MSc 'Animal Biology and Biomedical Sciences'
2nd Semester
You have to choose five modules from at least two main topics!
E-Mail an master.biology@tiho-hannover.de)

1st Main Topic
Evolution, animal biodiversity and behaviour

Name of module	**Biodiversity and modern species conservation**	**2101**
No. of semester	2	
Lecturers	Bernd Schierwater, Heike Hadrys; Kai Kamm	
Kind of course/SWS	Practical field course (4 SWS), seminar (1 SWS), lecture (2 SWS)	
Study performance	Regular attendance, written report	
Exam performance	Examined oral presentation (colloquium, 100%)	
ECTS-CP	6	

Study targets: Learning the basics of modern biodiversity research. Experiencing field research and understanding principles of living communities *in natura*. Competent scientific and political discussion of conservation management. Transfer of reality (field) data to presentation format.

Course contents:
Field work:
Real practice in identification and interpretation of (a) species communities (diversities and abundances) in the field, and (b) conservation units and its problems in unique European Nature Reserves (e.g. Crau, Camargue, Alpilles, Mediteranian Basin in Southern France)
Seminar:
Introduction to the biotope ecology of the study habitat. Biology and ecology of selected animal groups. Modern genetic techniques for diversity assessment.

Admissions requirements/recommended previous knowledge:
Knowledge of B.Sc. modules: Zoological Systematics and Species Knowledge, Functional Morphology of Animals.

Basic literature:
WILSON, E.O. & E. OSBORNE: The Diversity of Life
HOBOHM, C.: Biodiversität
BEGON, M., J.L. HARPER & C.R. TOWNSEND: Ecology

Didactic aids:.
Live samples in the field, instruments for field ecologists, special literature.

Exam requirements:
Knowledge of material experienced in field work and taught in seminar. Scientific presentation of observations.

Time and effort involved in studying (in hours)**:** 180
1. Presence during studies 60 h
2. Self-study 120 h
Max. Participants: 6

Name of module	Molecular systematics and conservation genetics/genomics	2102
No. of semester	2	
Lecturers	Heike Hadrys	
Kind of course/SWS	Practical course (4 SWS), seminar (1 SWS)	
Study performance	Regular attendance, written report	
Exam performance	Examined oral presentation (colloquium, 100%)	
ECTS-CP	6	

Study targets: Application of state-of-the-art techniques in conservation biology. Computer-based tree building. Defining conservation units. Transfer of new scientific data to presentation format.

Course contents:

Lab work:
Molecular genetic techniques for biodiversity assessment, species identification, speciation, and phylogeography. DNA-barcoding technique for integrative taxonomies and detection of conservation units. Cutting edge scientific studies on dragonflies, placozoans, and hydrozoans

Seminar:
Principles of modern evolutionary concepts, phylogenetics(omics), population genetics and - genomics
Biology and ecology of selected animal groups.
Modern genetic/genomic techniques for biodiversity assessment.
Recent examples published in high profile journals.

Admissions requirements/recommended previous knowledge:
Knowledge of B.Sc. modules: Zoological Systematics and Species Knowledge, Functional Morphology of Animals, Introduction to Methods in Molecular Genetics.

Basic literature:
RIDLEY: Evolutionsbiologie
DeSALLE & SCHIERWATER: Molecular Ecology and Evolution

Didactic aids:
recent bioinformatics software

Exam requirements:
Data analysis and preparation of a scientific talk (15 min) in English

Time and effort involved in studying (in hours): 180

1. Presence during studies	52,5 h
2. Self-study	127,5 h
Max. Participants:	3

Name of module	Evolutionary Genetics	2103
No. of semester	2	
Lecturers	Bernd Schierwater, Heike Hadrys, Kai Kamm	
Kind of course/SWS	Practical course (4 SWS), seminar (1 SWS)	
Study performance	Regular attendance, written report	
Exam performance	Examined oral presentation (colloquium, 100%)	
ECTS-CP	6	

Study targets: Understanding the basics of modern evolutionary biology. Application of the right molecular techniques to answer a specific question. evolutionary biology. Learning how to present complex genetic data meaningful.

Course contents:

Lab work:

Modern evolutionary biologists extract more and more useful information from genome data. The fields of systematics, developmental evolution and speciation could no longer exist without molecular genetic comparisons. Surprisingly the set of genetic tools is small compared to the width of possible applications. The genetic tools constantly improve at high speed. We will learn applications of the latest tools to recent questions.

Seminar:

As an addition to the lab work we will (i) discuss the theoretical backgrounds of methods, (ii) illustrate current and future research issues, (iii) learn how to prepare a scientific paper.

Admissions requirements/recommended previous knowledge:

Knowledge of B.Sc. modules: Zoological Systematics and Species Knowledge, Functional Morphology of Animals, Introduction to Methods in Molecular Genetics.

Basic literature:

RIDLEY: Evolutionsbiologie

Didactic aids:

Computer based analyses, live animal observations

Exam requirements:

Data analysis and preparation of a scientific talk (15 min) or scientific paper (4 pages) in English.

Time and effort involved in studying (in hours)**:** 180

1. Presence during studies	52,5 h
2. Self-study	127,5 h
Max. Participants:	3

Name of module	Gravtitation biology: cancer genetics in space	2104
Main subject area/ topic	1+2	
No. of semester	2	
Lecturers	Bernd Schierwater, Jens Hauslage, NN	
Kind of course/SWS	Practical course (4 SWS), seminar (1 SWS)	
Study performance	Regular attendance, written report	
Exam performance	Examined oral presentation (colloquium, 100%)	
ECTS-CP	6	

Study targets: Recognition and formulation of scientific questions in developmental genetics and gravitational biology. Understanding the concept of evolution of development (EvoDeo) research. Basic overview about methods in the field of gravitational biology and understanding of evolutionary developments and basal mechanisms in graviperception. Application of classic organismal observation and modern molecular tools. Learning how to present complex genetic and developmental data meaningful.

Course contents:

Lab work:

Molecular genetic studies on regulatory genes in basal metazoa. Use of modern molecular genetic methods, especially gene knock down via RNA-Interferencing & Morpholino-oligos, in-situ hybridisations. Introduction in ground based experiments to generate functional weightlessness (Clinostats).

Seminar:

Topics and methods in modern Evodevo research and gravitational biology.

Admissions requirements/recommended previous knowledge:

Knowledge of B.Sc. modules: Zoological Systematics and Species Knowledge, Functional Morphology of Animals, Introduction to Methods in Molecular Genetics.

Basic literature:

MÜLLER: Evolutionsbiologie

DEUTSCH: Hox-genes: Studies from the 20th to the 21st century.

Didactic aids:

state-of-the-art technologies and hardware

Exam requirements:

Data analysis and preparation of a scientific talk (15 min) or scientific paper (4 pages) in English.

Time and effort involved in studying (in hours)**:** 180

1. Presence during studies	52,5 h
2. Self-study	27,5 h
Max. Participants:	3

Name of module	Double Module: Molecular Ecology – Mini Thesis	2105
No. of semester	2	
Lecturers	Bernd Schierwater, Heike Hadrys	
Kind of course/SWS	Field & Lab Work & (8 SWS), seminar (2 SWS)	
Study performance	Regular attendance, written report	
Exam performance	Graded written report (Mini- Masterthesis, 5-8 pages, 100%)	
ECTS-CP	12	

Study targets: Learning the basics of modern biodiversity research. Experiencing field research and understanding principles of living communities *in natura*. Competent scientific and political discussion of conservation management in the era of climate change.
In the end the students shall learn the principals of scientific research through their own little project: (i) Finding an issue, (ii) formulating a working hypothesis, (iii) creating the experimental design, (iv) collecting samples and conducting experiments, (v) evaluate and discuss results, (vi) write mini-thesis.

Course contents:
Field Work (1. - 2. week):
On-site practice in identification and interpretation of (a) species communities (diversities and abundancies) in the field, and (b) conservation units in unique European Nature Reserves (e.g. Crau, Camargue, Alpilles, Mediteranian Basin in Southern France). Outlining an experimental design and collecting of material and tissue samples for genetic research in the laboratory.
Laboratory-Work (3. - 5. week):
DNA and RNA isolations, cDNA synthesis, DNA sequencing, and microsatellite analyses. Using selected animal groups (dragonflies, other insects, marine invertebrates) modern questions in molecular ecology will be addressed (e.g. evolution of mating systems, conservation unit detection, biodiversity patterns). Latest bioinformatics tools facilitate analyses.
Especially the technique of modern barcoding, from the isolation and sequencing of specific mitochondrial target genes, to the computer based generation of character-based barcodes, e.g. from odonates, will be the focus.
Mini-Thesis (6. week):
Writing of a Mini- Masterthesis using the basic principles of a scientific publication, that contain the generated datasets in 5 to 8 pages.
Seminar: (i) Introduction to the habitats where field samples are taken. Biology and ecology of the animal families that the research focuses on. Modern methods to measure diversity on the genetic level. (ii) The theoretical basics of barcoding will be acquired through case studies on recent scientific research. The possible multiple biological and medical applications will be critically discussed.

Admissions requirements/recommended previous knowledge:
Knowledge of B.Sc. modules: Zoological Systematics and Species Knowledge, Functional Morphology of Animals, Introduction to Methods in Molecular Genetics.
Knowledge of the modules “Developmental Genetics” and “Molecular Systematics and species Conservation”

Basic literature:
RACH et al. (2008): Character-based DNA barcoding allows discrimination of genera, species and populations in Odonata.
CORBET: Dragonflies - Behaviour and Ecology of Odonata.
WILSON, E.O. & E. OSBORNE: The Diversity of Life.
HOBOHM, C.: Biodiversität
BEGON, M., J.L. HARPER & C.R. TOWNSEND: Ecology
HILBERS D.: The nature guide to the Camargue, la Crau and les Alpilles

Didactic aids:
Molecular genetic DNA-Lab., modern hardware for computer-aided DNA-Analysis, CAOS-interface, experimental setup for ecological field work, handouts, videos, group discussions, Powerpoint presentations from lecturers as well as students.

Exam requirements:
Knowledge of the topics from field work and seminars. Independent preparation of a scientific presentation, evaluation of generated datasets as well as writing a report (mini thesis, 5-8 pages) using the basic principles of a scientific publication.

Time and effort involved in studying (in hours)**:** 360
1. Presence during studies 120 h
2. Self-study 240 h
Max. Participants: 3

Name of module	Module: Tropical Wildlife Biology: Model region Neotropics – Costa Rica	2109
No. of semester	2	
Lecturers	Heike Pröhl, Sabine Schmidt	
Kind of course/SWS	Lecture (1SWS), seminar (2 SWS), field course (3 SWS)	
Study performance	Regular attendance, implementation of a small-scale research project, three oral presentations, written project report	
Exam performance	Oral presentations (50%), performance of field project and written project report (50%)	
ECTS-CP	6 (2. semester)	

Study targets (Learning outcome):
The students will learn how…

- to organise and implement a research project in an international team using English as lingua franca
- to specify research questions and put forth hypotheses
- to implement research questions in goal-directed field research
- to assess and quantify tropical biodiversity and abundance using taxon–specific methods
- to catch, handle, apply identification markers, perform morphological measurements on, and identify tropical vertebrates
- to take and conserve non-invasive tissue samples for genetic, endocrinological or parasitological projects
- to use current bioacoustic and videographic tools
- to perform ecological and behavioural experiments in the field and /or a field lab
- to systematically obtain quantitative data under field conditions
- to conduct relevant graphical and statistical analyses
- to relate research concepts with own data, and to discuss them critically in oral presentations and the project report
- to reflect their own cultural norms and competences in an intercultural context

Course contents:
Lecture and seminar: Introduction to the history and culture of the guest country, as well as to its natural history and conservation efforts; overview of relevant vertebrate biodiversity; introduction to the relevant techniques and animal models used in the course; discussion of research projects before implementation; presentation and discussion of project results.
Field course: Scientific work in an international setup while implementing a research project on bioacoustics, echolocation, social behaviour, acoustic communication, or ecology, in the field, or in a field lab. The students use state of the art techniques to determine the diversity and abundance of vertebrate taxa, relevant methods of capture and marking, morphometry, behavioural observation including videography, audio recording and playback. They will develop and implement a scientific experiment under field conditions, perform project relevant data analysis and statistics which involves training on special software, defend their results orally and write a scientifically founded report.

Admissions requirements/recommended previous knowledge: successful participation in the "Lecture Biodiversity/Behaviour/Evolution" (semester 1)

Basic Literature:
Garrigues & Dean: The Birds of Costa Rica
Laval & Rodrigues: Murciélagos de Costa Rica – Bats
Martin/Bateson: Measuring Behaviour – an introductory guide
Savage: The Amphibians and Reptiles of Costa Rica
Wainwright: The Mammals of Costa Rica
Original publications relevant for the respective projects, as arranged with lecturers

Didactic aids:
project-related equipment and special software, powerpoint presentations of lecturers (lecture) and students (seminar), flip-chart, animated graphics, video film sequences, group discussions, hand-outs

Exam requirements: regular attendance and performance in the research project; powerpoint seminar presentations, written project report

Time and effort involved in studying (in hours): 180
1. Presence during studies: 80 h
2. Self-study: 100 h
Max. Participants: 1

Name of module	Tropical Wildlife Biology: Model region: Madagascar	2110
No. of semester	2	
Lecturers	Ute Radespiel	
Kind of course/SWS	Lecture (1SWS), seminar (2 SWS), field course (3 SWS)	
Study performance	Regular attendance, implementation of a small-scale research project, three oral presentations, written research report	
Exam performance	Oral presentations (30%), performance of field project and written research report (70%)	
ECTS-CP	6	

Study targets (Learning outcome):

The students learn…

- How to organise research and implement a research project in an international project team using English
- How to specify research questions and develop hypotheses
- How to implement research questions in goal-orientated field research
- How to assess and quantify tropical biodiversity and abundance taxon-specifically
- How to catch and handle tropical wildlife (especially small mammals) and perform morphological measurements
- How to mark and identify animals
- How to take and conserve non-invasive tissue samples for genetic, endocrinological or parasitological projects
- How to use current videografic tools to quantify behaviour
- How to apply GPS-based radiotelemetric techniques to assess spatio-temporal, feeding cognitive, communication or social behaviors
- How to perform ecological and behavioral experiments in the field/or field lab
- How to systematically obtain quantitative data under field conditions
- How to conduct graphical and statistical analysis of quantitative data
- How to relate research concepts to own data and discuss them critically by oral presentations and the project report
- How to improve presentation skills in English
- to reflect their own cultural norms and competences in an intercultural context

Course contents:

Lecture and seminar with the help of modern presentation techniques**:** Introduction to the history and culture of the respective country; the respective natural history and conservation biology; the biodiversity, ecoethology and evolution of tropical model groups; theoretical introduction into the respective field methods**,** discussion of research projects before implementation, presentation and critical discussion of project results

Field course: Scientific work on small-scale field research projects with modern techniques: GPS-based radiotelemetry to assess spatio-temporal, feeding, cognitive, or social behaviours; focal animal sampling techniques, survey and census techniques/ capture-recapture techniques to assess demography/abundance of populations/ diversity of communities; handling; health evaluation and biological sampling techniques; morphometry; collection and storage of non-invasive samples for further hormonal, parasitological and genetic analysis; photography and videography for field researchers; statistical analysis of field data; oral presentation and defense of research project, preparation of written field research report

Admissions requirements/recommended previous knowledge: successful participation in the “Lecture Biodiversity/Behaviour/Evolution (semester 1)
FELASA course is necessary

Basic Literature:

Engel: Signifikante Schule der schlichten Statistik
Huffmann/Chapman: Primate Parasite Ecology
Krebs: Ecological methodology
Magurran: Measuring Biological Diversity
Martin/Bateson: Measuring Behaviour – an introductory guide
Setchell/Curtis: Field & Lab methods in Primatology
Sutherland (Ed.): Ecological Census Techniques

Didactic aids:

Equipment for GPS-based radiotelemetry, focal animal sampling, survey and census techniques, videometry, photography, morphometry, analytical software packages, powerpoint presentations of lecturers (lecture) and students (seminar), flip-chart, animated graphics, video film sequences, group discussions, hand-outs

Exam requirements: powerpoint seminar presentations, regular attendance, performance of field research project, written field research report

Time and effort involved in studying (in hours): 180	
1. Presence during studies:	80 h
2. Self-study:	100 h
Max. Participants:	1

Name of module	Double Module: Experimental & developmental biology of marine model organisms	2111
Main subject area/topic	1 + 2	
No. of semester	2	
Lectures	Bernd Schierwater, NN	
Kind of course/SWS	Practical course (8 SWS), seminar (2 SWS)	
Study performance	Regular attendance & participation, protocols	
Exam performance	Participation/Journal club/exam (50%), final report (50%)	
ECTS-CP	6	

Aim of the course

The aim is to present and discuss modern experimental and scientific approaches used for basic and applied research on marine organisms. Students will be actively involved in practical lab work. They will also participate to discussions and debates on selected topics from newly published scientific articles.

Project Description:

The Schmid Training Course is part of the Master Course Programmes of Sorbonne University (France), University of Salento (Italy) and University of Fribourg (Switzerland). The course is open to master interested in marine organisms development, molecular studies and evolution.

COURSE TOPICS:

Model organisms:

- Acoela
- Cephalochordata
- Chondrichthyes
- Brown algae
- Echinodermata
- Urochordata
- Porifera
- Annelida
- Cnidaria
- Crustacea
- Placozoa

For each model:

Life cycle, Anatomy, Embryogenesis, Evolution, Evolutionary developmental biology (Evo-Devo), Tissue and Organ Regeneration, Genetic networks and genomic data, Behaviour - Neuroscience, Cell biology, Cellular morphogenesis, Functional approaches, Tools for molecular and cellular analyses

Basic literature

- Invertebrate Zoology: A Functional Evolutionary Approach [Hardcover] Edward E. Ruppert, Richard S. Fox and Robert D. Barnes
- Westheide, W. & R. Rieger (Hrsg.): Spezielle Zoologie, Gustav Fischer Verlag

Didactic aids

Microscopes, computers, software for phylogenetic analyses, examination of living animals.

Requirements

Participation to the course requires knowledge of fundamental principles of molecular biology and developmental genetics. Knowledge in metazoan phylogeny and evolution is also desirable.

Time and effort involved in studying (in hours): 180

1. Presence during studies: 60 h
2. Self-study: 120 h

Max. Participants: 3

Name of module	Basics of terrestrial wildlife research	2113
No. of semester	2	
Lecturers	Ursula Siebert, Oliver Keuling, Ulrich Voigt, Friederike Gethöffer (contact: Oliver Keuling)	
Kind of course/SWS	seminar (1 SWS), practical course (4 SWS)	
Study performance	Regular attendance, written report, oral presentation	
Exam performance	Examined oral presentation (colloquium), attendance, report (each 1/3)	
ECTS-CP	6	

Study targets:. Students will learn,…

- basic knowledge of native game animals
- basics of terrestrial wildlife research, wildlife management and hunting
- How to work in a project team and how to organise work
– How to set up, design and conduct experiments in wildlife research
– How to specify research questions, put forth hypotheses and to write a project proposal
– How to apply current methods of wildlife research and how to take further data for additional questions (e.g. tissue samples)
– How to conduct graphical and statistical analysis of quantitative data
– How to write a final report, to assess and present scientific results and to improve presentation skills

Course contents:

Seminar: Overview about relevant Vertebratentaxa; introduction to the relevant field-biological methods and the animal models used in the course; discussion of the project plans before her realisation; presentation and critical discussion of the project results.

Practical course: Scientific work for the realisation of research projects in the field by means of modern technologies to space use and habitat use, social behaviour, food ecology and reproduction of wildlife. The students use current technologies, e.g. density estimation, radiotelemetry, capture and mark methods, analysis of foto- and videotrap data. They develop a scientific question, they carry out, the data analyse under use of special software relevant for project and statistical methods, her results defend in a verbal presentation and write an academically sound report.

Excursions to illustrate learning contents

Admissions requirements/recommended previous knowledge:

Preliminary briefing, basic knowledge in statistics and GIS

Basic literature:

Köhler et al.: Biostatistik; Borchers et al.: Estimating animal abundance; Silvy: The Wildlife Techniques Manual; Schoolbook for hunters to get basic knowledge of native game species (e.g. Krebs, Blase, Schultz, Seibt…)

Advanced literature will be part of the module, all literature available in the ITAW

Didactic aids:

Specific equipment, software, and literature; Powerpoint presentations of lectureres and students; group discussions; handouts

Exam requirements:

Examined report, examined oral presentation, attendance, conduction of own data-examination^^

Time and effort involved in studying (in hours)**:** 180

1. Presence during studies	80 h
2. Self-study:	100 h
Max. Participants:	8

Name of module	Cognitive Ethology and Bioacoustics	2114
No. of semester	2	
Lecturer	Martina Scheumann	
Kind of course/SWS	Lab course in small groups (5 SWS)	
Study performance	Regular attendance, accomplishment of a scientific report	
Exam performance	Analysis and critical evaluation of data, scientific report (100%)	
ECTS-CP	6	

Study targets (Learning outcome):
The students learn how to perform hypothesis-driven research in the field of bioacoustics. This includes:

- animal identification techniques
- bioacoustics data collection and analysis
- statistical and graphical analysis of quantitative data
- critically evaluation and presentation of scientific results
- writing a final scientific report

Course contents:
Introduction in:

- quantitative acquisition of bioacoustic data (What is the correct equipment!),
- evaluation and measurement of bioacoustic data using different software programs (scanning: Audacity, DeepSqueak; semi-automated acoustic analysis: PRAAT)
- modern statistical methods for the evaluation of bioacoustic data sets (visualization, discriminant analysis, supervised and unsupervised cluster analysis, machine learning processes using R and SPSS)
- -Psychoacoustic methods for testing the perception of communication sounds.

Practical Application:

- Quantitative collection of bioacoustic data in the Zoo Hannover or in the animal house
- Application of the learned bioacoustic analysis methods as well as statistical methods to the own data set to test hypotheses.
- Critical evaluation of methodological aspects and the significance of the data sets.

Admissions requirements/recommended previous knowledge: successful participation in the “Lecture Biodiversity/Behaviour/Evolution (semester 1)

Basic Literature:
Fitch: The Evolution of Language
Hopp, Owren & Evans: Animal acoustic communication
Bradbury & Vehrencamp: Principles of animal communication

Didactic aids: observation on living animals, independent recording of animal sounds, PP lectures by the lecturer, introduction to special software for analysing data (Audacity, Praat, DeepSqueak) or for statistical evaluation (R and SPSS); animal voice quiz; student presentations on project-specific results, group discussion

Exam requirements: analysis and critical evaluation of data, written scientific report

Time and effort involved in studying (in hours): 180
1. Presence during studies: 80 h
2. Self-study: 100 h
Max. Participants: 6

Name of module	Behavioural Ecology	2115
Major topic	1	
No. of semester	2	
Lecturers	Ute Radespiel	
Kind of course/SWS	Course (5 SWS)	
Study performance	Regular attendance, scientific report	
Exam performance	Scientific report (100%)	
ECTS-CP	6	

Study targets (Learning outcome):

The students learn…

- how to conceptualize and perform hypothesis-driven research via standardized experiments in Behavioural Ecology
- how to apply modern methods and videografic tools to quantify behaviour
- how to conduct graphical and statistical analysis of quantitative data in behavioural ecology
- how to write a final scientific report
- how to critically assess scientific results and present them appropriately

Course content:

Practical course: modern observation and recording techniques, modern techniques of quantitative behavioural analyses (z.B. OBSERVER, ETHOVISION). The use of biostatistics for the analysis of the collected data and systematic testing of hypotheses.

Admission requirements/recommended previous knowledge:

Successful participation in the lecture series Biodiversity/Behaviour/Evolution (semester 1)

Basic Literature:

Kappeler: Verhaltensbiologie
Setchell/Curtis: Field & Lab Methods in Primatology
Mittermeier et al.: Lemurs of Madagascar
Geissmann: Verhaltensbiologische Forschungsmethoden
Engel: Signifikante Schule der schlichten Statistik

Didactic aids: DNA-lab, analytical and statistical software packages, Camcorder, experimental setup for behavioural experiments, observations on living animals

Exam requirements:

Analyses of the dataset that has been generated or provided. Critical evaluation of the data in a scientific report.

Time and effort involved in studying (in hours): 180 (2. Semester)

1. Presence during studies	80 h
2. Self-study	100 h
Max. Participants:	3

Name of module	Evolutionary Ecology	2116
Emphasis	1	
No. of semester	2	
Lecturer	Heike Pröhl, Ariel Rodriguez	
Kind of course/SWS	Lab course in small groups (5 SWS)	
Study performance	Regular attendance, accomplishment of a scientific report	
Exam performance	Scientific talk (20%), Analysis and critical evaluation of data, scientific report (60%); Collaboration in the project (20%)	
ECTS-CP	6	

Study targets (Learning outcome):
The students will learn:

- How to perform hypothesis-driven research via standardized observations and experiments in the area of Evolutionary Ecology
- How to handle animals, mark and (re-)identify them
- How to observe and register animal behaviour
- How to use bioacoustic and spectrometric equipment
- How to design and perform ecological experiments
- How to manage, save and analyze scientific data with statistical tools
- How to present, interpret and critically evaluate scientific data
- How to write a scientific paper

Course contents::
Practical course: Application of state-of-the-art techniques for hypothesis-driven data generation and analysis in Evolutionary Ecology (project dependent, e.g. bioacoustics, spectrometry, standardized photography, observation of behavior and adaptation, ecological experiments); application of bioacoustics (Avisoft, Batsound, Soundruler) and biostatistics methods (Statistica, R, OceanView, Visual modelling, Pavo, MicaToolbox) for analyzing ecological and evolutionary data and test hypotheses

Admissions requirements/recommended previous knowledge: successful participation in the Lecture "Biodiversity/Behaviour/Evolution" (semester 1)

Basic Literature:
Westneat: Evolutionary Behavioral Ecology
Mayhew: Discovering Evolutionary Ecology: Bringing Together Ecology and Evolution
Wells: Ecology and Behaviour of Amphibians
Geissmann: Verhaltensbiologische Forschungsmethoden
Krebs: Ecological Methodology
www.empiricalimaging.com micaToolbox

Didactic aids: Observation and measurement of animals, molecular lab, spectrometer and optic fibers, bioacoustic setup, devices for ecological and ethological tests, analytical software packages

Exam requirements:
Analysis and critical evaluation of data, written scientific report

Time and effort involved in studying (in hours): 180 h

1. Presence during studies:	80 h
2. Self-study	100 h
Max. Participants:	4

Name of module	**Functional Genomics**	**2117**
Topic	1	
No. of semester	2	
Lecturers	Julia Metzger	
Kind of course/SWS	Seminar (1 SWS), Praktikum (4 SWS)	
Study performance	Regelmäßige Teilnahme und Eigenstudium	
Exam performance	Mitarbeit im Praktikum (50%), Protokoll & Präsentation (50%)	
ECTS-CP	6	

Study targets:
The students will learn the basics about functional genomics (genome, transcriptome, epigenome). This includes learning methods for sampling, conservation of cells/tissues, isolation of high-quality DNA/RNA, preparation of libraries, high throughput sequencing and evaluation of data. We provide an overview of the complex interrelations of genome, transcriptome and epigenome to facilitate a first step into this research field. This includes leaning to present and discuss scientific results.

Course contents:
Seminar:
Basics for functional genomics from sampling, preparation, sequencing to data evaluation; Introduction to the most important methods; Basic knowledge about genome sequencers; How to make protocols; Examples in the lab

Lab work:
Introduction to appropriate lab methods for functional genomics. The students have the opportunity to follow experienced co-workers in the lab and work on their own project parts. Based on these methods, the sutdents are supposed to prepare a protocol and present their results.

Admissions requirements/recommended previous knowledge:
Successful participation in the leacture: „Evolution, Biodiversity and Behaviour in Genetics“.

Basic literature:
Kaufmann, Klinger: Functional Genomics, Methods and Protocols, Springer Verlag
Cornel Mülhardt: Der Experimentator: Molekularbiologie / Genomics, Springer Spektrum (Verlag)
Strachan, Read: Molekulare Humangenetik, Spektrum Verlag

Didactic aids:
Lab protocols, Publications

Exam requirements:
Knowledge and understanding oft he presented methods and protocols; Report.

Time and effort involved in studying (in hours)**:** 180

1. Presence during studies	60 h
2. Self-study	120 h
Max. Teiln.:	3

Name of module	Basics of aquatic wildlife research	2118
No. of semester	**2**	
Lecturers	**Ursula Siebert, Maria Morell, Stephanie Groβ, Bianca Unger, Eileen Heβe** (Contact: Maria Morell/Stephanie Groβ)	
Kind of course/SWS	**Practical exercise (4 SWS), seminar (1 SWS)**	
Study performance	**Regular attendance, project protocol, oral presentation**	
Exam performance	**Active participation and project protocol (50%), examined oral presentation (colloquium, 50%)**	
ECTS-CP	**6**	

Study targets: the students will increase their knowledge on:

native marine mammal species

- marine mammal anatomy and physiology including hands-on in a marine mammal necropsy
- hearing and effects of noise on aquatic organisms including the assessment of hearing impairment
-microplastic burden and detection of microplastic in marine mammals
- spatial usage and behaviour via telemetry data of marine mammals
- diet of marine mammals via stomach content analysis (own project) including cleaning process of the stomach content, identifying prey species via hard part analysis and calculation of the ingested biomass
- how to set up, design and conduct their own experiments in wildlife research
- how to assess and present scientific results and to improve presentation skills

Course contents:

- Seminar: marine mammal anatomy and physiology, hearing and effects of noise on aquatic organisms, microplastics, telemetry, diet analyses

- Practical course: participate in a marine mammal necropsy, stomach collection and dietary analysis (own project). Participate in experiments of telemetry, microplastics and ear analysis. Usage of stereo and fluorescence microscopy.

Admissions requirements/recommended previous knowledge:

Preliminary personal briefing; laboratory experience preferable

Basic literature:

https://otoliths-northsea.linnaeus.naturalis.nl/linnaeus_ng/app/views/introduction/topic.php?id=3327&epi=87

All needed literature is available in the ITAW or online.

Didactic aids:

Necropsy and sampling of deceased wildlife; boat trip for acoustic device replacement and maintenance; stereo and fluorescence microscopes; practical training of radio telemetry; trials data recording with different telemetry tag types; specific software and literature; PowerPoint presentations; group discussions;

Exam requirements:

Examined oral presentation, attendance, conduction of own data-examination (project protocol)

Time and effort involved in studying (in hours)**:** 180

1. Presence during studies 80 h
2. Self-study 100 h

Max. participants: 10

The course will take place in Büsum. Accommodation will be provided.

2nd Main Topic:
Cellular, development and system neurobiology

Name of module	**Cellular Neurophysiology**	**2201**
No. of semester	2	
Lecturers	Felix Felmy, Nikolaos Kladisios	
Kind of course/SWS	Lecture (1SWS), Practical field course (4 SWS)	
Study performance	Regular attendance, and self-study	
Exam performance	Practical course (70%), protocol (20%) and oral presentation (10%)	
ECTS-CP	6	

Study targets:
Acquiring scientific background knowledge
Experimental procedures
Independent data acquisition, documentation and analysis
Presentation and discussion of experimental results

Course contents:

Lecture: Topics related to cellular neurophysiology with focus on synaptic synapses, ion channels, action potential generation and coding of neuronal information.

Practical course: The biophysical description of membrane potentials and currents by the electrophysiological characterisation of sub- and supra-threshold responses of neurons in the acute brain slice preparation. Learn to prepare acute brain slices from small mammals, patch clamp recordings and electrophysiological data analysis.

Written protocol: The protocol should be written in English and oriented on the style of scientific writing.

Oral presentations: Presentations should be delivered in English and are regarded as practice of scientific presentation and discussion.

The practical course is limited to four students.

Admissions requirements/recommended previous knowledge:

Successful participation of the lecture: “Zell-, Entwicklungs- und Neurobiolgie”. The previous successful participation of the animal welfare course is recommended, but not mandatory.

Basic literature:

Kandel, Schwarz, Jessel: Principles of Neural Science (Part II & III)
Bear, Conners, Paradiso: Neuroscience, exploring the brain (Part I)

Didactic aids:

Script of the lecture, specific literature, software for data acquisition and analysis

Exam requirements:

Knowledge about cellular neurophysiology and membrane biophysics

Time and effort involved in studying (in hours)**:** 180

1. Presence during studies	70 h
2. Self-study	110 h
Max. Participants:	4

Name of module	Neuro- and sensory biology	2202
Topic	2	
No. of semester	2	
Lecturers	Karl-Heinz Esser, Sabine Schmidt	
Kind of course/SWS	practical course, seminar (2 SWS), lecture (1 SWS)	
Achievements in studies	regular attendance, seminar presentation	
Exam performance	examined oral presentation (50%), written final report (50%)	
ECTS-CP	6 (for topic 1 or 2)	

Study targets:
to learn how to design a scientific study and how to formulate hypotheses
to conduct a hypothesis-guided small research project in a group of 2 or 3 students; each team works on a project of its own which will be presented to, and discussed with, the other teams
to perform self-responsible data collection and analysis for the project
to learn cross-project presentation, discussion, and defence of scientific results
to learn how to write a scientific report following the standards for a master thesis and for publication in peer-reviewed journals

Course contents:

Practical course:
Electrophysiological and/or behavioural characterisation of sensory systems in different vertebrate models (bats, electric fish); usage of sensory systems (visual, acoustical, and/or electric displays) in echo- and electrolocation for orientation in space and for communication in the respective model species society

Methods:
Digital grabbing, conditioning and analysis of bioelectric signals, e.g. by oscillograms, power spectra and sonagrams; construction of a “fish detector” for weakly electric fish based on EOD(electric -organ discharge)-detection; insights (via lab simulations/ video materials) in corresponding field studies
Computer-based signal grabbing, processing and quantitative analyses of bat behaviour, e.g. videography and video analysis, ultrasound recordings (lab, or field), sound analysis, social network analysis

Seminar:
Presentation of state-of-the-art research papers on neurobiology and sensory biology topics relevant for the projects of the teams; defence (presentation and discussion) of own data from the practical course.

Lecture:
Project-related fundamentals of sensory/neuro-biology; in-depth discussion of selected topics

Admissions requirements/recommended previous knowledge:
Successful participation in the modules (lectures) “Biodiversity, Behaviour and Evolution” and “Cell, Developmental and Neurobiology”

Basic Literature:
Adams RA, Pedersen SC (2013) Bat evolution, ecology and conservation, Springer, New York, Heidelberg, Dordrecht, London
Fenton MB, Grinnell AD, Popper AN, Fay RR (2016) Bat bioacoustics conservation, Springer, New York
Moller, P. (letzte Auflage) Electric Fishes: History and behaviour, Chapman & Hall, London
Carlson B.A. (2019) Electroreception: Fundamental Insights from Comparative Approaches (Springer Handbook of Auditory Research, 70); Springer, New York

Didactic aids:
internet/ data bases, powerpoint presentations, animated graphics, video film sequences, group discussions, hand-outs

Exam requirements: powerpoint seminar presentation, written final report

Time and effort involved in studying (in hours): 180

1. Presence during studies	60 h
2. Self-study	120 h
Max. Participants:	6

Name of module	**Neuropharmacology**	**2204**
No. of semester	2	
Lecturers	Gernert, Feja, Gericke	
Kind of course/SWS	Lecture (1/2 SWS), Seminar (1/2 SWS), Practical course (5 SWS)	
Achievements in studies	Regular attendance	
Exam performance	Performance during course, Talk (50 % each)	
ECTS-CP	6	

Study targets:
Development of experimental designs and protocols
Ability to transfer academic problems into practicable methods
Analysis and documentation of results
Application of presentation techniques and the ability to present data according to a target audience
Capacity for organization and teamwork

Course contents:
Lecture:
Theoretical background of the experiment to be performed
Practical course:
In vivo:
Handling of small laboratory animals including injections (rats)
Tests in behavioural pharmacology
Pharmacological efficacy study
Ex vivo:
Development of experimental designs
Cell culture/Molecular biology
Histological investigations
Pharmacokinetic investigations
Seminar:
Presentation of an experiment including introduction, methods and results

Admission requirements/recommended backround:
Basic understanding of neurobiology (e.g., relevant modules for the bachelor degree)

Choice of basic literature:
Kandel ER, et al. (2021) Principles of Neural Science, 6th Edition, McGraw-Hill
Ritter J, et al. (2018) Pharmacology, 9th Edition, Elsevier

Didactic aids:
Handouts, graphic and statistic software, PowerPoint, literature

Exam requirements:
Knowledge of general and specific pharmacology
Presentation of scientific data

Time and effort involved in studying (in hours): 180
1. Presence during studies 80 h
2. Self-study 100 h
Max. Participants: 4

Name of module	**Physiology of the gastrointestinal tract**	**2205**
No. of semester	2	
Lecturers	Melanie Brede, Kristin Elfers, Pascal Hoffmann, Gemma Mazzuoli-Weber, Alexandra Muscher-Banse	
Kind of course/SWS	Lecture (1 SWS), Seminar (0.5 SWS), Practical course (3.5 SWS)	
Achievements in studies	regular attendance, seminar presentation	
Exam performance	Oral presentation (50 %), lab protocol (50 %)	
ECTS-CP	6	

Learning skills:
Physiology of gastrointestinal tract (GIT), characterization of epithelial, cellular and membrane transport processes by molecular biological and functional studies

Topics:

Lecture

Physiology of GIT

- Morphology of GIT, function of smooth muscle
- Enteric nervous system and innervations of gut
- Motility of GIT: contractions, passage of chymus and retention time
- Function of stomach: regulation of gastric secretion
- Function of small and large intestines: receptors; second messenger cascades; transporters, ATPases and channels

Seminar

Reading, understanding and presenting of ongoing research papers related to the topics of lecture with a main focus on regulatory mechanisms of nutrient transport

Practical course (potential contents)

Measurement of gastrointestinal motility
Characterization of epithelial nutrient transport processes (Ussing chamber)
Characterization of nutrient transport across the apical or basolateral membrane in isolated membrane vesicles (isolation of membranes by precipitation and centrifugation, rapid filtration technique to study nutrient uptake radioactively)
Molecular biological determination of nutrient transporter expression
Characterization of nutrient sensing mechanisms

Admission requirements/ recommended skills

Elementary knowledge in physiology, biochemistry and/or cell biology

Background literature:

v. Engelhardt, Breves: Physiologie der Haustiere, Schmidt, Lang, Thews: Physiologie des Menschen, Eckert: Tierphysiologie

Learning tools:

Handouts of lectures, copies of papers, lab protocols and experimental work plans

Required skills for final examination: Knowledge about the topics of lectures and seminars; knowledge about used methods and data analyses

Time load (in hours: 180 h

1. time at the institute:	52.5 h
2. time for self-studying:	127.5 h
Max. Participants:	4

Course/Module	**Pathomechanisms of Protein and Membrane Transport**	**2206**
Semester	2	
Lecturers	Hassan Y. Naim, Dalanda Wanes, Abdullah Hoter	
Course category /SWS	Practical course including lectures	
Study Performance	Regular participation in an ongoing research project in the area of pathobiochemistry of protein and membrane trafficking	
Examination requirements	• Seminar • Laboratory performance	
ECTS-CP	6	

Course targets:

- Practical implementation and expansion of the knowledge gained form the ZEN-lecture on the cellular and membrane trafficking via participating in an ongoing biomedical research project in the Naim laboratory.
- Unravelling cellular and biochemical mechanisms in the pathogenesis of neurological /or gastrointestinal disorders.

Course contents:

- ***Molecular Biology***:
  Site-directed mutagenesis of single nucleotide polymorphisms (SNPs) in cDNAs encoding lysosomal or intestinal proteins
- ***Cell Biology***:
  - Cell culture of mammalian cells
  - Transfection of cDNAs of wild type and mutant proteins into mammalian cells
  - Intracellular localization of expressed wild type and mutant proteins by immunofluorescence using confocal laser microscopy (***Q****: is altered localization indicative of potential pathogenicity*?)
- ***Biochemistry:***
  - Structural and functional analyses of wild type and mutant proteins (enzyme activity measurements and enzyme kinetics, Western blots) (***Q****: is reduced function indicative of potential pathogenicity*?)
  - Assessment of the glycosylation patterns of the mutant versus the wild type proteins as a criterion for trafficking competence and maturation (ER/ Golgi/Lysosome or ER/Golgi/cell surface) (***Q****: is altered glycosylation indicative of potential pathogenicity*?)
  - Separation of cellular compartments (ER, Golgi, lysosomes)
  - Analysis of protein folding (***Q****: is altered folding indicative of potential pathogenicity*?)
  - Isolation of membrane microdomains or lipid rafts (***Q****: is altered association with lipid rafts indicative of potential pathogenicity*?)

Admission requirements/recommended previous knowledge:
Successful participation in the course 1201

Appropriate literature:

- Alberts et al.: Molecular Biology of the Cell, Wiley-VCH
- Lodish et al.: Molecular Cell Biology
- Publications relevant to the topic

Didactic support:
Course script; Participation in the laboratory meetings; discussions within the group; frequent Q/A's.

Examination requirements
Active daily participation in the research project; knowledge in the biochemistry and molecular biology of the cell; technical skills in proteinbiochemitsry and cellular biology; presentation of scientific data

Anticipated entire time required to cover the aims of the module: 180 hours

Participation in the laboratory work: 90 hours
Self-study : 90 hours
Participants: 4 students

Name of module	Cellular Infection Biochemistry	2207
No. of semester	2	
Lecturers	Maren von Köckritz-Blickwede, Timo Henneck Marita Meurer, Marta Bonilla Gonzalez, Ahmed Mohamed	
Kind of course/SWS	lecture (1 SWS), seminar (4 SWS), practical course	
Achievements in studies	regular attendance	
Exam performance	50% lab protocol, 50% oral presentation	
ECTS-CP	6	

Study targets:
Methods in Biochemistry, Microbiology and primary cell culture; critical planning of experiments for studying host-pathogen interaction; knowledge on biochemical processes of host-pathogen interactions,

Course contents:
Lecture;
Isolation and cultivation of primary cells, handling of bacteria;
Biochemical detection of activation of cells after contact to pathogens;
Basics in fluorescence microscopy
Mechanisms of cell death
Presentation of actual publications by students, discussion about actual science

Admissions requirements/recommended previous knowledge:
Lecture in Cell, Developmental, and Neurobiology

Basic Literature:
Alberts et al.: Molekularbiologie der Zelle, Wiley-VCH
Lodish et al.: Molekulare Zellbiologie, Spektrum Akademischer Verlag
Hacker/Heesemann: Molekulare Infektionsbiologie, Spektrum Akademischer Verlag

Didactic aids:
hand-outs, experimental work plans

Exam requirements: powerpoint seminar presentation
knowledge on cell biology and cell death, special focus on NET-formation

Time and effort involved in studying (in hours): 180
1. Presence during studies: 52,5 h
2. Self-study: 127,5 h
Max. Participants: 4

Name of module	Methods in reproductive biology	2208
No. of semester	2	
Lecturers	Harriëtte Oldenhof, Harald Sieme (TiHo-REPRO), Willem F. Wolkers (TiHo-NIFE)	
Type of course/SWS	lab course, with introduction lectures and journal clubs	
'Studienleistung'/Achievements	presence and participation, experimental data acquisition and analysis, oral presentation	
Examination	participation, oral presentation, written exam; each 1/3	
ECTS-CP	6	

'Lernziele'/Aims:

- become acquainted with semen processing and evaluation procedures, and factors determining fertility
- learn procedures/methods involved in oocyte collection, in vitro fertilization, and biotechnological aspects/approaches
- obtain insights in gamete preservation strategies, including cryopreservation and freeze-drying, mass and heat transfer
- learn to use a broad range of practical approaches commonly used in reproductive medicine and biology, and understand the rationale behind these approaches
- learn how to critically interpret and discuss obtained experimental data and data presented in journal papers

Course contents:

- semen collection and processing; macroscopic and microscopic evaluation of an ejaculate and sperm quality (equine)
- evaluation of sperm fertilization-associated reactions; (computer assisted) microscopic and flow cytometric analysis of hyperactive sperm motility, acrosome reaction and oocyte binding
- sperm cryopreservation, oocyte vitrification, dry preservation of cells and tissues; mode of action of protective agents, water and solute transport, osmotic responses and membrane permeability
- isolation of epididymal sperm, sperm selection procedures, and assessment of chromatin structure
- oocyte isolation and in vitro maturation, in vitro fertilization (IVF) and culture (IVC); evaluation of developmental stages and blastocyst formation (porcine)
- micromanipulator use for holding oocytes and injecting sperm (ICSI), aspiration

Admissions requirements/recommended previous knowledge:

successful participation in the general lecture series, basic knowledge in reproductive biology

Basic literature:

Molecular biology of the cell (Alberts et al), Human reproductive biology (Jones et al),
Cryopreservation and freeze-drying protocols (Wolkers, Oldenhof)
Künstliche Besamung bei Haus- und Nutztieren (Busch, Waberski)

Didactic aids:

- lab equipment, analysis software, internet literature searches
- 'Skript'/lecture notes with background and protocols, selected scientific papers

Exam requirements, examination:

basic knowledge in reproductive biology, with special emphasis on practical approaches
participation, oral presentation, written exam

Time and effort involved in studying (in hours): 180

1. presence during introducing lectures and lab work: 50 h (i.e. 10 half days of 5 h)
2. self-study: 130 h

min-max. number of participants at REPRO: 2 - 4

Name of module	Neural plasticity in the insect nervous system	2210
No. of semester	2	
Lecturers	Stern	
Kind of course/SWS	Practical course (4 SWS), seminar (1 SWS)	
Study performance	Regular attendance	
Exam performance	Written report (2/3), seminar (1/6), presentation of results (1/6)	
ECTS-CP	6	

Study targets: Planning, performing, evaluation, documentation, and presentation of experiments

Course contents:

Students will perform a small research project on neural plasticity or neuro-immune interactions in the insect nervous system and discuss relevant literature

Methods: microdissection of insects and their brains, preparation of hemocyte cultures, histological techniques, anterograde tracing, immunofluorescence, histochemical techniques, electrophysiology, behavioral assays

Admissions requirements/recommended previous knowledge: Contents of Lecture series on cellular, neuro-, and developmental biology

Basic literature: Heinrich Reichert, Neurobiologie, Thieme Verlag

Didactic aids: course script, scientific literature, power point presentations

Exam requirements: Advanced knowledge of contents of course and seminar

Time and effort involved in studying (in hours)**:** 180

1. Presence during studies 60
2. Self-study 120

Max. Participants: 4

Name of module	**Cellular and Molecular Mechanisms of Cancer Metastasis**	**2213**
No. of semester	2	
Lecturers	Hassan Naim, Marwan El-Sabban (guest lecturer of the American University of Beirut);	
Kind of course/SWS	lecture (1 SWS), seminar (1 SWS), practical course (3 SWS)	
Achievements in studies	regular attendance	
Exam performance	Seminar, laboratory performance	
ECTS-CP	6	

Study targets:

1. Know principles and basic concepts of cancer invasion and metastasis
2. Understand applications of latest development in cancer research techniques
3. Develop critical thinking skills in cancer research

Course contents:

- Cultivation of mammalian cells
- Basics in fluorescence microscopy
- Basics in flow cytometry
- Cancer research techniques
- Presentation and paper discussion

Admissions requirements/recommended previous knowledge:
Lecture in Cell, Developmental, and Neurobiology

Basic Literature:
Mühlhardt: Der Experimentator: Molekularbiologie / Genomics, Spektrum Akademischer Verlag
Alberts et al.: Molekularbiologie der Zelle, Wiley-VCH
Lodish et al.: Molekulare Zellbiologie, Spektrum Akademischer Verlag

Didactic aids:
hand-outs, experimental work plans

Exam requirements: powerpoint seminar presentation
Knowledge of cells and tissues and understanding of the initiation and progression of cancer; Understanding c
culture, microscopy and molecular biological methods

Time and effort involved in studying (in hours): 180

1. Presence during studies:	90 h
2. Self-study:	90 h
Max. Participants:	4

3rd Main Topic: Infection Biology

Name of module	Current methods in virology	2301 (Virology)
No. of semester	2	
Lecturers	Asisa Volz, Sabrina Clever, Christian Meyer zu Natrup	
Kind of course/SWS	Practical course/3 SWS, Lecture/1 SWS, Seminar/1SWS	
Achievements in studies	Regular attendance, protocol, oral presentation	
Exam performance	Participation and protocol (50%), oral presentation with colloquium (50%)	
ECTS-CP	6	

Study targets:
techniques in virology, organization and team work, ability to summarize and present complex subjects to an audience

Course contents:
Lecture e.g.:
current topics in virology, biology & pathology of zoonotic viruses, emerging and zoonotic pathogens, modern approaches in vaccinology, animal models of infectious diseases
Practical course e.g.:
methods in diagnostic virology, preparation of nucleic acids, molecular techniques of viral genome detection, detection of viral proteins (immunofluorescence, Western blot), cloning of viral genes, reverse genetics, expression and purification of viral antigens
Seminar:
oral presentation of methods applied in virology

Admissions requirements/recommended previous knowledge:
knowledge of lecture: Infection biology

Basic literature:
Modrow,Falke,Truyen: „Molekulare Virologie"
Flint, Enquist, Racaniello, Skalka: „Principles of Virology"
Selbitz, Truyen, Valentin-Weigand „Tiermedizinische Mikrobiologie, Infektions- und Seuchenlehre"

Didactic aids:
slides, hand-outs, lab protocols, scientific literature

Exam requirements:
knowledge of information provided by lecture and practical course

Time and effort involved in studying (in hours): 180
1. Presence during studies: 52,5 h
2. Self-study: 127,5 h
Max. Participants: Virologie:3

Name of module	**Current methods in virology**	**2301 (fishdiseases)**
No. of semester	2	
Lecturers	Verena Jung-Schroers, Mikolaj Adamek	
Kind of course/SWS	Practical course/3 SWS, Lecture/1 SWS, Seminar/1SWS	
Achievements in studies	Regular attendance, protocol, oral presentation	
Exam performance	Participation and protocol (50%), oral presentation with colloquium (50%)	
ECTS-CP	6	

Study targets:
techniques in virology, organization and team work, ability to summarize and present complex subjects to an audience

Course contents:
Lecture e.g.:
current topics in virology, biology & pathology of zoonotic viruses, emerging and zoonotic pathogens, modern approaches in vaccinology, animal models of infectious diseases
Practical course e.g.:
methods in diagnostic virology, preparation of nucleic acids, molecular techniques of viral genome detection, detection of viral proteins (immunofluorescence, Western blot), cloning of viral genes, reverse genetics, expression and purification of viral antigens
Seminar:
oral presentation of methods applied in virology

Admissions requirements/recommended previous knowledge:
knowledge of lecture: Infection biology

Basic literature:
Modrow,Falke,Truyen: „Molekulare Virologie"
Flint, Enquist, Racaniello, Skalka: „Principles of Virology"
Selbitz, Truyen, Valentin-Weigand „Tiermedizinische Mikrobiologie, Infektions- und Seuchenlehre"

Didactic aids:
slides, hand-outs, lab protocols, scientific literature

Exam requirements:
knowledge of information provided by lecture and practical course

Time and effort involved in studying (in hours): 180
1. Presence during studies: 52,5 h
2. Self-study: 127,5 h
Max. Participants: Fischkrankheiten: 2

Name of module	**Methods in Medical Mikrobiology**	**2302**
No. of semester	2	
Lecturers	Jochen Meens, Peter Valentin-Weigand	
Kind of course/SWS	Practical course/3 SWS, Lecture/1 SWS, Seminar 1 SWS	
Achievements in studies	Regular attendance, protocol, seminar	
Exam performance	Seminar presentation, protocol, written exam (each 1/3)	
ECTS-CP	6	

Study targets:
techniques in microbiology,
organisation and team work,
Abilty to summarize and present complex subjects to an audience

Course contents:
Practical course:
Cultural-biochemical and genetic identification and characterization of pathogenic bacteria.
Lecture
Introduction to the major groups of pathogens
Seminar
Presentation of selected topics in Infection biology (e.g. enterotoxins, secretion systems, regulation of virulence genes)

Admission requirements/recommended previous knowledge:
Lecture „Infection Biology“

Basic literature:
Madigan et al. (eds.): Brock Biology of Microorganisms
Additional literature:
Selbitz, Truyen, Valentin-Weigand „Tiermedizinische Mikrobiologie, Infektions- und Seuchenlehre“

Didactic aids:
Practical course script; power point presentations

Exam requirements:
knowledge in Medical Microbiology methods

Time and effort involved in studying (in hours)**:** 180
1. Presence study: 52,5 h
2. Self-study: 127,5 h
Max. Participants: 8

Name of module	Acquisition and assessment of immune mechanisms	2303
No. of semester	2	
Lecturers	Hans-Joachim Schuberth / Bernd Lepenies	
Kind of course/SWS	lecture (1 SWS), seminar (1 SWS), practical course (3 SWS)	
Achievements in studies	regular attendance, seminar presentation, protocols	
Exam performance	Oral presentation (50%), written exam (50%)	
ECTS-CP	6	

Study targets:
Ability to analyse experimental results; Ability to evaluate different techniques comparatively; Ability to summarize and to communicate a professional topic in a coherent way.

Course contents:
practical course
Methods for the isolation and characterization of phenotypical and functional properties of components of the immune system (immune cell differentiation, cell stimulation, flow cytometry, cell sorting, and confocal fluorescence microscopy)
Lecture
Criteria for the identification, differentiation and functional properties of immune components as well as their interactions and cybernetic regulation
Seminar
Oral presentations and discussions on selected immunological topics

Admissions requirements/recommended previous knowledge:
Knowledge about the contents of the lecture cycle infection biology

Basic Literature:
Janeway, Travers, Walport, Shlomchik : Immunobiology

Didactic aids:
Practical course script; powerpoint presentations; group discussions, hand-outs

Exam requirements:
Deep knowledge of lecture and practical course content; Literature knowledge about oral presentation topic

Time and effort involved in studying (in hours): 180
1. Presence during studies: 52,5 h
2. Self-study: 127,5 h
Max. Participants: 4

Name des Moduls	Current parasitological methods	2304
No. of semester	2	
Lecturers	Stefanie Becker,	
Kind of course/SWS	Lecture (1 SWS), Practical (4 SWS)	
Achievements in studies	Experimental work, protocols	
Exam performance	Mini projects and protocol in paper format (100%)	
ECTS-CP	6	

Study targets: Students should acquire basic knowledge on practical aspects of Entomology with special emphasis on medically important arthropods e.g. disease vectors (mosquitoes and ticks). Furthermore basic knowledge of arthropod-transmitted pathogens with special emphasis on viral pathogens will be given

Course contents:

- Lectures will include: Biology and ecology of blood-feeding arthropods, Infection cycles of the most important zoonotic vector-borne diseases (viruses), taxonomy of vectors (morphological and molecular), molecular mechanisms of vector competence, insect models for vector-pathogen interaction studies
- Practical course/excursion will include: Habitats and breeding sites of endemic mosquito and tick species; use of different traps for surveillance studies; taxonomic differentiation of endemic mosquito species; pathogen screening using PCR methods (classical and quantitative real time PCR); basic virological methods; handling, rearing and genetics of the insect model organism *Drosophila melanogaster*; infection experiments with *Drosophila melanogaster,* handling, rearing and genetics of mosquitoes, handling, rearing and genetics of ticks

Admissions requirements:
Participation at the lecture series “Infektionsbiologie”, basic knowledge in molecular biology, a TBEV vaccination is recommended for tick habitat visits

Basic literature:
Mosquitoes and Their Control
Becker, N.; Petric, D.; Zgomba, M.; Boase, C. Minoo, M; Dahl, C., Kaiser, A.
2010,Springer Verlag Hardcover; ISBN: 978-3-540-92873-7
Fly pushing *the theory and practice of Drosophila genetics*
Ralph J. Greenspan
2004, Cold Spring Harbor Laboratory Press; ISBN: 0-87969-711-3
Molekulare Virologie
Modrow, S., Falke, D., Truyen, U., Schätzl, H.
2012, Springer Verlag, Hardcover; ISBN: 978-38274-1833-3

Didactic aids:
Handouts and protocols

Exam requirements:
Deepened knowledge of course contents, protocol

Time and effort involved in studying (in hours): 180 h
1. Presence during studies: 52,5 h
2. Self-study: 127,5 h
Max. Participants: 6

Name of module	Bioinformatic Tools for the Analysis of Omics data	2308
No. of semester	2	
Lecturers	Klaus Jung and research fellows	
Kind of course/SWS	Practical software course (4 SWS), lecture (1 SWS)	
Study performance	Regular attendance, written analysis report	
Exam performance	Analysis report (33%), Examined oral presentation (67%)	
ECTS-CP	6	

Study targets:

Students will be able to identify common data and file types in genomics, transcriptomics or other Omics fields and to perform standard analyses using bioinformatic freewares and online-tools.

Students will be able to associate the relevant questions of sequence- and expression analysis in the context of a biological or medical field of application.

Course contents:

Practical software course:
Selection and preparation of appropriate data examples from public databases; analysis of data example with online-tools and interpretation of results; analysis of different high-throughput data (microarray, next-generation sequencing) from biological or medical fields of application; critical view of results under the aspect of scientific evidence; writing of analysis resport
Lecture:
Introduction into common data and file types of bioinformatics (sequence data, expression data); typical problems in genomics and transcriptomics; presentation of relevant freeware and online-tools in bioinformatics (e.g. sequence alignments, differential expression analysis)

Admissions requirements/recommended previous knowledge:

Basic biological knowledge in genomics and gen regulation

Basic literature:

Bergman CE et al. (2015) The European Bioinformatics Institute in 2016 : Data growth and integration. Nucleic Acids Research, 44, D20-D26.
Barrett T et al. (2013) NCBI GEO: archive for functional genomics data sets – update. Nucleic Acids Research, 41, D991-D995.
Johnson M et al. (2008) NCBI BLAST: a better web interface. Nucleic Acids Research, 36, W5-W9.

Didactic aids:

Lecture slides, software manuals, desktop computer, joint discussions

Exam requirements:

Knowledge of the presented softwares, analysis of example data and writing of report

Time and effort involved in studying (in hours)**:** 180

1. Presence during studies: 52,5 h
2. Self-study: 127,5 h
Max. Participants: 4

Name of module	Sampling of airborne viruses	2309
No. of semester	2	
Lecturer	Jochen Schulz	
Kind of course/SWS	Practical course (4 SWS), seminar (1 SWS)	
Study performance	Using and understanding of sampling methods, preparing samples for analyses, documentation and interpretation of results	
Exam performance	Presentation, protocol, colloquium, (one-third each)	
ECTS-CP	6 (2.Sem)	

Study targets:

- Introduction in sampling and difficulties of detection of virus aerosols
- Learning how to use bioaerosol sampling techniques in current projects
- Detection of airborne viruses and surrogate viruses from samples
- Scientific documentation of results and interpretation of outcomes

Course contents:

Seminar

Presentation of sampling techniques, describing advantages and disadvantages of different sampling techniques, applications

Practical course

Learning how to use different bioarosol samplers. Sampling of virus aerosols from test tubes or test chamber. Preparation and analyzing of samples with microbiological and molecular biological methods to detect airborne infectious agents. Documentation and interpretation of the results.

Admissions requirements/recommended previous knowledge:

Basic knowledge of microbiology and cultivation of microorganisms. Basic knowledge of molecular biological methods (PCR). Interests in physical properties are of advantage.

Basic literature:

Bioaerosols Handbook, 1st Edition, Christopher S. Cox, Christopher M. Wathes, CRC Press, Published March 29, 1995, ISBN 9780873716154 - CAT# L615
Aerosol Technology, Second Edition, William C. Hinds, John Wiley & Sons Inc., Published 1999, ISBN 978-0-471-19410-1

Didactic aids:

Manuals, protocols, original articles

Exam requirements:

Participants should have understood principles of the used methods and they should be able to interpret the outcomes of their measurements and analyses.

Time and effort involved in studying (in hours)**:** 180 (2.Sem)

1. Presence during studies 52,5 h
2. Self-study 127,5 h

Max. number of participants: 2