analysis of water constituents, especially in the sediment. Microanalysis of the small-scale distribution of redox metabolites, application of microelectrodes, molecular biological methods in identification of bacteria in natural habitats. Measurement and calculation of distribution gradients and the corresponding substrate fluxes. Aerobic and anaerobic degradation of organic matter (fermentations, sulfate reduction, methanogenesis, syntrophic associations, phototrophic bacteria). Limits and principles of microbial degradation, transformation cycles of C, N, S, P. Starvation and survival. Intra- and interspecific cell-cell interactions, chemical communication, signalling molecules. Microbial communities, biofilms. Biology and chemistry of pollutants in waters (organic pollutants, nitrogen compounds, phosphate).
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				At least one course in microbiology and experience in basic microbiological lab work. Basic knowledge in chemistry and biochemistry is required. Experience in molecular biology may be useful.
Language				English
Time slot and frequency of the				Winter term, 2. Half

course	
Module unit	**b. Internship**
Coordinator	Prof. Dr. Schink
Teaching content	Projects are defined by the running research projects in the lab and vary with time. They can include: measurements of distribution profiles of chemical (O2, N-, S-, and Fe compounds, phosphate, methane) and bacteriological parameters in littoral and profundal sediments of Lake Constance. Comparison of microbial activities in the various layers of the sediment, quantification of key activities of microbial metabolism. Cultivation of bacteria with novel metabolic properties and biochemical analysis of their metabolic capacities. Studies on competition between bacteria for various substrates, chemical communication, antibiosis.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Winter term, 2. Half

Study program/Usability Master Biological Sciences Master Life Science				**Module Title: Advanced Courses: Limnology: Limnology of the Lakes**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				The advanced course consists of a theoretical part with lecture and seminar and an internship with individual projects
Educational objectives				The course is intended to convey occupational skills in fundamental and applied Limnology.
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Rothhaupt
Teaching content				The students get to know basic limnological field and laboratory methods. They are instructed in statistics and experimental design, they learn to present results adequately and to assess their scientific relevance and implications. The students are trained in various forms of the communication of scientific results (oral presentation, poster, written report).
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Seminar
Prerequisites				Introductory lecture in Aquatic Ecology and/or Limnology; Basic computer skills.
Language				English
Time slot and frequency of the course				Summer term, 2. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Rothhaupt
Teaching content				In a short propaedeutic part, basic laboratory and field methods are taught. After that the students work on projects (usually in teams) under the guidance of a supervising tutor. Usually the projects stem from actual research projects. This parts ends with a poster presentation of project results. Afterwards, a written report has to be prepared. The course includes a one day excursion.

Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Summer term, 2. Half

Study program/Usability **Master Biological Sciences** **Master Life Science** **Credits** 15 **Duration** 6 weeks	**Module Title: Advanced Courses: Microbial Physiology and Ecology**
Module grade	The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units	Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives	Understanding the activities of micro¬organisms in aquatic environments, how they influence the transformation of matter and use these processes for covering their energy needs
Module unit	**a. Lecture and Seminar**
Coordinator	Prof. Dr. Schink
Teaching content	Cultivation of bacteria. Batch and continuous culture, kinetics of continuous flow systems. Dissimilatory and assimilatory metabolism, aerobic and anaerobic degradation of organic matter (fermentations, sulfate reduction, methanogenesis, syntrophic associations, phototrophic bacteria). Limits and principles of microbial degradation, transformation cycles of C, N, S, P. Starvation and survival. Intra- and interspecific cell-cell interactions, chemical communication, signalling molecules. Microbial communities, biofilms. Microbial ecology of specific environments e.g., sediments, water column, deep sea, soil, digestion tracts of animals, extreme environments (hot springs, saline lakes etc.).
Forms of teaching/Amount of SWS	5
Work load	60 h Attendance time 90 h Preparation and post-processing
Credits for this unit	5
Examination and unit completion	Journal club / seminar
Prerequisites	At least one course in microbiology and experience in basic microbiological lab work. Basic knowledge in chemistry and biochemistry is required. Experience in molecular biology may be useful.
Language	English
Time slot and frequency of the course	Winter term, 2. Half
Module unit	**b. Internship**

Coordinator	Prof. Dr. Schink
Teaching content	Novel, metabolically interesting bacterial isolates are being characterized and the underlying biochemistry is studied. This includes overall balances of metabolism, growth in batch or continuous culture, quantification of energy input and of metabolic capacities. In the past, novel pathways of fermentation of organic matter have been studied, including novel enzymes which catalyze unusual reactions with aromatic compounds or hydrocarbons. We also isolated novel aerobic and anaerobic bacteria which transform primary amines or ketones, or phototrophic bacteria which utilize iron(II) compounds, organosulfur compounds, or nitrite. Moreover, the strategy of certain bacteria to form cell aggregates in the presence of detergents has been studied as a means to protect themselves against toxic influences.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Winter term, 2. Half

Study program/Usability **Master Biological Sciences** **Master Life Science**				**Module Title: Advanced Courses: Molecular Evolutionary Biology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				The advanced course consists of a theoretical part with lecture and seminar and an internship with individual projects.
Educational objectives				We study several fundamental issues in evolutionary and developmental biology, as well as comparative genomics and bioinformatics. The evolution of biodiversity, and specifically the developmental basis and molecular and genomic causes of morphological diversity between species are of interest to us. We would like to better understand the relationship between tempo and mode of evolution both in terms of morphological adaptation and speciation on one hand and genetic differentiation among species and speciation on the other. In trying to understand the origin and maintenance of biodiversity we mostly use molecular approaches, namely the study of mitochondrial and nuclear DNA variation (in protein coding genes and microsatellites), to ask how much genetic divergence accompanies morphological differentiation among populations and separates species.
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Meyer
Teaching content				We will have daily lectures on topics including developmental-evolutionary biology as well as major themes in evolutionary biology. Other topics will cover some of the theory behind molecular phylogenetics, genomics and bioinformatics.
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Seminar
Prerequisites				B.Sc. degree
Language				English
Time slot and frequency of the course				Summer term, 1. Half

Module unit	Compulsory/Optional course
Module unit	**b. Internship**
Coordinator	Prof. Dr. Meyer
Teaching content	In order to address the central issues in organismal evolutionary biology we are conducting multidisciplinary, integrative research that ranges from population genetics, molecular evolution, and molecular phylogenetics, to comparative genomics and bioinformatics and also includes work on the connections between developmental and evolutionary biology. Our model organisms include the zebrafish and also the evolutionary highly diverse cichlid fishes.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Time slot and frequency of the course	Summer term, 1. Half

Study program/Usability **Master Biological Sciences** **Master Life Science**				**Module Title: Advanced Courses: Molecular Genetics**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				This course enables students to understand the molecular mechanism underlying mitotic and meiotic divisions in higher eukaryotes. At the end of the course, the students will understand how cell cycle progression is regulated by posttranslational modifications of key cell cycle regulators and how mitotic kinesins facilitate the equal distribution of the genome in mitosis.
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Th. Mayer
Teaching content				Molecular insights into the regulatory mechanisms controlling cell cycle progression in mitosis and meiosis. A particular focus will be on the function and regulation of ubiquitin ligases during the cell cycle. In addition, the molecular mechanisms enabling motor proteins to move along microtubules and the regulation of this process in mitosis will be explained in detail.
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				Knowledge of the basic concepts of mitotic and meiotic cell cycle regulation in higher eukaryotes. Insights into the function and regulation of mitotic motor proteins. Knowledge of the respective chapters in the textbook " Cell Cycle" by David Morgan is regarded as prerequisite.
Language				English
Time slot and frequency of the course				Winter term, 1. Half
Module unit				**b. Internship**

Coordinator	Prof. Dr. Th. Mayer
Teaching content	Experimental insights into the regulatory mechanisms underlying mitotic and meiotic cell cycle progression. Experimental insights into the function and regulation of motor proteins. The Xenopus egg extract and human tissue culture cells are used as model systems. Biochemical, cell biological approaches are combined with high resolution live-cell microscopy. In addition, small molecules are applied to modulate protein function on a fast time scale.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Winter term, 1. Half

Study program/Usability **Master Biological Sciences** **Master Life Science**				**Module Title: Advanced Courses: Molecular Microbiology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				Conducting research projects independently, presenting data in seminars
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Deuerling
Teaching content				a) Theoretical part: Protein folding, function and mechanisms of molecular chaperones, protein folding defects, molecular basis of neurodegenerative diseases and aging, E. coli, yeast and C. elegans as genetic model systems; biochemical methods for the analysis of protein-protein interactions: crosslinking techniques and fluorescence spectroscopy; detailed structural and functional insights into ribosomes and translation regulation. b) Practical part The practical part of this advanced course orients itself at our current research projects. Our major goal is to enhance our understanding of protein synthesis and folding in health and disease. We work on - principles of molecular chaperones - cotranslational folding pathways of nascent polypeptides - protein processing and quality control mechanisms in the cell - functions of ribosome-associated chaperones in aging and diseases related to protein misfolding c) Model organisms and range of methods We use three different model organisms: the bacterium Escherichia coli, the yeast Saccharomyces cerevisiae and the nematode C. elegans. We combine demanding genetic analyses of chaperone and ribosome mutants in vivo with protein analysis in vitro. This includes RNAi experiments in C. elegans, knockout mutations in E. coli and yeast and

	fluorescence microscopy analysis with all three model systems. State-of-the-art kinetic and mechanistic investigations of translation and chaperone-assisted protein folding in vitro are performed using translation systems, ribosome profiling, qPCR, fluorescence spectroscopy and crosslinking techniques.
Forms of teaching/Amount of SWS	5
Work load	60 h Attendance time 90 h Preparation and post-processing
Credits for this unit	5
Examination and unit completion	Journal club / seminar
Prerequisites	a) Compact course Molecular Microbiology b) Elementary knowledge in microbiology, biochemistry and molecular biology including all the techniques like protein purification methods, PCR, cloning, etc.
Language	English
Time slot and frequency of the course	Summer term, 2. Half
Module unit	**b. Internship**
Coordinator	Prof. Dr. Deuerling
Teaching content	Same as above, part b)
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Summer term, 2. Half

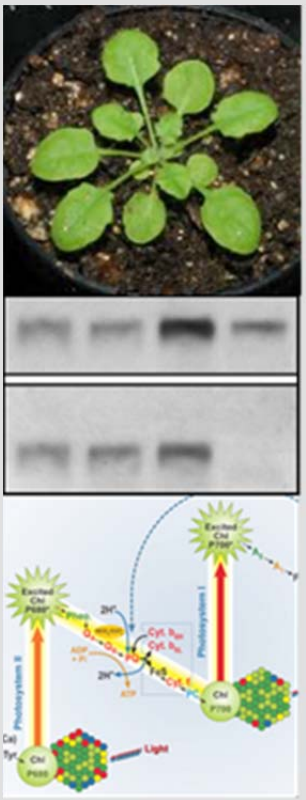
Study program/Usability **Master Biological Sciences** **Master Life Science**				**Module Title: Advanced Courses: Molecular Toxicology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				The advanced course consists of a theoretical part with lecture and seminar and an internship with individual projects.
Educational objectives				Basic & advanced knowledge in Molecular Toxicology Presentation of a scientific poster, literature seminar
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Bürkle, apl. Prof. Dr. May, Dr. Mangerich
Teaching content				Molecular Toxicology, Genotoxicology, Mechanisms of Aging & Carcinogenesis
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Poster Production and presentation
Prerequisites				Successful participation in modules like "Humanbiologie" and "Pharmakologie & Toxikologie" during Bachelor-Studies
Language				English
Time slot and frequency of the course				Winter term, 2. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Bürkle, apl. Prof. Dr. May, Dr. Mangerich
Teaching content				Design, planning and running of experiments, data evaluation, interpretation & presentation
Forms of teaching/Amount of SWS				10
Work load				200 h Attendance time 100 h Preparation and post-processing
Credits for this unit				10
Examination and unit completion				Colloquium and written report
Language				English
Time slot and frequency of the course				Winter term, 2. Half

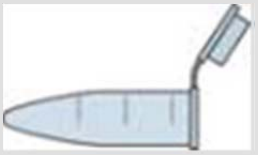
Study program/Usability **Master Biological Sciences** **Master Life Science**				**Module Title: Advanced Courses:** **Novel in vitro methods in pharmacology & toxicology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				Knowledge on in vitro methods for toxicity testing Knowledge on novel approaches in toxicology Knowledge on mechanisms governing neurodegeneration and neurodevelopment
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Leist
Teaching content				Ethical aspects of animal experimentation, overview of non-animal approaches for toxicity testing, cytotoxicity assays, neurotoxicology, basics of pharmacology and toxicology, pluripotent stem cells and stem cell neuronal differentiation, epigenetic mechanisms in differentiation and toxicity, Parkinson's disease, neural crest function and toxicity, cell migration assays, test method development and validation, transcriptome analysis by PCR and microarray, data mining and statistics of genome-wide expression data, biostatistics.
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				Good background in biochemistry (e.g. biochemistry II lecture), cell biology, pharmacology (e.g. pharmacology and toxicology I lecture) and physiology;
Language				English
Time slot and frequency of the course				Summer term, 2. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Leist

Teaching content	Laboratory techniques related to stem cell and neuronal cell cultures, their exposure to toxicants and analysis of transcript, functional, metabolic, epigenetic and other changes. Data mining, statistical evaluation and presentation. Critical evaluation of literature.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Summer term, 2. Half

Study program/Usability **Master Biological Sciences** **Master Life Science**	**Module Title: Advanced Courses: Organismal Biology: Going Wild**
Module grade	The module mark is composed of the individual examination results within this module.
Module units	Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives	Field ecological methods, such as animal marking and behavioural observations. Movement ecology and animal behavior. Design and conducting of field experiments in animal ecology including statistical analysis of the results and scientific communication and presentation.
Module unit	**a. Lecture and Seminar**
Coordinator	Prof. Dr. Wikelski, Dr. Dechmann, Dr. Fiedler, Dr. Safi
Teaching content	Animal ecology, movement ecology, ethology, behavioural ecology, statistics and programming.
Forms of teaching/Amount of SWS	5
Work load	60 h Attendance time 90 h Preparation and post-processing
Credits for this unit	5
Examination and unit completion	Colloquium
Prerequisites	The participants should be willing to spend long hours in the field, including night work. Readings in ecology and organismal biology are suggested.
Language	English
Time slot and frequency of the course	Summer term, 1. Half
Module unit	**b. Internship**
Coordinator	Prof. Dr. Wikelski, Dr. Dechmann, Dr. Fiedler, Dr. Safi
Teaching content	Combination of field work and lectures with problem based learning on organismal biology and animal ecology. Statistics and visualization in the R programming language.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10

Examination and unit completion	Report
Language	English
Time slot and frequency of the course	Summer term, 1. Half

<table>
<tr><td colspan="4">Study program/Usability
Master Biological Sciences
Master Life Science</td><td colspan="2" rowspan="2"><u>Module Title: Advanced Courses:
Physiology and Biochemistry of Plants</u></td></tr>
<tr><td>Credits</td><td>15</td><td>Duration</td><td>6 weeks</td></tr>
<tr><td colspan="4">Module grade</td><td colspan="2">The module mark for Life-Science-Students is composed of the individual examination results within this module.</td></tr>
<tr><td colspan="4">Module units</td><td colspan="2">The advanced course consists of a theoretical part with lecture and seminar and an internship with individual projects.</td></tr>
<tr><td colspan="4">Educational objectives
  </td><td colspan="2">Lecture: The students will learn to understand the molecular and genetic basis of selected topics in physiology and biochemistry of plants and algae. A special focus is on experimental approaches that allow to gain new information about functional aspects of plant and algae metabolism and its regulation by internal and external factors.
Seminar: The students will learn how to read and interpret scientific literature and how to present hypotheses or experimental data to a broader audience.
Internship: In close contact with the active researchers in the lab the students will learn how to perceive a scientific problem and how to develop an experimental approach to test a hypothesis or how to extract knowledge from unbiased data aquisition. They will have the opportunity to learn and apply up to date methods in plant and cyanobacteria research. The students will also learn how to summarise and discuss their project work in written form.
Colloquium: The students will learn to present their scientific project and the results obtained during the internship. They will also learn how to perceive and analyse a scientific presentation.</td></tr>
<tr><td colspan="4">Module unit</td><td colspan="2">a. Lecture and Seminar</td></tr>
<tr><td colspan="4">Coordinator</td><td colspan="2">Prof. P. Kroth, PD J. Simon</td></tr>
<tr><td colspan="4">Teaching content</td><td colspan="2">Lecture:
Based on the current research projects in the Adamska and Kroth labs, the lecture will present recent results in the field of physiology and biochemistry of plants and algae.
The topics currently include adaptation of plants to environmental stress, especially high light stress and drought/salinity as well as the regulation of cellular functions by proteases.</td></tr>
</table>

	On the algae side, the focus is on compartimentation of metabolism and protein transport in diatoms and other algae with complex plastids. Recent advances in algae genomics are also presented. Seminar: Topics will be chosen by the students in accordance with the topics of their internships.
Forms of teaching/Amount of SWS	5
Work load	60 h Attendance time 90 h Preparation and post-processing
Credits for this unit	5
Examination and unit completion	Seminar
Prerequisites	The course is open to all master students. Experience in laboratory work is presumed. Good basic knowledge of botany and plant physiology are expected along with a genuine interest in the special challenges that autotrophic organsims have to face in the environment.
Language	English
Time slot and frequency of the course	Summer term, 1. Half
Module unit	**b. Internship**
Coordinator	Prof. P. Kroth, PD J. Simon
Teaching content 	Internship: The students will participate in current research projects of the plant physiology and biochemistry lab. 1 or 2 students will be supervised by a PhD student or advanced researcher. The actual content depends on the topics available and the methodolocical focus of the supervisors. Colloquium: Each student will give an oral presentation of the results obtained during the internship. Special focus is on the comprehensivness and professionality of the presentation.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report

Language	English
Time slot and frequency of the course	Summer term, 1. Half

Study program/Usability Master Biological Sciences Master Life Science				**Module Title: Advanced Courses: Physiology, Ecology and Molecular Biology of Algae**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				Design and performance of scientific experiments Development of approaches to solve scientific questions Drawing conclusions from obtained results Presentation of results in front of an audience Scientific writing
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. Kroth
Teaching content				Molecular biology, biochemistry and physiology of algae Regulation of photosynthesis Algal Biology Algal Genomics
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				Experience in laboratory work
Language				English
Time slot and frequency of the course				Summer term, 1. Half
Module unit				**b. Internship**
Coordinator				Prof. Dr. Kroth
Teaching content				Molecular biology, biochemistry and physiology of algae. Each students will work on a a project during th course and present his/her results in a final seminar
Forms of teaching/Amount of SWS				10
Work load				200 h Attendance time 100 h Preparation and post-processing

Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Summer term, 1. Half

Study program/Usability **Master Biological Sciences** **Master Life Science**				**Module Title: Advanced Courses:** **Plant Ecology**
Credits	15	**Duration**	6 weeks	
Module grade				The module mark for Life-Science-Students is composed of the individual examination results within this module.
Module units				Advanced course of scientific lab work consisting of lecture, internship and single projects.
Educational objectives				The major objectives are that by the end of this course, the students will know: • What is plant ecology, and why it is important. • What are big questions in plant ecology. • How to test hypotheses in plant ecology. • What are the major methods and approaches in plant ecology. • How to set-up, run and analyse experiments in plant ecology. • How to present results of plant ecological studies.
Module unit				**a. Lecture and Seminar**
Coordinator				Prof. Dr. van Kleunen
Teaching content				In the lectures, we teach the major theories in plant ecology. Some examples of topics are plant life-histories, dispersal and pollination, functional diversity and invasion ecology. In seminars, the students present and discuss recent publications.
Forms of teaching/Amount of SWS				5
Work load				60 h Attendance time 90 h Preparation and post-processing
Credits for this unit				5
Examination and unit completion				Journal club / seminar
Prerequisites				Requirement for the course are basic knowledge of ecology (the 3rd semester course “Ökologie”, the book “The Ecology of Plants” by Gurevitch, Scheiner and Fox, particularly Chapter 1 and Chapters 5-13) and basic knowledge of statistical methods.
Language				English
Time slot and frequency of the course				Summer term, 2. Half

Module unit	**b. Internship**
Coordinator	Prof. Dr. van Kleunen
Teaching content	In addtion to the lectures and seminars, we teach practicals and workshop, and the students have to do a research project. In the practicals and workshops, we teach major skills and methods in plant ecology. In the research projects, the students will have to put the acquired skills and knowledge into practice. Collaborating in groups of 2-4 persons, students will obtain experience in all aspects of scientific research: from design and planning to analysis and presentation of results. The projects will be independent or directly linked to ongoing studies in our group, and are supervised by PhD students and postdocs.
Forms of teaching/Amount of SWS	10
Work load	200 h Attendance time 100 h Preparation and post-processing
Credits for this unit	10
Examination and unit completion	Colloquium and written report
Language	English
Time slot and frequency of the course	Summer term, 2. Half

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: An Introduction to R and Analysis of ecological Data**
Module grade		The compulsory/optional course is not graded.
Educational objectives		This weekly course will teach students how to use the program R to analyse ecological data.
Coordinator		Dr. W. Dawson, Prof. Dr. M. van Kleunen, PD Dr. D. Straile
Teaching content		The course will begin by introducing students to the general use of R, and will progress to cover standard but important analyses commonly used in ecology and other biological disciplines. Toward the end of the course, students will learn about more complex statistical methods. The course will include short lectures, but will have an emphasis on 'hands-on' practicals using R to analyse real data. Students will also have the opportunity to use R themselves in order to complete homework assignments.
Forms of teaching/Amount of SWS		Lecture and excersises combined, 2 SWS
Work load		2 hours per week (including homework tasks)
Credits for this unit		2
Examination and unit completion		No examinations
Prerequisites		None
Language		English
Time slot and frequency of the course		WS, weekly
Recommended Term		All Master terms

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Animal Protection: Legal and Ethical Principles - Focus on Laboratory Animals**
Module grade		The compulsory/optional course is not graded.
Educational objectives		solid learning of legal regulations/prerequistes and ethical evaluation of animal experiments
Coordinator		PD Dr. Schopper
Teaching content		short history of laboratory animal science and legislation respecting animal use for scientific purposes; European and national laws concerning the use of animals in experiments; ethical evaluation of animal experiments
Forms of teaching/Amount of SWS		Lecture / 2 SWS
Work load		about 60 hours
Credits for this unit		2
Examination and unit completion		Powerpoint-presentation and written report
Prerequisites		none
Language		English
Time slot and frequency of the course		WS and SS
Recommended Term		from semester one

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Biochemistry, Regulation and Systems Biology of Signal Transduction**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Get an overview of signaling, the recent advances made by systems biology approaches and the involvement of signaling in human diseases
Coordinator		PD Dr. Farhan
Teaching content		In this lecture series an introduction is given into basic principles of signal transduction. Then, it also will be discussed in greater detail various types of signal transduction pathways and give an outlook into diseases associated with them. There will also be give an overview about recent systems biology approaches. Finally, a very basic introduction in network modeling will also be provided to illustrate what types of design principles a signaling network must obey in order to fulfil a certain biologic task. The lecture will be held in English.
Forms of teaching/Amount of SWS		1 SWS
Work load		9 h lecture, 1,5 h oral exam
Credits for this unit		1
Examination and unit completion		Oral exam
Prerequisites		Master student
Language		English
Time slot and frequency of the course		Summer semester
Recommended Term		Master students at any level

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Bioorganic Chemistry - Chemistry and Biochemistry of Natural Products**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Knowledge of the major natural product classes and their biosynthetic pathways Retrobiosynthetic approach to deduce biosynthetic pathways of unkown compounds Reactivity of natural products
Coordinator		Prof. Dr. Spiteller
Teaching content		Bioorganic chemisty/natural products chemistry/biosynthetic pathways: fatty acids, oxylipins, polyketides, non-ribosomal peptides, ribosomal peptides, terpenes, steroids, shikimate pathway, alkaloids, vitamins, hormones, antibiotics, antibiotic resistance.
Forms of teaching/Amount of SWS		2
Work load		30 h Attendance time 30 h Post processing/preparation for examination
Credits for this unit		2
Examination and unit completion		Written examination
Prerequisites		Solid knowledge in organic chemistry and biochemistry
Language		English
Time slot and frequency of the course		Each winter semester
Recommended Term		From 1st master semester

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Chemical Ecology**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Knowledge about the role of chemistry in diverse organismal interactions Function of chemical compounds in biology/ecosystems
Coordinator		Prof. Dr. Spiteller
Teaching content		Aquatic ecology, animal defense strategies, food quality, multitrophic interactions, chemical communication, pheromones, quorum sensing, quorum quenching, antibiotics, symbioses, microbial interactions, plant defense strategies, plant hormones, plant signalling cascades, plant defense elicitors, fungal defense strategies, evolution of defense, counterdefense strategies.
Forms of teaching/Amount of SWS		2
Work load		30 h Attendance time 30 h Post processing/preparation for colloquium
Credits for this unit		2
Examination and unit completion		Colloquium
Prerequisites		solid knowledge in biochemistry, organic chemistry and analytical chemistry
Language		Englisch/German
Time slot and frequency		each summer term
Recommended term		from 6th semester

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Common errors and mistakes as revealed by retracted papers**
Module grade		The compulsory/optional course is not graded.
Educational objectives		1) Critical and self-critical thinking 2) Proper application of statistics 3) Enabling assessment of aspects of psychology, scientific culture, and ethics
Coordinator		Prof. Dr. Kay Diederichs
Teaching content		We will analyze and discuss statistical and methodological mistakes in publications.
Forms of teaching/Amount of SWS		Seminar
Work load		2
Credits for this unit		2
Examination and unit completion		--
Prerequisites		Course participants should have a Bacchelor degree
Language		German / English
Time slot and frequency of the course		Weekly (2 h)
Recommended Term		SS

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Ecological and evolutionary physiology**
Module grade		The compulsory/optional course is not graded.
Educational objectives		This course aims at providing MA students with an insight into the concepts and techniques of the field of ecological and evolutionary physiology. Students will actively participate in the process of scientific research by taking part in original research projects. Students will be embedded in a lively scientific community and can interact with an international set of Ph.D. students and staff scientists.
Coordinator		Prof. Dr. Michaela Hau (for information and enrollment and please contact me at mhau@orn.mpg.de)
Teaching content		We will be provide formal teaching (lectures) on topics in ecological and evolutionary physiology, endocrinology, and natural history of birds. We will teach students techniques of behavioral observations, data collection and management, and techniques of field endocrinology in birds. We will discuss conceptual approaches, study design and experimental techniques. Students will learn hormone assays (enzyme immuno assays), data analysis, data presentation and hone their writing skills. We will browse the primary literature and have regular discussions of seminal papers (‚journal club').
Forms of teaching/Amount of SWS		5 SWS, lectures plus practical work.
Work load		3 weeks, full-time.
Credits for this unit		5 credits
Examination and unit completion		Student evaluation will be based on active participation in the course (lectures and practical components), on journal club presentations as well as the final report.
Prerequisites		This field course will be taught at the Max Planck Institute for Ornithology, Seewiesen, Bavaria. Housing will be provided. Early morning and mid evening work hour field work (always in teams) may be required for a few days. Driver's licence advantageous. Maximal number of student participants: 3.
Language		English
Time slot and frequency of the		24.3.2013-12.4.2013 (2 years in a row)

course	
Recommended Term	Winter term

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Endocrinology of Mammals I**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Solid learning of endocrine regulations; understanding about environmental influences on endocrine regulations.
Coordinator		PD Dr. Schopper
Teaching content		short history of endocrinology; definitions; short survey on biochemistry and metabolism of hormones (hormone synthesis, secretion, transport, metabolism and excretion); general principles of endocrine regulation and hormone action; environmental influences on hormonal regulation; examples of physiological hormonal regulation
Forms of teaching/Amount of SWS		lecture / 2
Work load		about 60 hours
Credits for this unit		2
Examination and unit completion		written exam
Prerequisites		none
Language		English
Time slot and frequency of the course		WS
Recommended Term		from semester one

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Endocrinology of Mammals II (Selected Chapters)**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Understanding of function of and influences on endocrine regulations; risk assessment of hormonal manipulations (e.g. related to biotechnical procedures)
Coordinator		PD Dr. Schopper
Teaching content		examples for hormonal regulation (e.g. reproduction, lactation, growth); annual rhythms; biotechnical manipulation of hormonal regulations; consequences and risks of the use of hormones for biotechnical purposes
Forms of teaching/Amount of SWS		lecture / 2
Work load		about 60 hours
Credits for this unit		2
Examination and unit completion		written exam (alternativly oral exam)
Prerequisites		participating in "Mammalian Endocrinology I: Basics"
Language		English
Time slot and frequency of the course		SS
Recommended Term		from semester two

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration: 1 Week **29.2.2016 - 4.3.2016**	1 Term	**Title: Evaluation of Pharmacological and Toxicological Data sets**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Independent and critical evaluation of data Work with large data sets Independent interpretation of data
Coordinator		PD Dr. Stefan Schildknecht (Uni Konstanz), Dr. Stefan Röpcke (Takeda, Zürich)
Teaching content		In the first part of the course, participants will perform toxicity experiments with neuronal cells in the laboratory. Different readouts such as viability, neurite mass etc. will be determined. In the first part, basic principles and concepts of toxicology are taught in parallel. In the second part of the course, participants will evaluate their own data with a particular focus on the application of appropriate statistical evaluations, and other relevant parameters. Then, participants will continue with the evaluation of large data sets (array data). Focus is on the question of how to get qualitative, biologically relevant information out of large data sets and how these data are interpreted in a critical way.
Forms of teaching/Amount of SWS		2 SWS
Work load		The course will last the whole day for the entire week. A few weeks before the course, material is handed out to the participants for preparation (mandatory !)
Credits for this unit		2
Examination and unit completion		
Prerequisites		Preparation of hand-out material before the course absolutely mandatory; no examination; preparation of a protocol after the course
Language		Optional english/german
Time slot and frequency of the course		29.2.2016 – 4.3.2016
Recommended Term		Master-students

Study program/Usability Master Biological Sciences Master Life Science		Module: Compulsory/Optional Courses
Duration	1 Term	**Title: Evolutionary Organismal Biology**
Module grade		The compulsory/optional course is not graded.
Educational objectives		The students will get an overview over the diverse topics of the research group involved in the MSc program Ecology and Evolution. They will gain a broad theoretical and up-to-date background in the represented disciplines.
Coordinator		Dr. Robert Kraus
Teaching content		"Evolutionary Organismal Biology" is a lecture series that gives a wide overview of research in ecology and evolution at the University of Konstanz. Each lecture presents a general theme of one active researcher, with particular focus on ecological and evolutionary context. The lecture series is integrative and includes a wide range of contributions, e.g., from physiologists, limnologists and developmental and behavioural biologists. It is specifically intended for MA students who chose "Ecology and Evolution" as emphasis area but it is also open to other interested persons.
Forms of teaching/Amount of SWS		Lecture course / 2
Work load		30 h Attendance time 60 h Preparation and post-processing 30 h Exam preparation
Credits for this unit		4
Examination and unit completion		written examination
Prerequisites		none
Language		English
Time slot and frequency of the course		Summer term
Recommended Term		Master students

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: How to write a thesis in biology: a practical guide**
Module grade		The compulsory/optional course is not graded.
Educational objectives		This weekly course will give a practical guide how to work on independent project and write a thesis.
Coordinator		Dr. E. Yohannes
Teaching content		This weekly course will give a practical guide to how students need to choose their own topic and select the right adviser, how to work steadily for some time on their research, write, and manage an independent project. The course is designed as a mentor to offer step-by-step advice on how to turn an unclear idea into a clearly defined research project (proposal), then into a rough-draft paper, and finally a thesis. The course will use real-time examples and easy-to-use tips, time schedules that show when to begin various tasks, which steps need special attention and how much time to spend on each. Additionally, issues beyond the research such as good work habits and as how to coping personal problems that interfere with research and writing will be discussed.
Amount of SWS		Lecture and exercise combined, 2 SWS
Work load		2 hours per week (including homework assignment)
Credits for this unit		2
Examination and unit completion		No examinations
Prerequisites		None
Language		English
Time slot and frequency		WS, weekly
Recommended term		All master terms

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: ImageJ Workshop**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Understanding of basic principles of image analysis. Practical use of open source software. Critical evaluation of image parameters.
Coordinator		Prof. Dr. E. May
Teaching content		One day course on the freeware Image analysis platform Image J. General introduction into the analysis of digital images (quantization of images, pixels, filters, contrast, segmentation, registration etc.) Guided exercises using Image J. Application of learned skills to the analysis of own images.
Forms of teaching/Amount of SWS		1 SWS
Work load		One full day
Credits for this unit		0,5
Examination and unit completion		no examination required
Prerequisites		Bachelor's degree
Language		English
Time slot and frequency of the course		1 x /Semester, 8.30 - 16.00 h
Recommended Term		Starting 1 Semester Master

Study program/Usability Master Biological Sciences Master Life Science		Module: Compulsory/Optional Courses
Duration	1 Term	**Title: Innovations in Vertebrate Evolution**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Students will learn an integrative view of vertebrate morphological innovations. Each week, students will read and discuss a chapter from the book „Great Transformations in Vertebrate Evolution“. Students will also be required to provide a formal presentation of one of the books chapters to the entire class.
Coordinator		Dr. Claudius Kratochwil Dr. C. Darrin Hulsey
Teaching content		This class will discuss topics ranging from how birds evolved from running dinosaurs to how tetrapods evolved from swimming fish. The class will provide students with an integrative view of some of the great transformation in the 500 million year history of vertebrate life. The utility of new techniques and approaches across fields spanning levels of biological organization from DNA sequences to the ecology of whole organisms will be discussed. The class will center on discussion of the book „Great Transformations in Vertebrate Evolution“ and students will be required to read and discuss this material. They will also make a presentation of one of the chapters.
Forms of teaching/Amount of SWS		Seminar/2
Work load		
Credits for this unit		2
Examination and unit completion		-
Prerequisites		-
Language		English
Time slot and frequency of the course		Winter term
Recommended Term		Master students

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Laboratory Animal Science**
Module grade		The compulsory/optional course is not graded.
Educational objectives		theoretical and practical basics on laboratory animal science
Coordinator		PD Dr. Schopper
Teaching content		theoretical and practical basics on laboratory animal science according to FELASA education guidelines for persons carrying out animal experiments (FELASA B)
Forms of teaching/Amount of SWS		compact course (1 week): lessons and practicum / 2 SWS
Work load		about 65 hours
Credits for this unit		2
Examination and unit completion		written exam
Prerequisites		none
Language		English
Time slot and frequency of the course		twice a year
Recommended Term		from semester three

Study program/Usability Master Biological Sciences Master Life Science		Module: Compulsory/Optional Courses
Duration	1 Term	**Title: Molecular Ecology**
Module grade		The compulsory/optional course is not graded.
Educational objectives		In this course students learn about the application of molecular biology to ecological questions. The objective is to understand the history, reasoning and benefits behind using molecular technology in ecology, and to get acquainted with real-life examples from this field.
Coordinator		Dr. Robert Kraus
Teaching content		We will learn several application possibilities of molecular ecology, as well as to apply this knowledge in selected case studies.
Forms of teaching/Amount of SWS		2
Work load		1 week of intense course from 09:15 – 17:00 followed by a week of independent data analysis to prepare a case study in smaller groups. The course consists of lectures, computer demonstrations, and computer exercises. Students are then divided into small groups and given real-life data sets for independent analysis: the case studies. On the last day of the second week students present their studies.
Credits for this unit		3
Examination and unit completion		No examination. Successful course participation is conditional on the presentation of the case study analyses.
Prerequisites		None
Language		English
Time slot and frequency of the course		Winter term
Recommended Term		Master students

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Nature and culture as false dichotomy**
Module grade		The compulsory/optional course is not graded.
Educational objectives		This course has the purpose to explore recent research within anthropology and biology on overlaps between natural and cultural causes of social behaviour.
Coordinators		Dr. Acosta Garcia/Dr. Hütteroth
Teaching content		A combination of invited lectures and seminar sessions will provide students with stimulating ideas within a framework of holistic understandings of the social world. Sociology and biology students will explore a branch of anthropology that integrates biological aspects of life in qualitative studies of sociality. They will do so by engaging directly with scholars working in interdisciplinary projects, and learn about contrasting approaches to similar issues. The different departmental background of students will allow for constructing debates on sociality across disciplinary lines. Within a context of an enhanced awareness of humanity's impact on our planet, this course offers a stimulating opportunity to explore the complex interactions between the biophysical and symbolic roots of human life.
Forms of teaching/Amount of SWS		2
Work load		Students will be required to: 1) read one essay per session and submit a 250 word note on it; 2) writing 500 word reviews on each of the 8 guest lectures; 3) prepare and formulate two questions for guest speakers (one for an anthropologist and one for a biologist), and write down the questions and responses; and 4) write a short essay at the end of the course.
Credits for this unit		4
Examination and unit completion		Turn in all the material required (1-4 in workload), and active participation in class.
Prerequisites		None
Language		English
Time slot and frequency of the course		Summerterm, weekly
Recommended Term		Course for MA and graduate school PhD students

Study program/Usability Master Biological Sciences Master Life Science		Module: Compulsory/Optional Courses
Duration	1 Term	**Title: Pharmacology and Toxicology III**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Deepened background concerning the nervous system und human development with respect to central controlling processes and their modification by drugs and toxicants. Understanding of methodological basis of experimental approaches
Coordinator		Prof. Dr. Marcel Leist
Teaching content		Neurotoxicity, Stem cell development, Signalling in developmental processes (Wnt, BMP, Notch, Shh, G-proteins, Tyr-kinase receptors, Nuclear receptors). Modulation of these processes by diseases and drugs. Methods to study signaling, nervous system functioning and differentiation processes. Formats of scientific presentations and discussions.
Forms of teaching/Amount of SWS		Lectures, student seminars and seminar discussion
Work load		60 h (16 h Präsenz, 20 h Seminarvorbereitung, 24 h Vor- und Nachbereitung der Vorlesungen)
Credits for this unit		2 ECTS
Examination and unit completion		Seminar presentation, oral questions on lecture topics
Prerequisites		Pharmacology and Toxicology I, Cell Biology I+II, Biochemistry II
Language		English
Time slot and frequency of the course		Tuesdays 17:00 – 18:30, pre-registration by email (brigitte.schanze@uni-konstanz.de)
Recommended Term		WS

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Photoshop Workshop**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Understanding basic principles of image processing. Practical use of Photoshop.
Coordinator		Prof. Dr. E. May
Teaching content		One day course on the image processing program Photoshop. General introduction into the principles of image processing with the help of Photoshop (Histogam , layers, objects, channels, masks, filters etc.) Application of learned skills to example images.
Forms of teaching/Amount of SWS		1 SWS
Work load		One full day
Credits for this unit		0,5
Examination and unit completion		no examination required
Prerequisites		Bachelor's degree
Language		English
Time slot and frequency of the course		1 x /Semester, 8.30 - 16.00
Recommended Term		starting 1 Semester Master

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Pluripotent stem cells – novel uses and approaches**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Understanding the biology of pluripotent stem cells and their use for biological model systems
Coordinator		Prof. Dr. M. Leist
Teaching content		Generation of embryonic stem cells and induced pluripotent stem cells. Reprogramming and transprogramming. Stem-cell based toxicological tests. Principles of test development. Generation of knock-in, reporter and inducible mouse models. Epigenetic modifications of the stem cell genome. Signal transduction important for stem cell maintenance and differentiation.
Forms of teaching/Amount of SWS		Lectures (1 SWS)
Work load		12 h presence + 25 h preparation
Credits for this unit		2
Examination and unit completion		Test at end of lecture series
Prerequisites		Good knowledge in biochemistry, genetics and cell biology
Language		English
Time slot and frequency of the course		Summer term, second half
Recommended Term		SS

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Quantitative Aspects of Light Microscopy**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Understanding of basic principles of optics image formation in a microscope. Critical assessment of microscope performance. Critical Evaluation of different microscopy techniques
Coordinator		Prof. Dr. E. May
Teaching content		Three lectures on principles of optics, image formation in the compound mircroscopy, confocal microscopy, advanced techniques of fluorescence imaging. Three practical sessions with hands-on experience
Forms of teaching/Amount of SWS		1 SWS
Work load		Three full days
Credits for this unit		1
Examination and unit completion		Report and discussion of results from each group
Prerequisites		Bachelor degree
Language		English
Time slot and frequency of the course		1 x / Semester 9.00 - 17.30
Recommended Term		starting 1 Semester Master

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: R coding sessions**
Module grade		The compulsory/optional course is not graded.
Educational objectives		In this course daily R programming issues are discussed and solved in the plenary. The R coding session provides the opportunity to all participants to present their specific issues and find an interested community of scholars helping to improve their programming skills.
Coordinator		Dr. Kamran Safi
Teaching content		R programming, Scientific visual communication, Statistics
Forms of teaching/Amount of SWS		This is a tutorial. 1 SWS
Work load		Attendance during the session, proposing and presenting problems to the audience, writing short reports after sessions
Credits for this unit		2
Examination and unit completion		There is no examination
Prerequisites		None, interest and work in R programming
Language		English
Time slot and frequency of the course		Thursday 12:15 - 13:00, Z816
Recommended Term		WS and SS

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: R for Biologists I: Introduction course in R programming language**
Module grade		The compulsory/optional course is not graded.
Educational objectives		This course gives an introduction in programming using the R programming language, a widely used open source statistical programming language. The objective is to get started in using R to solve a variety of problems that biologists may encounter during their daily business.
Coordinator		Dr. Kamran Safi
Teaching content		R programming language. This course is not a statistic course! It is about learning a programming language.
Forms of teaching/Amount of SWS		The days are split in half, where in the morning lectures are held and in the afternoon a guided hands-on programming is conducted.
Work load		1 Week of intense course from 09:15 – 17:00 followed by a week of “Nacharbeit” to conclude the course reader.
Credits for this unit		2
Examination and unit completion		No examination. A successful course participation is conditional on the delivery of a course reader after the second week.
Prerequisites		None.
Language		English
Time slot and frequency of the course		1 week depending on availability of computer teaching rooms. 09:15–17:00 daily
Recommended Term		WS

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: R for Biologists II: Visualisation and analysis of spatial information**
Module grade		The compulsory/optional course is not graded.
Educational objectives		This course is intended for the attendants of R for Biologists I or scholar familiar with R programming who want to go in depth in particular areas. The course will have a changing topic from a series of recurrent fields such as GIS in R, analysis and visualization of animal movement, comparative phylogenetic methods etc.
Coordinator		Dr. Kamran Safi
Teaching content		R programming language, scientific communication, visualisations, statistics.
Forms of teaching/Amount of SWS		Half day of teaching / lecturing followed by half day of tutorial and problem based teaching.
Work load		1 week of intense course from 09:15-17:00 followed by a week of “Nacharbeit” to conclude the course reader
Credits for this unit		2
Examination and unit completion		No examination. Successful course participation is conditional on the delivery of a course reader after the second week.
Prerequisites		R programming skills.
Language		English
Time slot and frequency of the course		Varying depending on the availability of the teaching facility. 09:15-17:00 daily for 1 week.
Recommended Term		SS

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Self-Organization in Social Insects and other Communities**
Module grade		The compulsory/optional course is not graded.
Educational objectives		An integrative perspective on group dynamics, its proximate mechanisms and ultimate consequences
Coordinator		PD Dr. Ch. Kleineidam
Teaching content		We will discuss recent publications on self-organization and emergent properties of large communities. Starting with social insects, we will then expand our view on ther groups, e. g. fish schools, traffic in humans and emergent properties of structures. Participants from other disciplines e.g. psychology or informatics are welcome to join
Forms of teaching/Amount of SWS		2 SWS
Work load		26 h + preparation
Credits for this unit		1
Examination and unit completion		Presentation of recent publication
Prerequisites		none
Language		English
Time slot and frequency of the course		summer term
Recommended Term		> 3. Semester

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Seminar in Phylogenetic Comparative Methods**
Module grade		The compulsory/optional course is not graded.
Educational objectives		1. Become familiar with the theory and implementation of several phylogenetic comparative methods. 2. Learn how to implement these methods in the R programming environment 3. Formulate questions that can be addressed using comparative methods.
Coordinator		Dr. Darrin Hulsey
Teaching content		Phylogenetic Comparative Methods is a sub-discipline of evolutionary biology that has exploded in importance with the widespread availability of phylogenetic trees and the desire to compare traits across organismal diversity. This class will combine lectures, discussion of primary literature, and hands-on experience with methods using a number of packages implemented in the R programming environment. We will examine methods ranging from independent contrasts, ancestral state reconstruction, speciation through time, categorical trait correspondence, molecular clock calibration, biogeographic reconstructions, as well as rates of phenotypic evolution. The class will meet for three hours each week in the second half of the summer semester and should be valuable for students interested in any aspect of comparative biology and trait evolution from genes to species assemblages
Forms of teaching/Amount of SWS		Seminar / 3
Work load		Students are responsible for reading all papers to be presented in class. They are also responsible for presenting a recent published paper on phylogenetic comparative methods to the class. They are will generate responses to homework questions posed for programming in the R environment. They will also perform their own phylogenetic comparative analysis and write a synopsis of their analyses.
Credits for this unit		3

Examination and unit completion	Completing the workload and turning in their analysis and project description.
Prerequisites	Suggested experience with R programming and evolutionary biology
Language	english
Time slot and frequency of the course	Summer term
Recommended Term	Summer term

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Signal Transduction: Regulation and Disease Relevance**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Get an overview of signaling, the recent advances made by systems biology approaches and the involvement of signaling in human diseases
Coordinator		PD Dr. Hesso Farhan
Teaching content		In this lecture series an introduction is given into basic principles of signal transduction. Then, it also will be discussed in greater detail various types of signal transduction pathways and give an outlook into diseases associated with them. There will also be give an overview about recent systems biology approaches. Finally, a very basic introduction in network modeling will also be provided to illustrate what types of design principles a signaling network must obey in order to fulfil a certain biologic task. The lecture will be held in English.
Forms of teaching/Amount of SWS		lecture course / 2
Work load		9 h lecture, 1,5 h oral exam
Credits for this unit		2
Examination and unit completion		Oral exam
Prerequisites		Master students
Language		english
Time slot and frequency of the course		Summer term
Recommended Term		Master students at any level

Study program/Usability Master Biological Sciences Master Life Science		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Stable isotope ecology / Journal Club**
Module grade		Das Wahlpflichtmodul ist unbenotet. The compulsory/optional course is not graded.
Educational objectives		This weekly journal club will discuss current and upcoming topics on stable isotope technique in aquatic and terrestrial ecology
Coordinator		Dr. E. Yohannes
Teaching content		This weekly journal club discusses new papers, ideas and concept as well as published reports on stable isotope ecology.
Forms of teaching/Amount of SWS		Lecture and exercise combined, 2 SWS
Work load		1 hours per week (including homework assignment)
Credits for this unit		1
Examination and unit completion		No examinations
Prerequisites		None
Language		English
Time slot and frequency of the course		WS, weekly
Recommended Term		All bachelor terms All master terms

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: Topics and questions of current biological research**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Presentation and discussion of actual research problems
Coordinator		Head of the research group
Teaching content		Actual research on the field of biology will be presented and discussed that are within the focus of the respective lab.
Forms of teaching/Amount of SWS		Seminar
Work load		2
Credits for this unit		2
Examination and unit completion		Presentation
Prerequisites		Course participants have to started their master thesis
Language		German / English
Time slot and frequency of the course		Weekly (2 h)
Recommended Term		WS/SS

Study program/Usability **Master Biological Sciences** **Master Life Science**		**Module: Compulsory/Optional Courses**
Duration	1 Term	**Title: X-Ray Structure Analysis of Proteins**
Module grade		The compulsory/optional course is not graded.
Educational objectives		Students should learn the basic principles and procedures of X-ray structure analysis.
Coordinator		Prof. Dr. Diederichs
Teaching content		Crystallization, diffraction, lattice spacegroups, data collection, molecular replacement, experimental phasing, refinement, validation
Forms of teaching/Amount of SWS		Lecture / 1 SWS
Work load		15 h
Credits for this unit		1
Examination and unit completion		Oral exam
Prerequisites		If possible, advanced course „Bioinformatics and X-ray structure analysis of proteins“. Interest for Mathematics
Language		English
Time slot and frequency of the course		winter term, weekly
Recommended Term		advanced Bachelorstudents and Masterstudents

Study program/Usability Master Biological Sciences Master Life Science				Module TITLE Masters project	
Credits	30	**Duration**	6 Month	**Part of module of total rating**	33 %
Module grade	The grade of the Masters project is calculated as the average of the grades provided by the two referees.				
Coordinator	Lecturers of the Department of Biology				
Educational objectives	The students are expected to pursue a scientific project in the area of biology, within a given time frame, in an independent manner, and to document their achievements in form of a written thesis.				
Teaching content	Aim is to impart the ability to independently establish a work-plan suited to complete the proposed masters-project within the prescribed time-frame, independently acquire knowledge corresponding to the current state of the scientific literature, gaining expertise in the methods and approaches required to perform the experimental work, independently examine, analyze, rate and discuss the achieved results, and collate all of the above in form of a written masters-thesis.				
Forms of teaching/ Amount of SWS	full-day tutoring in how to work scientifically as part of a team				
Work load	900 hours				
Examination and unit completion	Preparation of the written masters thesis				
Prerequisites	Successful completion of all exams specified in the rules and regulations governing the “Masters Biological Sciences” or “Masters Life Science” course of studies Immatriculation at the University of Konstanz				
Language	German, English				
Time slot and frequency of the course	Winter- and Summer-semester				
Recommended Term	4. Semester				
Compulsory/ Optional course	Compulsory course				