Subject studies / Compulsory Elective area specialization: Supplementary learning content and learning outcomes

In the modules “Profile Module 1” (a, b, c), students have the opportunity to complete ONE of the PM1 courses listed below. The titles, learning content, and skills to be acquired are listed here. The listed courses take place either in the winter or summer semester.

Human Genetics
Allgemeine Humangenetik

Learning content:
- Fundamentals of human genetics
- Fundamentals of genetics
- Fundamentals for understanding our genetic material
- Formal genetics, mitochondrial genetics
- Fundamentals of human gene expression
- Examples of human diseases and their diagnosis

Learning outcomes:
Students should…
- be familiar with the fundamentals of human genetics, with a particular focus on genetic diseases and their relevance in everyday life
- be familiar with possible fields of work for biologists in clinical diagnostics.

Avifauna of Europe and the Mediterraneis
Avifauna Europas und der Mediterraneis

Learning content:
The birds of the Western Palearctic are mostly presented at the species level, focusing on ecology, life history, behavior, and distribution patterns in their ecological and historical context. Current threats and conservation issues are discussed.

Learning outcomes:
Students should…
- gain an overview of the diversity and distribution patterns of the avifauna of the Western Palearctic and understand the genesis of these patterns as a result of migration, extinction, and adaptation processes in the context of Earth's history.
- be aware of conservation issues in the context of general change.

Identification of marine Invertebrates
Bestimmungsübungen an marinen Invertebraten

Learning content:
Taxonomy of endo- and epibiontic crustaceans, polychaetes, mollusks, and echinoderms; taxonomy of zooplankton (especially copepods); functional morphology, ecology, and reproductive strategies of important taxa in the North Sea

Learning outcomes:
Students are familiar with the biodiversity, functional morphology, ecology, and reproductive strategies of North Sea invertebrates and can identify the most important species. They can use general identification literature for marine invertebrates and apply identification keys. Students gain initial experience with English-language identification keys and detailed keys for specific groups (Polychaeta) in preparation for international master's programs at the University of Bremen.

Subject studies / Compulsory Elective area specialization: Supplementary learning content and learning outcomes

Basics in Biodiversity
Basics in Biodiversity

Learning content:
- Concepts of ecology
- Global and local variation in biodiversity
- Ecology and global change
- Design of ecological experiments and sampling in the field
- Working with scientific literature
- Presentation of scientific content
- Organization, structure, and statistical analysis of data

Learning outcomes:
Students who successfully complete this module will be able to:
- Select, apply, and evaluate sampling techniques for plant and animal populations
- Interpret and discuss patterns of populations and species communities in the context of theory and the environment in which they occur
- Evaluate experiments on sampling plant and animal populations and explain how they address ecological hypotheses
- Apply statistical evaluation methods to test hypotheses
- Communicate and discuss results from ecological work and their significance to a scientific audience

Coastal and Intertidal Ecology
Coastal and Intertidal Ecology

Learning content:
Based on relevant specialist literature from professional journals, students learn about the content and current developments in the ecology of coastal and tidal zone ecosystems and their inhabitants through their own research and presentations, followed by critical discussion in the group and with the specialist background of the course instructors. In addition to basic knowledge of biology, ecology, and (bio-geo)chemistry, this content also includes aspects of the threats to, use of, and protection of these ecosystems.

Learning outcomes:
Students will be able to
- use scientific journals and corresponding search engines to search for current work on specific topics;
- understand, summarize, comprehensively reproduce, and critically discuss scientific articles in all their diversity;
- clearly present and critically examine scientific findings and the underlying methodological approaches.

Concepts of Marine Biology
Concepts of Marine Biology

Learning content:
Introduction to the marine environment: properties of water, morphology of ocean basins, basic oceanography, classification of the marine environment, comparison of terrestrial and marine ecosystems; tropical coastal ecosystems, mangrove forests, coral reefs, symbiotic relationships between algae and animals or among animals; plankton communities, phytoplankton, zooplankton, primary production, marine food webs; Meiofauna, environmental characteristics, composition of interstitial communities; subtidal benthic associations in shallow water, benthic biology of polar seas, tidal ecology, adaptations of tidal organisms, rocky coasts, sandy and muddy coasts, tidal flat ecology, kelp forests, seagrass communities; marine microorganisms, their ecological role in the ocean and their impact on global biogeochemical cycles, microbial cycling, the changing model of marine food webs, what marine microorganisms can do that other organisms cannot; deep-sea biology, adaptations of deep-sea organisms, mesopelagic communities in the twilight zone; human impact on the sea: fishing, mariculture, pollution, medicine from the sea, global warming, and sea level rise.

Learning outcomes:

- Students understand relevant concepts of marine biology in relation to primary production and food webs in the ocean, pelagic and benthic communities, and adaptations of marine organisms to environmental factors in various marine ecosystems, from coastal habitats to the deep sea.
- Students can draw on knowledge from English-language teaching and textbooks.
- Students are familiar with various researchers and research groups at the University of Bremen, the AWI, and the ZMT, and can find supervisors and topics for their bachelor's theses in the following semester.

The World Inside The Brain - Introduction to Cognitive Neurobiology

Die Welt im Gehirn - Einführung in die kognitive Neurobiologie

Learning content:

The course covers selected topics from the field of systems neuroscience. In particular, it introduces students to the analysis and critical discussion of the relevant content.

Learning outcomes:

Students can read literature on the selected topic, comprehend and analyze its content, summarize it, and evaluate it critically.

Short Excursion

Kleine Exkursion

Learning content:

Excursion(s):

- To various destinations, with a focus on landscape history, regional geology and geography, flora and fauna
- Identification of plant and animal species
- Ecology and habitat requirements of plants and animals
- Changes in flora and fauna as a result of anthropogenic influence

Learning outcomes:

Students...

- are familiar with the plant and animal communities of selected habitats
- are familiar with the most important abiotic, biotic, and anthropogenic environmental factors for selected communities
- can identify plants and animals
- can name the most important factors that lead to biodiversity loss

The short excursion can take various forms:

(a) As a 6-day block excursion, usually within Germany
(b) As two 2- to 3-day (weekend) excursions within Germany
(c) As six half-day or full-day excursions within Germany

or as a combination of (b) and (c)

Long Excursion
Große Exkursion

Learning content:
Excursion(s):
- To various destinations, with a focus on landscape history, regional geology and geography, flora and fauna
- Identification of plant and animal species
- Ecology and habitat requirements of plants and animals
- Changes in flora and fauna as a result of anthropogenic influence

Learning outcomes:
Students...
- are familiar with the plant and animal communities of selected habitats
- are familiar with the most important abiotic, biotic, and anthropogenic environmental factors for selected communities
- can identify plants and animals
- can name the most important factors that lead to biodiversity loss

The major field trip can take various forms:
(a) As a block field trip lasting around 10 days within or outside Germany
(b) As a combination of a block field trip lasting around 6 days and two 2- to 3-day (weekend) field trips within Germany

Lecture for the Excursion
Lecture for the Excursion

Learning content:
Introduction to the geology, geography, climate, culture, vegetation, flora, fauna, and cultural history of the destination region (accompanying seminar for short or long excursions)

Learning outcomes:
Students should
- be familiar with plant and animal communities in different habitats
- be familiar with abiotic, biotic, and anthropogenic factors that determine habitat characteristics and communities
- be familiar with a wide range of ecological methods

Global importance of terrestrial tropical ecosystems

Learning content:
Tropical terrestrial ecosystems—such as rainforests and savannas—are among the most biologically diverse and ecologically complex systems on Earth. They play a critical role in global biogeochemical cycles and support a wide range of ecosystem services vital to both local livelihoods and global sustainability.
This Master's level course combines lectures and seminar-based discussions to provide a comprehensive understanding of the structure, function, and global significance of tropical terrestrial ecosystems. Lectures introduce key topics including tropical ecology, biogeography, evolutionary patterns of diversity, the ecological characteristics of major ecosystem types (forests and savannas) and elevation gradients.
A central focus lies on the fragility of tropical biodiversity and ecosystem services in the course of global change. Through thematic blocks, students explore the consequences of climate and land use changes on biodiversity and key ecosystem services like pollination and frugivory. Lastly, the course offers insights into the challenges and solutions for preserving tropical biodiversity in the future.
Seminars complement the lectures through critical reading and discussion of scientific literature. Students learn to analyse and interpret primary research and relate it to broader ecological and conservation contexts. This integrated format fosters a deeper understanding of the challenges and responsibilities faced by ecologists working in tropical regions.

Learning outcomes:
By the end of this course, students will be able to:
- Explain the ecological and evolutionary foundations of tropical biodiversity.
- Distinguish key tropical ecosystem types and understand their global roles.
- Analyze how climate change and human activities affect ecological processes in the tropics.
- Evaluate current research on ecosystem services and their threats.
- Critically assess and discuss conservation and sustainable use strategies for tropical ecosystems.

Basics of Immunobiology
Grundlagen der Immunbiologie

Learning content:
Building on the classification into innate and adaptive immune systems, the corresponding cell types and organs, cellular and humoral factors, and their function and mode of action are discussed. The basic principles of immunological reactions are taught. Induction processes, signal transduction, and final response reactions are presented. The interactions that take place between the different cell types of the immune system and the cytokines involved are explained. Against this background, an overview of vaccinations, allergies, and autoimmune diseases is provided.

Learning outcomes:
Students can define immunobiological principles and demonstrate them using examples. They are familiar with the cell types, organs, and factors that make up the immune system and understand their function, mode of action, and interaction. Students understand the basic mechanisms of immunological defense reactions (innate and acquired) against infectious agents. They can navigate the regulatory, molecular network of immune responses and connect the reciprocal interactions. Students can apply their knowledge to various immunological issues (e.g., infection processes, effects of vaccinations, development of allergic reactions).

Basic Principles of Neurophysiology and Neuroanatomy
Grundprinzipien der Neurophysiologie und -anatomie

Learning content:
The structure and functions of the brain in vertebrates, including humans, are presented in overview and, in selected cases, in detail. Similarities and differences in the organization of brain structures as well as fundamental information-processing processes between nerve cells are presented. These include, among other things, the network architecture in structures such as the cerebral cortex and transmitter-specific systems of the brain. Brain functions such as perception, learning, memory, emotions, action planning, and movement execution are explained in terms of behavior, at the network level, and at the cellular level.

Learning outcomes:
Students should
- acquire basic knowledge about the structure and functioning of vertebrate brains.
- become familiar with the basic concepts of neuroanatomy and neurophysiology.
- become familiar with the basic principles of the interconnection of the main structures of the brain, the principles of information processing by nerve cells, and neuronal cellular mechanisms.

Herpetofauna of Europe and the Mediterraneis
Herpetofauna Europas und der Mediterraneis

Learning content:
The amphibians and reptiles of the Western Palearctic are mostly presented at the species level, with a focus on ecology, life history, behavior, and distribution patterns in their ecological and historical context. Current threats and conservation issues are discussed.

Learning outcomes:
Students should
- gain an overview of the diversity and distribution patterns of the herpetofauna of the Western Palearctic and understand the genesis of these patterns as a result of migration, extinction, and adaptation processes in the context of Earth's history.
- be aware of conservation issues in the context of general change.

Wildlife Habitats in the Northern Region of Central Europe
Lebensräume der Fauna im nördlichen Mitteleuropa

Learning content:
- Habitat types and their indicator and characteristic species, especially vertebrates, dragonflies, butterflies, and beetles.
- Recording and presenting distribution areas.
- Recording and presentation of distribution areas
- Ecological and historical factors of area boundaries
- Spread, animal migrations, and migration
- Neozoa
- Lecture to supplement the zoological excursions
- Vorlesung zur Ergänzung der zoologischen Exkursionen

Learning outcomes:
Students should be able to:
- recognize, name, and explain the main types of landscape in northern Germany.
- describe the interactions between landscape ecology and cultural history.

- explain the conditions for the existence of vertebrate fauna in particular, based on the ecological conditions in the cultural landscape habitat.

Marine Organisms
Marine Organisms

Learning content:
Systematics, functional morphology, adaptations, ecology, and reproductive strategies of important taxa of marine algae (cyanobacteria, diatoms, dinoflagellates, green, red, and brown algae), invertebrates (cnidarians, mollusks, crustaceans, echinoderms), and microorganisms. Metabolic pathways of marine microorganisms. Interactions of marine organisms with biogeochemical cycles.

Learning outcomes:
Students are familiar with the biodiversity, functional morphology, ecology, and reproductive strategies of the most important taxa of marine algae and invertebrates.
Students understand the diversity of metabolic pathways in marine microorganisms and how marine organisms interact with global element cycles.
Students are able to draw conclusions from English-language teaching.

Methods in Molecular Biosciences
Methoden der Molekularen Biowissenschaften

Learning content:
The topics covered include:
- Separation methods for biomolecules
- Protein purification
- Centrifugation techniques
- Methods of immunology
- Methods of genetic engineering and biotechnology
- Methods of cell biology (cell fractionation methods, microscopy, etc.)

Learning outcomes:
Students should
- have a theoretical understanding of a wide range of methods used in molecular biosciences.
- be familiar with the techniques used in molecular biosciences research groups.

Plant developmental genetics
Plant developmental genetics

Learning content:
- Molecular mechanisms of various developmental processes, including patterning, self-incompatibility, meristem and embryo development, flowering induction, and sexual reproduction
- Methods for investigating the molecular and genetic basis of developmental processes
- Science communication: Target group-oriented techniques for scientific presentation and writing
- Strategies for promoting creativity

Learning outcomes:
Students will be able to:

- Derive and understand molecular mechanisms of selected developmental processes.
- Understand methods for investigating developmental biology questions and formulate concept-oriented hypotheses based on raw data.
- Identify thematically relevant literature and efficiently familiarize themselves with selected topics.
- Identify goals, target groups, and suitable forms of communication for different types of science communication.
- Apply basic knowledge of scientific writing.
- Design professional and inspiring specialist presentations and present them in a seminar.
- Develop creative elements using selected techniques and integrate them into science communication.

Reptiles on earth: taxonomy, distribution, endangerment and protection
Reptilien der Erde: Biologie, Systematik, Verbreitung, Gefährdung und Schutz

Learning content:
The course covers the basic anatomy and physiology of reptiles and their evolution throughout Earth's history. It also provides a phylogenetic overview of their distribution in the biogeographical regions of the world, explaining the specific characteristics of their ecology and behavior as well as special conservation issues at the family or genus level.

Learning outcomes:
Students should recognize, within complex diversity, the underlying patterns and conditions in which convergent evolutionary processes generate diversity.

Mammals in Europe: taxonomy, distribution, endangerment and protection
Systematik, Verbreitung, Biologie und Schutz der Säugetiere Europas

Learning content:
The basic features of mammalian evolution, anatomy, and physiology are explained, and then, based on the phylogenetic system, the groups are presented, mostly down to the genus level, and in some cases down to the species level, with regard to distribution, behavior, ecology, and specific conservation issues.

Learning content:
Students should have an overview of diversity, understand ecological and historical patterns, comprehend niche formation using concrete examples, and recognize that there is no such thing as “the whale,” “the zebra,” or “the monkey,” etc.

Systems Neurobiology
Systemneurobiologie

Learning content:
The module deals with fundamental cellular and neurophysiological mechanisms of systems neurobiology based on scientific literature.

Learning outcomes:
Students understand the importance of cellular and neurophysiological mechanisms for information processing in the brain. They can learn about these relationships from the literature, analyze them critically, and explain them clearly.

Virology
Virologie

Learning content:
Based on the presentation of selected viruses (herpes viruses, hepatitis viruses, oncogenic viruses, plant viruses, viroids), the principles of virology (transmission, replication, host defense mechanisms) and the fundamental interactions between viruses and their hosts are taught in order to understand the molecular mechanisms that lead to the development of disease and specific clinical symptoms (pathogenesis). In addition, vaccination strategies and therapeutic measures are explained.

Learning outcomes:
Students are familiar with the basic principles of the viral lifestyle and the fundamental mechanisms of molecular cell parasitism. They understand the causes and processes that lead to the development of disease and specific clinical symptoms in viral infections.

Where do plants grow?
Warum wachsen Pflanzen wo sie wachsen?

Content-related prior knowledge or skills:
Highly recommended: Prior knowledge of
plant physiology and anatomy

Learning content:
The main focus of the course is on autecology. The environmental factors of light, temperature, water, and nutrient supply will be discussed. Special emphasis will be placed on mechanisms for plant stress management. Another focus will be on interactions between plants and microorganisms. Here, the ecological potential of these interactions will be examined, and necessary changes in plant development will be discussed.

Learning outcomes:
Students should
- understand the competitiveness of plants in defined ecosystems.
- understand the interaction of various environmental factors on the occurrence and dispersal success of plants (connection between ecosystem structure and selected plant functions).
- be familiar with mechanisms of plant stress tolerance.
- understand the increase in competitiveness through interaction with microorganisms.
- be familiar with the biological principles of obtaining, producing, and processing natural plant and fungal products.

Life Sciences - life and science
Wissenschaft vom Leben - Leben und Wissenschaft

Learning content:
Biographies of ecologists and evolutionary biologists from the 20th century are presented with regard to the interactions between politics, ideological history, life paths, and scientific work, and discussed in the context of other biographies.

Learning outcomes:
Students should learn about the careers of selected scientists in their personal socio-cultural environment and the respective political situation, and understand the interactions between them.

Cell culture techniques in cancer genetics
Zellkulturtechniken in der Tumorgenetik

Learning content:
Seminar:
- Theoretical and practical introduction to cell culture techniques
- Cultivation of human cell cultures
- Establishment of cell lines
- Chromosome isolation
- Fluorescence in situ hybridization (FISH)
- Cell storage, cryopreservation
- Growth curve
- Transfection/transformation of cells
- Genetic mechanisms of tumor development
- Use of cell cultures in practice:
- Tumor genetics, human genetics, genetic engineering, reproductive medicine, gene therapy
- Genetics and aging
- Mutagenicity tests
- Biomarkers
- Stem cells

Practical training:
- Cultivation of human cells
- Creation of a growth curve
- Chromosome isolation from venous blood and adherent cell lines
- Transfection of cell lines

Learning outcomes:
Students should be able to:
- cultivate human cells.
- perform cell transfection.
- learn about the genetic mechanisms of tumor development.
- learn about the importance of cell culture techniques in diagnostics.