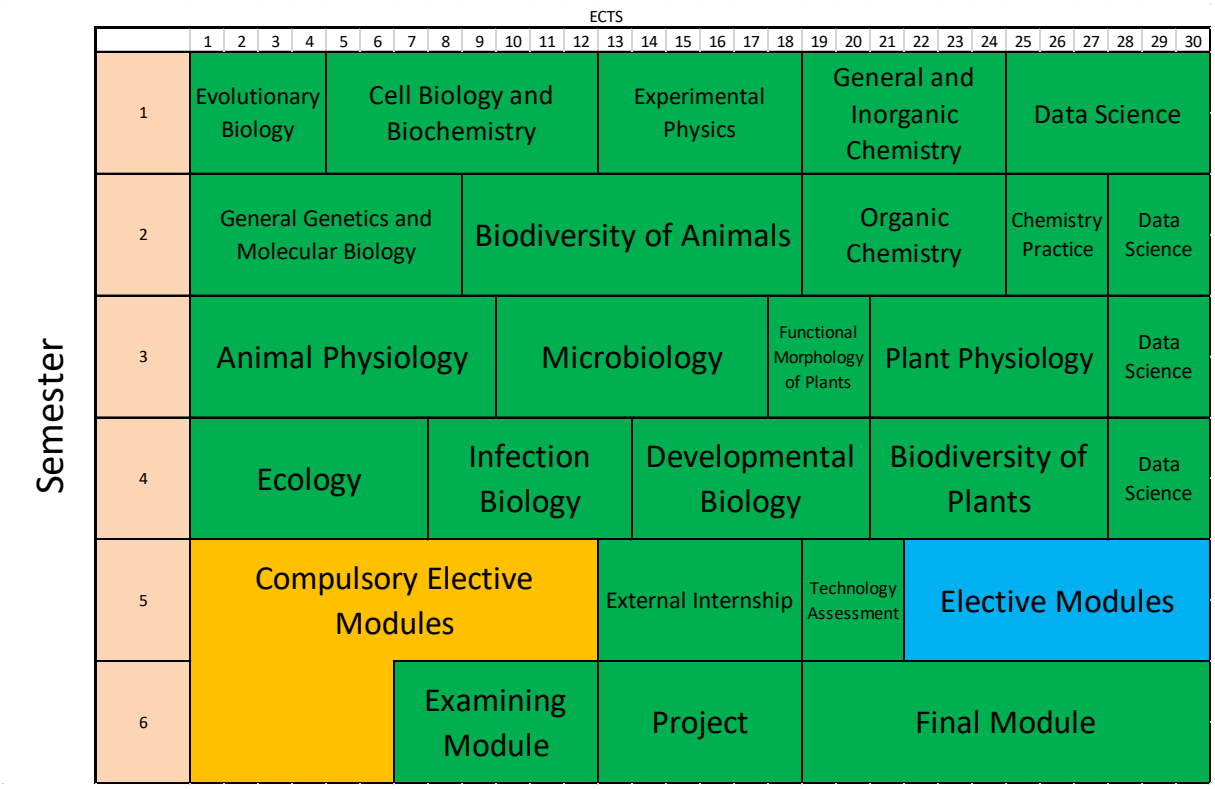
Module Handbook

Bachelor of Science Biologie

(state: October 21th, 2024)



Learning outcomes:

Through the bachelor's degree program in biology, graduates have acquired both a comprehensive theoretical foundation and knowledge and skills in all areas of biology that qualify them for a profession. They have internalized the "rules of good scientific work" and possess job-qualifying and social skills. In addition, graduates have acquired in-depth knowledge of specific areas of biology through the selection of elective modules.

Content

Title:	**Fundamentals in Cell Biology and Biochemistry**
Module number:	BIO-01
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Sigrun Reumann, Phone: 42816 743, sigrun.reumann (at) uni-hamburg.de
Instructors:	Prof. Dr. Tim Gilberger Prof. Dr. Stefan Hoth Prof. Dr. Sigrun Reumann PD Dr. Dirk Warnecke
Language	German
Intended learning objectives:	The students are familiar with the general principles and mechanisms of cell biology, such as the structure of the cell, the functions of various cell organelles and the properties of biological membranes. They possess knowledge about the structure and functions of relevant biomolecules and about the basic biochemical relationships such as central metabolic processes. They have acquired a basic understanding of life processes and principles of evolution that qualify for the following semesters. Fundamental techniques of cell biological-microscopic examinations (micro-scope handling, histology and documentation of microscopic experiments) were learned during the practical training. The students were introduced to analytical methods and quantitative biochemical experiments and learned basic skills in biological laboratory work (planning, evaluation and discussion of test results). Group work and team skills are in the foreground and have been learned or improved.
Contents	The module combines the imparting of key qualifications (in particular methodological competence, social relevance of biological theories, social competence / teamwork) with biological contents and thus forms the basis for subsequent modules. Presentation of the organisms kingdoms; Construction and function of the cells and their building blocks; basic research methods (including microscopy, tissue sections, staining); Structure and function of biomolecules and central metabolic processes; during the internship, the contents of the lectures will be consolidated and relevant biological connections will be illustrated
Course types and forms of instruction:	• L: Introduction to Molecular Plant Science — 4 SEM./HRS • T: Cell Biology and Biochemistry — 1 SEM./HRS • P: Practical Course in Cell Biology and Biochemistry — 1,5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L:Introduction to Molecular Plant Science		*56*	*80*	*30*
• T: Cell Biology and Biochemistry		*14*		
• P: Practical Course in Cell Biology and Biochemistry		*21*	*43*	*15*
Total Workload	*8*	*91*	*104*	*45*

Coursework and examinations:	*Formal requirements for examinations:* Attendance at the safety instruction is obligatory *examinations:* Written examination (graded; 100%)

Duration	one semester
Module frequency:	annual
Literature:	Müller-Esterl, W.: Biochemie - eine Einführung für Mediziner und Naturwissenschaftler. Spektrum-Verlag, Heidelberg. In der jeweils aktuellen Auflage. Campbell, N. A., et al.: Biologie. – 8th ed., Pearson Studium, München. In der jeweils aktuellen Auflage

Title:	**Evolutionary Biology**				
Module number:	BIO-02				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Susanne Dobler, Phone: 42838 4288, susanne.dobler (at) uni-hamburg (dot) de				
Instructors:	Prof. Dr. Susanne Dobler Prof. Dr. Jutta Schneider And others				
Language	German				
Intended learning objectives:	The students gain an overview of the mechanisms, processes and concepts of evolution with evidence by experimental research. Selected case studies facilitate appreciation of overlaps between scientific disciplines, different approaches to elucidate biological questions in the light of evolutionary theory as well as their application.				
Contents	The evolutionary biology lecture presents the mechanisms of evolution as interaction of mutation, selection and genetic drift and provides an introduction to population genetics and speciation mechanisms. A lightning tour through the history of the earth presents key events for the emergence of life, the colonization of land and air space and the evolution of humans and introduces the reasons for and resulting opportunities of extinction events. The case studies use exciting examples from the animal and plant kingdoms to illustrate the interconnection of scientific disciplines and to keep a sense of wonder about biology alive.				
Course types and forms of instruction:	• L: Fundamentals in Evolutionary Biology • L: Case Studies in Evolutionary Biology				2 SEM./HRS 1 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Fundamentals in Evolutionary Biology		*28*	*35*	*18*
	• L: Case Studies in Evolutionary Biology		*14*	*15*	*10*
	Total Workload	*4*	*42*	*50*	*28*
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written examination (graded; 100%)				
Duration	two semester				
Module frequency:	annual				
Literature:					

Title:	**Experimental physics**				
Module number:	PHY-BBIO-02				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Erika Garutti				
Instructors:	Prof. Dr. Erika Garutti Dr. Ole Windmüller				
Language	German				
Intended learning objectives:	Students have knowledge of the physical fundamentals that enable them to understand measuring instruments and biological mechanisms and processes; They have the basic understanding of scientific knowledge research and first experiences in the experimental setup, the observational logging and the evaluation of measurement results.				
Contents	Mathematical basics, error calculation. Physical basics in the fields of mechanics, thermodynamics, mechanical vibrations and waves, electricity and magnetism, optics as well as atomic and nuclear physics. In the practical course simple experiments for the deepening of the lecture material, acquaintance of measuring instruments, error calculation, protocol management.				
Course types and forms of instruction:	• L: Experimental physics • P: Practical course in physics				4 SEM./HRS 1,5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Experimental physics		*56*	*49*	*30*
	• P: Practical course in physics		*21*	*24*	-
	Total Workload	*6*	*77*	*73*	*30*
Coursework and examinations:	*Formal requirements for examinations:* None for the first partial examination, for the second partial examination successful completion of the internship (colloquia, internship protocols). *examinations:* The module examination consists of two partial examinations: The first partial examination (interim exam, graded, 20 points, 40% of the module final grade) and takes place in writing in the first half of the semester. The second part examination (written, graded, 30 points, 60% of the module grade) takes place at the end of the semester or during the semester break.				
Duration	one semester				
Module frequency:	annual				
Literature:	Hüttermann et al.: Physik für Mediziner, Biologen, Pharmazeuten. de Gruyter, Berlin. In der jeweils aktuellen Auflage				

Module title	**General and Inorganic Chemistry**				
Module ID	**CHE 080 A**				
Module applicability and type	B.Sc. Computing in Science: Focus in Biochemistry/Chemistry: Required area M.Sc. Data Science and Artificial Intelligence: Domain Knowledge in Data Science and Artificial Intelligence: Chemistry B.Sc. Biology: Mandatory module B.Sc. Marine Ecosystem and Fisheries Sciences: Mandatory module B.A.-Studies with Chemistry as a minor subject: Mandatory module				
Prerequisites	Mandatory: none Recommended: mathematics on Abitur level, general education in natural sciences				
Responsible person	Dr. D. Schaarschmidt				
Teaching person(s)	Dr. D. Schaarschmidt, Dr. F. Hoffmann				
Language	German or English; usually German				
Learning outcomes	Students are able to explain the relationship between the properties of chemical elements and chemical reactions in narrative descriptions and chemical formulae. They can independently derive chemical equations using stoichiometry and the law of mass action, correctly applying the necessary units. They understand the atomic structure and can distinguish between the properties of the nucleus and the electron shell. They are able to understand the different types of chemicals bonds based on fundamental physical and chemical knowledge and can argue which bonding situation should be present in certain compounds or elements. They have understood the organization of elements in the periodic table and can predict general properties of elements based on their location within the periodic table. They can name and explain important industrial and biogeochemical cycles as well as types of chemical reactions.				
Content	Fundamental concepts of chemistry; atomic theory and atomic structure, electronic structure of atoms, periodic table of the elements; stoichiometry, chemical formulae and equations, gas laws; chemical bonding and chemical compounds: ionic bonding, covalent bonding, metallic bonding, van der Waals forces, molecules, coordination compounds, nomenclature; chemical reactions: thermochemistry and thermodynamics, chemical equilibria, kinetics, catalysis; chemistry of aqueous solutions: water, dissolution process, solubility equilibrium, acid-base equilibrium; redox reactions; inorganic chemistry of selected main group and transition elements: important technical processes, biological or biochemical relevance.				
Teaching format(s)	Lecture General and Inorganic Chemistry				4 SWS
	Exercises General and Inorganic Chemistry				2 SWS
Workload (by course and in total)	Lecture General and Inorganic Chemistry	LP 4	P (Std) 56	S (Std) 44	PV (Std) 20
	Exercises General and Inorganic Chemistry	2	26	24	10
	total	6	82	68	30
Coursework/Exams	Coursework: Voraussetzungen zur Modulprüfung: successful completion of exercises Exam(s): Written exam Grades will be awarded for the module examination(s).				
Duration	1 semester				
Frequency	Winter semester, every year				
Literature	E. Riedel, H.-J. Meyer, *Allgemeine und Anorganische Chemie*, 12. Auflage, de Gruyter, Berlin, **2019**.				

	C. E. Mortimer, U. Müller, *Chemie: Das Basiswissen der Chemie*, 13. Auflage, Thieme, Stuttgart, **2020**.

Title:	**Data Science 1 - Programming and Visualization**
Module number:	BIO-03
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory module
Prerequisites for participation:	none
Module coordinator:	Dr. Saskia Otto, Tel.: 42838 6696, saskia.otto (at) uni-hamburg (dot) de
Instructors:	Dr. Saskia Otto N.N.
Language	German
Intended learning objectives:	Students are familiar with the basic concepts of data science and have practical data processing skills using a spreadsheet program such as LibreOffice Calc. Furthermore, students are familiar with the programming language R and can write well-structured scripts for data analysis and visualization. Students will be able to get an overview of data and describe it in terms of its properties. They are able to find meaningful numerical representations for different data sets and to manipulate them compactly and efficiently. Students are confident in the use of various visualization techniques. The guiding question of the module is: What is data and how do I extract information from it?
Contents	In this module, an introduction to the various components of 'Data Sci-ence' is taught. Building on an introduction to the spreadsheet program LibreOffice Calc, the introduction to the programming language R and the integrated development environment RStudio follows. In this environment, methods and tools for data entry and organization, importing, manipulating, visualizing and describing data are introduced and applied. Different file types as well as numerical representation of data are dealt with in depth. The module is accompanied by application-related exercises and a final case study on descriptive data analysis and visualization using selected sample data sets from the various disciplines of biology.
Course types and forms of instruction:	• L: Fundamentals in Data Science and Introduction to Calc and R — 2 SEM./HRS • E: Exercises in Calc, R, Data Processing and Visualization — 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Fundamentals in Data Science and Introduction to Calc and R		*28*	*51*	*11*
• E: Exercises in Calc, R, Data Processing and Visualization		*28*	*51*	*11*
Total Workload	*6*	*56*	*102*	*22*

Coursework and examinations:	*Formal requirements for examinations:* Regular successful completion of the exercises and online quizzes as well as the successful completion of a case study. *examinations:* Written examination (graded; 100%)
Duration	one semester
Module frequency:	In the winter semester as face-to-face courses, in the summer semester as self-study online courses.

Literature:	• Michael J. Crawley (2013): *The R Book*, 2nd edition, Wiley & Sons, Ltd., West Sussex, UK, 975 S. (Online verfügbar als PDF) • Hadley Wickham & Garret Grolemund (2017): *R for Data Science,* O'Reilly Media Inc., CA, U.S.A, 494 S. (Online verfügbar) Hadley Wickham (2016): *ggplot2 - Elegant Graphics for Data Analysis*, 2nd edition, Springer International Publishing, Switzerland, 260p.

Title:	**General Genetics and Molecular Biology**				
Module number:	BIO-04				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	The successful completion of the module "Cell Biology and Biochemistry" is recommended.				
Module coordinator:	Prof. Dr. Julia Kehr, Phone: 42816 312, julia.kehr (at) uni-hamburg (dot) de				
Instructors:	Dr. Dirk Becker Dr. Reinhold Brettschneider Prof. Dr. Julia Kehr Dr. Jantjeline Kluth				
Language	German				
Intended learning objectives:	Students understand the basic principles of genetics and molecular biology and know the main methods of genetics and molecular biology. Ability to work in the lab, to independently research, to structure and present.				
Contents	Classical and formal genetics (Mendel, population genetics); Cytogenetics (cell cycle, mitosis, meiosis); Human genetics; Structure and function of nucleic acids (replication, transcription, translation, mutation, recombination); Gene regulation (operons, promoters, transcription factors); posttranscriptional regulation of gene expression; Methods of molecular biology and genetic engineering, epigenetics.				
Course types and forms of instruction:	• L: General Genetics and Molecular Biology • S: Literature Seminar in Genetics • P: Practical Course in Genetics				2 SEM./HRS 1 SEM./HRS 2,5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: General Genetics and Molecular Biology		*28*	*45*	*40*
	• S: Literature Seminar in Genetics		*14*	*33*	
	• P: Practical Course in Genetics		*35*	*45*	
	Total Workload	*8*	*77*	*123*	*40*
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the seminar and internship, presentation and / or protocol. *examinations:* Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Graw: Genetik. Springer-Verlag, Berlin Heidelberg. In der jeweils aktuellen Auflage Nordheim, Knippers: Molekulare Genetik. Thieme-Verlag, Stuttgart. In der jeweils aktuellen Auflage				

Title:	**Biodiversity of Animals**
Module number:	BIO-05
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Jochen Fründ, Phone: 42816-660, jochen.fruend (at) uni-hamburg.de
Instructors:	Dr. Monika Eberhard Dr. Frank Friedrich Prof. Dr. Jochen Fründ Prof. Dr. Alexander Haas Dr. Jakob Hallermann Dr. Ilka Sötje
Language	German
Intended learning objectives:	Students possess basic knowledge of the species, in particular the construction, characteristics and biology; They have the ability to classify animal species taxonomically correct and can safely deal with zoological terms. They are capable of dealing with zoological keys of determination. They have basic preparation techniques.
Contents	Introduction to species of the animal kingdom, their taxonomy, their phylogenetic relationships, their construction and basic features of their biology. Own preparations, interpretation of histological specimens, and application of determination keys.
Course types and forms of instruction:	• L: Systematics of Animals — 2 SEM./HRS • P: Function and Diversity in the Animal Kingdom — 5 SEM./HRS • P: Field Course in Zoology — 4 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Systematics of Animals		*28*	*36*	*26*
• P: Function and Diversity in the Animal Kingdom		*70*	*84*	-
• P: Field Course in Zoology		*56*		-
Total Workload	*10*	*154*	*120*	*26*

Coursework and examinations:	*Formal requirements for examinations:* Completion of internships (active participation in practical course, review of minutes and drawings, ungraded exams requiring at least 50% of the possible credits). *examinations:* Written examination (graded; 100%)
Duration	one semester
Module frequency:	annual
Literature:	Wehner, R., Gehring, W.: Zoologie. Thieme, Stuttgart. In der jeweils aktuellen Auflage Storch, V., Welsch, U.: Kurzes Lehrbuch der Zoologie. Elsevier, Spektrum Akad. Verl., München. In der jeweils aktuellen Auflage Storch, V., Welsch, U.: Kükenthal zoologisches Praktikum. Spektrum Akad. Verl., Heidelberg. In der jeweils aktuellen Auflage Schäfer, M.: Brohmer -Fauna von Deutschland : ein Bestimmungsbuch unserer heimischen Tierwelt. Quelle & Meyer, Wiebelsheim. In der jeweils aktuellen Auflage

Title:	**Organic Chemistry**
Module number:	CHE 081 A
Semester:	Summer
Applicability, type of module, and curricular area	• B.Sc. Computing in Science: Focus in Biochemistry/Chemistry: Required area • M.Sc. Data Science and Artificial Intelligence: Domain Knowledge in Data Science and Artificial Intelligence: Chemistry • B.Sc. Biology: Mandatory module • B.Sc. Marine Ecosystem and Fisheries Sciences: Mandatory module • B.Sc. Nanoscience: Mandatory module • B.Ed. Partial degree program Chemistry (LAB, LAS-Sek): Mandatory module • B.A.- Study programmes with chemistry as a minor subject: Mandatory module
Prerequisites for participation:	Recommended: CHE 080 A
Module coordinator:	Dr. Gunnar Ehrlich, phone: 42838 2822, Gunnar.Ehrlich (at) chemie.uni-hamburg.de
Instructors:	Dr. Gunnar Ehrlich
Language	German
Intended learning objectives:	Students have fundamental specialist knowledge in organic chemistry. They are able to recognize functional groups of complex molecules and to assign examples of compounds to the corresponding (natural) substance classes. They can name molecules according to the IUPAC nomenclature and correctly apply stereochemical terms. Students are moreover familiar with the main reactions of functional groups and can formulate and apply their syntheses and reaction modes, including the reaction mechanisms.
Contents	Alkanes (conformation of alkanes), cycloalkanes (ring strain and chair conformation), haloalkanes, radical substitution, nucleophilic substitution on aliphatic systems (SN1 and SN2), alkanols, alkenes (elimination and electrophilic addition), aromatic compounds (electrophilic substitution and first and second substitution), alkynes, carbonyl compounds (aldehydes, ketones, carboxylic acids, esters, lipids, oils, waxes, and phospholipids), amines, amino acids, for admission to the module, and isomerism (structural isomers, stereoisomers, conformational isomers, chiral compounds, and cis-trans isomerism).
Course types and forms of instruction:	• L: Organic Chemistry — 3 SEM./HRS • E: Exercises in Organic Chemistry — 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Organic Chemistry		*42*	*63*	*15*
• E: Exercises in Organic Chemistry		*26*	*20*	*14*
Total Workload	*6*	*68*	*83*	*29*

Coursework and examinations:	*Formal requirements for examinations:* none. *examinations:* Written examination (graded; 100%)
Duration	one semester
Module frequency:	annual
Literature:	Bruice, P.Y.: Organische Chemie. Pearson. In der jeweils aktuellen Auflage Organikum. Wiley VCH. In der jeweils aktuellen Auflage

Title:	**Inorganic and Organic Chemistry Practice**
Module number:	CHE 083
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory module
Prerequisites for participation:	Successful completion of the modules CHE 080 A (General and Inorganic Chemistry) and CHE 081 A (Organic Chemistry)
Module coordinator:	Dr. Gunnar Ehrlich, Dr. C. Wittenburg,
Instructors:	N.N.
Language	German
Intended learning objectives:	The students have an understanding of the fundamentals of general, organic and organic chemistry, of chemical transformations, transfer reactions of electrons and protons, and of the energetic and kinetic aspects of chemical reactions. They know important material cycles, reaction types, qualitative, and quantitative analysis methods. They have practical skills in handling laboratory equipment, building reaction equipment, and handling organic solvents.
Contents	Basic concepts of chemistry, concentration data, stoichiometry, nature of chemical bonding, energetics of chemical reactions, equilibrium reactions, catalysis, gas laws, acid-base reactions, buffers, re-dox reactions, detection reactions and initial experience with analytical methods, complex compounds, methods and reactions for the conversion of organic functional groups, eg Esterification, nucleophilic substitution, elimination.
Course types and forms of instruction:	• P: Inorganic and Organic Chemistry Practice (During the safety briefing, there is a presence obligation) — 3 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• P: Inorganic and Organic Chemistry Practice		*60*	*20*	*10*
Total Workload	*3*	*60*	*20*	*10*

Coursework and examinations:	*Formal requirements for examinations:* none. *examinations:* Traineeship (correctly performed experiments, attestation of the experiments). The module is assessed as passed / failed.
Duration	one semester
Module frequency:	annual
Literature:	Script

Title:	**Data Science 2 – Introduction to Statistics & Experimental**
Module number:	BIO-06
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory module
Prerequisites for participation:	The module „Data Science 1“ should be passed successfully
Module coordinator:	Dr. Saskia Otto, Tel.: 42838 6696, saskia.otto (at) uni-hamburg.de
Instructors:	Dr. Monika Eberhard Dr. Saskia Otto N.N.
Language	German
Intended learning objectives:	The students have basic knowledge in the basic areas of statistics and probability theory and have an overview of data distributions. They are able to understand the relationship between biological processes in linguistic description and in mathematical formulation. They better understand the concepts of data collection and the relationship between experimental design and statistical analysis. Have sharpened judgment about appropriate and inappropriate models and have the ability to interpret parameter values. Be able to apply this knowledge using the R programming language. Have an overview of the application of Data Science techniques in the biological disciplines. The guiding question of the module is: How do I collect data and is what I see generalizable?
Contents	This module provides an introduction to inferential statistics and experimental design. Building on an introduction to stochastics (event, probability, conditional probability, independence, random variables), the differences between descriptive and explorative, classical inferential and Bayesian statistics as well as basics such as measures, distributions, density functions, central limit theorem and hypothesis formulation are covered. Starting with simple acceptance tests and 1-2 sample tests, an insight into the world of linear statistical models with the 1-factor analysis of variance (ANOVA), the simple linear regression and the analysis of covariance (ANCOVA) is given. The relationship between test power, sample size, significance level and variance will be discussed in order to build a better understanding for the determination of the experimental design. The module is accompanied by applied exercises and a final case study from the various disciplines of biology, combining descriptive data analysis with inferential statistical analysis.
Course types and forms of instruction:	• L: Fundamentals of Inferential Statistics and Experimental Design — 1 SEM./HRS • E: Exercises on Inferential Statistics and Experimental Design — 1 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Fundamentals of Inferential Statistics and Experimental Design		*14*	*24*	*7*
• E: Exercises on Inferential Statistics and Experimental Design		*14*	*24*	*7*
Total Workload	*3*	28	40	22

Coursework and examinations:	*Formal requirements for examinations:*

	Regular successful completion of the exercises and online quizzes as well as the successful completion of a case study *examinations:* Written examination (graded; 100%)
Duration	one semester
Module frequency:	In the winter semester as face-to-face courses, in the summer semester as self-study online courses.
Literature:	• Kerns, G. J. (2011). *Introduction to Probability and Statistics Using R* • Gerald Peter Quinn and Michael J. Keough (2002): *Experimental Design and Data Analysis for Biologists,* Cambridge, UK, 553 S. • Lazic, Stanely E. (2017): *Experimental Design for Laboratory Biologists: Maximising Information and Improving Reproducibility*. Cambridge University Press, 422 S.

Title:	**Microbiology**				
Module number:	BIO-07				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	The successful visit of the following modules is recommended: Cell Biology and Biochemistry; Data Science 1 + 2; Experimental Physics; General and Inorganic Chemistry; Organic chemistry and Practical Course in Inorganic and Organic Chemistry.				
Module coordinator:	Prof. Dr. Wolfgang Streit, Phone: 42816 463, wolfgang.streit (at) uni-hamburg.de				
Instructors:	PD Dr. Andreas Pommerening-Röser PD Dr. Eva Spieck Prof. Dr. Wolfgang Streit Dr. Gabriele Timmermann Dr. Christel Vollstedt				
Language	German				
Intended learning objectives:	The students have basic theoretical knowledge of general microbiology and have practical skills, such as: sterile work, isolation, characterization and cultivation of microorganisms, detection of microbial metabolism, use of microorganisms in biotechnological applications, isolation and characterization of microbial DNA.				
Contents	Basics of microbiology: - Structure and function of the bacterial cell - bacterial taxonomy and phylogeny - bacterial physiology aerobic / anaerobic - bacterial genetics and genomics - microbial biotechnology - Archaea - pathogenicity - Material cycles - Bacterial eukaryotic interaction				
Course types and forms of instruction:	• L: Introduction to Microbiology • P: Introduction to Microbiology				2,5 SEM./HRS 4,5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Microbiology		*35*	*60*	*32*
	• P: Introduction to Microbiology		*53*	*50*	
	Total Workload	*8*	*98*	*110*	*32*
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the practical course, internship *examinations:* Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	Annual				
Literature:	Brock et al.: Biology of microorganisms. Prentice Hall. In der jeweils aktuellen Auflage				

Title:	**Animal Physiology**				
Module number:	BIO-08				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	The successful visit of the following modules is recommended: Cell Biology and Biochemistry; Applied Mathematics; Experimental Physics; General and Inorganic Chemistry; Organic chemistry and Practical Course in Inorganic and Organic Chemistry.				
Module coordinator:	Prof. Dr. Thorsten Burmester; Thorsten.burmester (at) uni-hamburg.de				
Instructors:	Prof. Dr. Thorsten Burmester Dr. Andrej Fabrizius Prof. Dr. Christian Lohr				
Language	German				
Intended learning objectives:	Students are able to understand the physiological processes in animal organisms; have experience in setting up and conducting physiological tests; independent work in small groups; have safe handling of devices using personal computers; have the ability to critically scrutinize and discuss test results and draft scientific protocols.				
Contents	Introduction to the basics of animal physiology, vegetative animal physiology, neurophysiology and ecophysiology; comparative considerations of basic physiological processes in animal organisms; physical and chemical fundamentals; Introduction to physiological work methods				
Course types and forms of instruction:	• L: Introduction to Animal Physiology • L: Preliminary Talk to Practical Course • P: Animal Physiology				2 SEM./HRS 1 SEM./HRS 6 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Animal Physiology		*28*	*40*	*22*
	• L: Preliminary Talk to Practical Course		*14*	*16*	-
	• P: Animal Physiology		*84*	*66*	-
	Total Workload	*9*	*126*	*122*	*22*
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the practical course, internship *examinations:* Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Müller, W., Frings, S.: Tier- und Humanphysiologie: Eine Einführung, Springer, Berlin. In der jeweils aktuellen Auflage. Moyes, C.D., Schulte, P.M.: Tierphysiologie. Pearson Verlag. In der jeweils aktuellen Auflage				

Title:	**Functional Morphology of Plants**
Module number:	BIO-09
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Dominik Begerow, phone 42816 260, dominik.begerow (at) uni-hamburg (dot) de
Instructors:	Prof. Dr. Dominik Begerow Angela Niebel-Lohmann Dr. Barbara Rudolph Stefan Rust
Language	German
Intended learning objectives:	Students understand the structural requirements of the life functions of seed plants, they know the general basics of the construction and function of plant tissues and organs, the life cycle of flowering plants, their evolution and various morphological adaptation strategies to different environmental conditions. In addition to strengthening the content of the lectures, the basic techniques of morphological-functional examinations (microscopy, histology, experiments on the function of plant tissue and organs) will be learned during the practical training. Working in the group is an essential aspect. The module is linked to the module Plant Physiology in the same semester and forms the basis for the module Biodiversity of Plants in the following semester.
Contents	Construction and function of the plant cell types, the tissues and organs of the plants and their development; Metamorphoses and adaptation mechanisms, life cycle of flowering plants; Construction and function of the flower and a sill, basic examination methods (including microscopy, tissue slices, staining, simple experiments on the function of the organs)
Course types and forms of instruction:	• L: Structure and Function of Plants — 0,5 SEM./HRS • P: Practical Course — 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Structure and Function of Plants		*7*	*31*	
• P: Practical Course		*28*	*20*	*20*
Total Workload	*3*	*35*	*51*	*20*

Coursework and examinations:	*Formal requirements for examinations:* Active participation in the practical course (drawings and protocols) *examinations:* Protocol (pass/fail)
Duration	one semester
Module frequency:	annual
Literature:	Kadereit, J. W. et al.: Strasburger - Lehrbuch der Pflanzenwissenschaften, jeweils aktuelle Auflage Weiler, E. W. und Nover, L.: Allgemeine und molekulare Botanik, Thieme Verlag, Stuttgart, jeweils die aktuelle Auflage Wanner, G.: Mikroskopisch-botanisches Praktikum, jeweils die aktuelle Auflage

Title:	**Plant Physiology**
Module number:	BIO-10
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory module
Prerequisites for participation:	The successful visit of the following modules is recommended: Cell Biology and Biochemistry; Applied Mathematics; Experimental Physics; General and Inorganic Chemistry; Organic chemistry and Practical Course in Inorganic and Organic Chemistry.
Module coordinator:	Prof. Dr. Stefan Hoth, Phone: 42816 582, stefan.hoth(at)uni-hamburg(dot)de
Instructors:	Dr. Olaf Döring Prof. Dr. Stefan Hoth PD Dr. Hartwig Lüthen Dr. Magdalena Weingartner
Language	German
Intended learning objectives:	The students understand the basic physiological processes vital for the plant and their molecular biological and biochemical basics. They master selected physiological and molecular methods. They know important metabolic pathways of plants and the regulation of plant development. Ability to formulate objectives, to document experimental results, to stoichiometrically calculate and to discuss the results achieved.
Contents	Central developmental, metabolic and stress physiological processes. Water Resources; Plant Nutrition; Membranes and membrane transport processes; Photosynthesis; Signal transduction pathways to regulate the growth and development of plants by light and plant hormones; Function of proteins, nucleic acids, lipids and carbohydrates in the plant; gene regulation; Plant Physiological Methods; chromatography; Molecular biological, genetic and biochemical methods in physiology
Course types and forms of instruction:	• L: Plant Physiology — 2 SEM./HRS • L: Preliminary Talk to Practical Course — 0,5 SEM./HRS • P: Practical Course in Plant Physiology — 3 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Plant Physiology		*28*	*40*	*30*
• L: Preliminary Talk to Practical Course		*7*		-
• P: Practical Course in Plant Physiology		*42*	*70*	-
Total Workload	*7*	*70*	*110*	*30*

Coursework and examinations:	*Formal requirements for examinations:* Active participation in the practical course, internship *examinations:* Oral examination (graded; 100%)
Duration	one semester
Module frequency:	annual
Literature:	Taiz L., Zeiger E.: Plant Physiology. Sinauer Ass. Inc. Sunderland, Massachusetts (Physiologie der Pflanzen, Spektrum Akad. Verlag, Heidelberg). In der jeweils aktuellen Auflage Strasburger, E. et al.,: Lehrbuch der Pflanzenwissenschaften. Spektrum Akademischer Verlag, Heidelberg. In der jeweils aktuellen Auflage

	Schopfer P., Brennicke: Pflanzenphysiologie. Spektrum Akademischer Verlag, Heidelberg. In der jeweils aktuellen Auflage

Title:	**Data Science 3 - Exploratory Data Analysis and Data Mining**				
Module number:	BIO-16				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	The modules Data Science 1 and 2 should be successfully completed.				
Module coordinator:	Dr. Saskia Otto, Tel.: 42838 6696, saskia.otto (at) uni-hamburg (dot) de				
Instructors:	Dr. Saskia Otto N.N.				
Language	German				
Intended learning objectives:	Students will have an in-depth look at all 4 components of 'Data Science' and basic knowledge in handling and managing big data. Upon successful completion of this module, students will be able to independently retrieve data from publicly available databases and process and model it in R. In addition, students will be able to create a scientific report using R Markdown and then convert it to various formats such as Word, PDF or HTML and publish it via a 'git repository' in the spirit of transparent, open science. The guiding theme is: applying statistical methods to large datasets to identify new cross-connections and trends.				
Contents	This module is an in-depth study of data science, with a focus on applying statistical models to large data sets to identify new cross-connections and trends. It starts with an in-depth look at data management (including database systems such as MySQL and SQL Lite and publicly available biological databases) and the basics of Open Science (R Markdown, introduction to git and repositories). This is followed by an introduction to explorative data analysis and statistical modeling (multiple linear and polynomial regression models, generalized linear models) with an outlook into the world of machine learning. The module is accompanied by application-oriented exercises and a final case study on exploratory data analysis from the various disciplines of biology.				
Course types and forms of instruction:	• L: Exploratory Data Analysis and Data Mining • E: Exploratory Data Analysis and Data Mining				1 SEM./HRS 1 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Fundamentals of Inferential Statistics and Experimental Design	*1,5*	*14*	*24*	*7*
	• E: Exercises on Inferential Statistics and Experimental Design	*1,5*	*14*	*24*	*7*
	Total Workload	*3*	28	40	22
Coursework and examinations:	*Formal requirements for examinations:* Regular successful completion of the exercises and online quizzes as well as the successful completion of a case study *examinations:* Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	In the winter semester as face-to-face courses, in the summer semester as self-study online courses.				

Literature:	• James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). *An Introduction to Statistical Learning: with Applications in R (Springer Texts in Statistics)*. Springer-Verlag.

Title:	**Ecology**
Module number:	BIO-12
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory module
Prerequisites for participation:	Successful completion of the modules "Evolutionary Biology", "Biodiversity of Animals" and "Functional Morphology of Plants" is strongly recommended.
Module coordinator:	Prof. Dr. Kai Jensen, Phone: 42816 576, kai.jensen(at)uni-hamburg(dot)de
Instructors:	Prof. Dr Susanne Dobler Prof. Dr. Kathrin Dausmann Dr. Veit Hennig Prof. Dr. Kai Jensen Prof. Dr. Philipp Porada
Language	German
Intended learning objectives:	Students have basic knowledge of general ecology and biostatistics, the biomes of the earth and the Central European habitats. Furthermore, they have experience in the application of selected ecological methods and statistical procedures. They possess basic knowledge on species in the animal and plant kingdom. The students have developed the ability to discuss ecological issues in their specific spatial context and in connection with other natural and social science disciplines. They can evaluate ecological data by means of suitable statistical procedures and present ecological findings with suitable media. Students can assess their social responsibility as scientists and are aware that processing "ecological" questions often benefits from interdisciplinary cooperation.
Contents	Ecology: Introduction to general ecology including behavioural ecology: functions, principles and methods; Introduction to the biomes of the earth and into habitats of Central European ; Surveying animal and plant species in their habitats; Conducting ecological experiments in the laboratory and in the field. Relation between occurrences of species or communities with abiotic site conditions; Experience in field work; Application of ecological and behavioural-ecological knowledge to specific problems.
Course types and forms of instruction:	• L: Ecology — 2 SEM./HRS • S: Ecology — 1 SEM./HRS • P: Ecology — 2,5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Ecology		*28*	*50*	*33*
• S: Ecology		*14*	*20*	*10*
• P: Ecology		*35*	*20*	
Total Workload	*7*	*77*	*90*	*43*

Coursework and examinations:	*Formal requirements for examinations:* Active participation in the practical course *examinations:* Written examination (100%)
Duration	one semester
Module frequency:	annual
Literature:	Smith & Smith: Ökologie. Pearson Studium. In der jeweils aktuellen Auflage Nentwig et al.: Ökologie kompakt. Spektrum, Akad. Verl., Heidelberg. In der jeweils aktuellen Auflage.

Title:	**Infection Biology**				
Module number:	BIO-13				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	Successful attendance of the modules "Cell Biology and Biochemistry", "General and Inorganic Chemistry", "General Genetics and Molecular Biology" "Organic Chemistry" "Basic Practical Course in Inorganic and Organic Chemistry" and "Experimental Physics" is strongly recommended.				
Module coordinator:	Prof. Dr. Tobias Lenz, Tel.: 42838 5369, tobias.lenz(at)uni-hamburg.de				
Instructors:	Prof. Dr. Tim Gilberger Prof. Dr. Tobias Lenz Prof. Dr. Sigrun Reumann Prof. Dr. Jonas Schmidt-Chanasit Prof. Dr. Esther Schnettler Prof. Wolfgang Streit				
Language	German				
Intended learning objectives:	Students will have basic knowledge of infection biology, of a selection of pathogens and their infection strategies, of innate and acquired immunity, and of antibiotic resistance. They have understood the principles of host-pathogen coevolution and have gained insight into epidemiology. In addition, they have gained knowledge in some specialized areas of infection biology.				
Contents	- Pathogens and their infection strategies - Host-pathogen interaction: Innate immunity in plants - Pathogens and their infection strategies: viruses in plants and in animals - Pathogens and their infection strategies: parasites - Host-Pathogen Coevolution - Antibiotic resistance - And other special topics in the seminar				
Course types and forms of instruction:	• L: Fundamentals in Infection Biology • S: Special Topics of Infection Biology				3 SEM./HRS 1 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Fundamentals in Infection Biology		*42*	*84*	*30*
	• S: Special Topics of Infection Biology		*14*	*20*	
	Total Workload	*6*	*56*	*104*	*30*
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the seminar, talk *examinations:* Written examination (100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Developmental Biology**				
Module number:	BIO-14				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Arp Schnittger, Phone: 42816 502, arp.schnittger(at)uni-hanburg(dot)de				
Instructors:	Dr. Reinhold Brettschneider Dr. Oliver Hallas Dr. Jantjeline Kluth Prof. Dr. Arp Schnittger Prof. Baris Tursun				
Language	German				
Intended learning objectives:	Students have basic knowledge of the developmental principles of plants and animals, the conserved basic concepts and their modification in complex differentiation processes; they have knowledge of developmental processes that are essential for understanding the genetic basis; they are able to understand different types of development as a continuum in changed environmental conditions and to understand malformations as a consequence of developmental disorders; They have the knowledge to take part in the discussion about stem cell research in a professionally sound manner.				
Contents					
Course types and forms of instruction:	• L: Developmental Biology • P: Developmental Biology				2 SEM./HRS 4 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Developmental Biology		*28*	*40*	*22*
	• P: Developmental Biology		*56*	*54*	-
	Total Workload	*7*	*84*	*94*	*22*
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the practical course *examinations:* Written examination (100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Biodiversity of Plants**
Module number:	BIO-15
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Dominik Begerow, Phone: 42816 260, dominik.begerow (at) uni-hamburg.de
Instructors:	Prof. Dr. Dominik Begerow Prof. Dr. Dieter Hanelt Prof. Dr. Kai Jensen Angela Niebel-Lohmann Dr. Barbara Rudolph Stefan Rust Dr. Matthias Schultz
language	German
Intended learning objectives:	The students are able to assign organisms from the plant kingdom s.l. to a major phylogenetic group. They have learned about botanical terminology and its application, and they can name selected native vascular plants directly. They know how to determine native plant species.
Contents	Overview of a part of the diversity of organisms that are traditionally the subject of botany (plants plus "fungi"). Brief introduction to phylogenetic relationships, morphological terminology, relationships with the environment and physiological peculiarities, references to crops. Fundamentals of the determination of native vascular plants.

Course types and forms of instruction:	
• L: Synopsis of the Plant Kingdom	1 SEM./HRS
• E: Selected Examples from the Plant Kingdom	0,2 SEM./HRS
• P: Selected Examples from the Plant Kingdom	0,8 SEM./HRS
• L: Morphology and Systematics of Native Vascular Plants	1 SEM./HRS
• P: Introduction to Plant Determination	1 SEM./HRS
• P: Field Course in Botany	1 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Synopsis of the Plant Kingdom				
• E: Selected Examples from the Plant Kingdom		*14*	*25*	*40*
• P: Selected Examples from the Plant Kingdom		*4*		
• L: Morphology and Systematics of Native Vascular Plants		*10*	*20*	
• P: Introduction to Plant Determination		*14*	*25*	
• P: Field Course in Botany		*14* *14*	*20* *10*	
Total Workload	*7*	*70*	*100*	*40*

Coursework and examinations:	
Formal requirements for examinations:	
Active participation in the practical course and field course	
examinations:	
Written examination (100%)	

Duration	one semester
Module frequency:	annual
Literature:	Strasburger, Lehrbuch der Pflanzenwissenschaften. Springer-Spektrum, Berlin, Heidelberg; most recent edition Braune et al., Pflanzenanatomisches Praktikum. Springer-Spektrum, Berlin, Heidelberg; most recent edition Schmeil-Fitschen, Die Flora Deutschlands und angrenzender Länder. Quelle & Meyer, Wiebelsheim; most recent edition. Additional literature may be announced by the Instructors:

Title:	**Data Science 4 - Modeling in Biology**				
Module number:	BIO-11				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	Successful completion of the modules "Data Science 1 and 2" is strongly recommended.				
Module coordinator:	Prof. Dr. Philipp Porada, Phone: 42816 577 , philipp.porada (at)uni-hamburg.de				
Instructors:	Suman Halder Yunyao Ma Imke Petersen Prof. Dr. Philipp Porada Youssef Saadaoui				
Language	German				
Intended learning objectives:	Students have basic knowledge of the mathematical description of biological processes. The focus is on dynamic processes (e.g. population dynamics). They can apply this knowledge to numerically integrate the underlying differential equations with the help of computer models. Students can independently develop their own approaches to solving dynamic biological processes and implement them in a computer model.				
Contents	Fundamentals of the quantitative representation of biological processes by mathematical functions: Exponential and logistic growth, Michaelis-Menten kinetics; Derivation and integration of functions; Analytical and numerical solution of differential equations for the prediction of dynamic biological processes; Coupled differential equations (box models). Programming in Matlab/Octave and Fortran.				
Course types and forms of instruction:	• L: Numerical Modeling of Biological Processes				2 SEM./HRS
Workload (module components and total):	• L: Numerical Modeling of Biological Processes	*credits* *3*	P (hrs) *28*	S(hrs) *40*	EP (hrs) *22*
	Total Workload	*3*	28	40	22
Coursework and examinations:	*Formal requirements for examinations:* Independent solution of exercises *examinations:* Term paper (independent development and application of a simple numerical model to a chosen problem, graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Technology Assessment**				
Module number:	BIO-17				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Susanne Stirn, Phone: 42816 533, Susanne.stirn(at)uni-hamburg.de				
Instructors:	Dr. Susanne Stirn				
Language	German				
Intended learning objectives:	Students have acquired knowledge of technology assessment on the use of modern biotechnologies in agriculture and the food industry. In doing so, they have become acquainted with various disciplinary approaches to motivational forces, assessment approaches and possible options for shaping future developments (molecular biology, ecology, law, ethics, socioeconomics). They know the reasons for the public perception of the topic as well as methods for dealing with controversies, uncertainty and openness of the future (e.g. participation processes, scenarios).				
Contents	The challenge of shaping the future towards more sustainable development; introduction to scientific and technological assessment, evaluation and design (TA); analysis, evaluation and options at the interface between biology, society and the environment; options for land use, nutrition and the role of alternative paths in science and technology.				
Course types and forms of instruction:	• L: Technology Assessment				2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Technology Assessment		*28*	*42*	*20*
	Total Workload	*3*	*28*	*42*	*20*
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written examination (pass or fail)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**External Internship**				
Module number:	BIO-18				
Semester:	Winter or Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Markus Brändel, Phone: 42816 648, markus.braendel(at)uni-hamburg.de				
Instructors:	N.N.				
Language	German				
Intended learning objectives:	The students acquire knowledge about their own abilities, talents, interests, possibilities in the practical application in the operational everyday life and recognize own deficits.				
Contents	Applying acquired knowledge to practice; Occupational fields, industry structure, operational procedures, biological areas in economy, administration and authorities				
Course types and forms of instruction:	• L: Job descriptions of biologists • P: External internship (at least 4 weeks)				2 SEM./HRS 6 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Job descriptions of biologists		*28*		
	• P: External internship		*142*		*10*
	Total Workload	*6*	*170*	-	*10*
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Project completion (confirmation of activities by the company)				
Duration	one semester				
Module frequency:	Each semester				
Literature:					

Title:	**Examining Module**				
Module number:	BIO-19				
Semester:	Winter or Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	The compulsory modules scheduled for the first three semesters must be completed successfully. Successful participation in compulsory modules scheduled for the fourth semester is strongly recommended				
Module coordinator:	N.N.				
Instructors:	N.N.				
Language	German				
Intended learning objectives:	Students acquire in-depth knowledge of selected basic and / or current research topics. They can put a topic in the context of other biological topics and understand the complexity of biological processes.				
Contents					
Course types and forms of instruction:	• S: Preparation Seminar				1 SEM./HRS
Workload (module components and total):	• S: Preparation Seminar	*credits*	P (hrs) *14*	S(hrs)	EP (hrs) *166*
	Total Workload	*6*	*14*	-	*166*
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Oral examination (100%)				
Duration	one semester				
Module frequency:	Each semester				
Literature:					

Title:	**Project**				
Module number:	BIO-20				
Semester:	Winter or Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	Advanced knowledge of biology is recommended. Occasionally individual elective and / or compulsory elective modules are recommended.				
Module coordinator:	N.N.				
Instructors:	N.N.				
Language	German				
Intended learning objectives:	Students acquire in-depth knowledge of selected basic and / or current research topics. In e.g. Behavioural, ecological or molecular biology / genetically oriented project studies, the students' ability to actively develop and reflect on in-depth insights and knowledge independently, to scientific research and to the presentation of scientific knowledge is reinforced. Through the exemplary deepening of biological sub-areas, the students are introduced to the working methods and idea development of biological research.				
Contents					
Course types and forms of instruction:	• Project Study				1 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Preparation Seminar				
	Total Workload	*6*	*180*		
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Examination (pass or fail)				
Duration	one semester				
Module frequency:	Each semester				
Literature:					

Title:	**Final Module**				
Module number:	BIO-AB				
Semester:	Winter or Summer				
Applicability, type of module, and curricular area	• Compulsory module				
Prerequisites for participation:	Advanced knowledge of biology, usually evidenced by the successful completion of modules amounting to 120 LP. Sometimes individual elective and / or elective modules are recommended.				
Module coordinator:	N.N.				
Instructors:	N.N.				
Language	German				
Intended learning objectives:	Entry into independent scientific work through exemplary deepening of a branch of biology in theory and / or practice. The students have knowledge of the rules of good scientific practice as well as important publications and theories of the specialty of their Bachelor's thesis.				
Contents	In-depth elaboration of a current or fundamental biological theme in a researcher's working group with experimental design, drawing up a work plan and, if necessary, revising it with project progress, literature research (in the library and on the internet), learning the subject-specific methodology, documentation and (statistical) evaluation of the data, evaluation of the results, critical discussion in comparison to scientific publications and lectures.				
Course types and forms of instruction:					
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	Total Workload	*12*	*360*		
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Exam components of the final module are the written preparation of the Bachelor thesis (graded 100%) and an oral exam (pass or fail). The bachelor thesis can be written in German or English. The bachelor thesis is to be preceded by a summary in English and German. (pass or fail)				
Duration	one semester				
Module frequency:	Each semester				
Literature:					

compulsory elective modules

Title:	**Current Issues on Marine Ecology and Fisheries Sciences**				
Module number:	BMARSYS-23				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	None				
Module coordinator:	Prof. Dr. Christian Möllmann, Phone.: 42838 6620, christian.moellmann(at)uni-hamburg.de				
Instructors:	Prof. Dr. Christian Möllmann				
Language	German				
Intended learning objectives:	Students have an in-depth understanding of the state of knowledge and research topics in fisheries science. They have explicit knowledge of the effects of overfishing and climate change on commercial fish stocks and marine food webs. Furthermore, students know the current literature on the topic of social-ecological systems analysis in the field of exploited marine ecosystems.				
Contents	Definition of overfishing; climate influence on productivity (recruitment and growth) and geographic distribution of exploited fish stocks; relevance of climate change to modern ecosystem-based fisheries management; vulnerability analyses; ecosystem indicators; conflicts in fisheries management; participatory modeling; interactions among ecological, societal, and economic system components.				
Course types and forms of instruction:	• S: Current Topics on Marine Ecology and Fisheries Sciences				2 SEM./HRS
Workload (module components and total):	• S: Current Topics on Marine Ecology and Fisheries Sciences	*credits*	P (hrs) *28*	S(hrs) *80*	EP (hrs) *162*
	Total Workload	*9*	28	80	162
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the seminar, talk *examinations:* Term paper (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Applied Bioinformatics: Structures**				
Module number:	MBI-07				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	None				
Module coordinator:	Prof. Dr. Andrew Torda, Phone: 42838 7331, Email: torda (at) zbh.uni-hamburg.de				
Instructors:	Prof. Dr. Andrew Torda				
Language	German or English				
Intended learning objectives:	Students will see how one analyses biological macromolecular structures. They will learn about modelling, optimization methods and when discrete or continuous representations of systems are appropriate.				
Contents	The analysis of macromolecular structures, and quality assessment. Simple energy models. Protein and nucleotide sequence design.				
Course types and forms of instruction:	• L: Applied Bioinformatics: Structures • E: Applied Bioinformatics: Structures				2 SEM./HRS 2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Applied Bioinformatics: Structures		*28*	*42*	*20*
	• E: Applied Bioinformatics: Structures		*28*	*42*	*20*
	Total Workload	*6*	*56*	*84*	*40*
Coursework and examinations:	*Formal requirements for examinations:* Regular and successful participation in the exercises as in other courses. *examinations:* Written examination (100%) in German (last week of semester or in the semester break)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Structure and Function of the Human Body**
Module number:	BIO-WPW-48
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Knowledge of the contents of the modules "Biodiversity of Animals" and "Animal Physiology" is assumed.
Module coordinator:	Dr. Oliver Hallas, Phone : 42838 3928, oliver.hallas(at)uni-hamburg(dot)de
Instructors:	Dr. Oliver Hallas
Language	German
Intended learning objectives:	Students have a detailed overview of the anatomy and physi-ology of human organ systems. Emphasis is placed on the relationships between structure and function at the level of molecules, cells, tissues, and organs. The goal is to work out the interaction of structure and function at each of these levels. You will be familiar with selected, generally relevant clinical pictures and know what effects physiological malfunctions or morphological disorders have on the human organism.
Contents	• Structure and function of human cells, tissues and organs. • Presentation of the anatomy and physiology of selected organ systems such as integument, musculoskeletal system, digestive system, cardiovascular and respiratory system, immune system, urogenital system,) • Reproduction and development • Causes and consequences of general or historically relevant diseases (e.g. scurvy, rickets, muscular dystrophy type Duchenne, defective vision)
Course types and forms of instruction:	• L: Structure and Function of the Human Body — 3 SEM./HRS

Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Structure and Function of the Human Body		*42*	*72*	*66*
	Total Workload	*6*	*42*	*72*	*66*

Coursework and examinations:	*Formal requirements for examinations:* Attendance of the lecture "Structure and Function of the Human Body" is strongly recommended. *examinations:* Written examination (100%)
Duration	one semester
Module frequency:	annual
Literature:	Marieb, E. N. & Hoehn, K. (2019): Human anatomy & physiology. Pearson M. P. McKinley, V. D. O'Loughlin & Th. Stouter Bidle (2019): Anatomy & physiology : an integrative approach. McGraw-Hill Education Tortora, G. J. & Derrickson, B. H. (2008): Anatomie und Physiologie. Wiley

Title:	**Biochemical Analysis**				
Module number:	CHE 410 B				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Patrick Ziegelmüller, Phone: 42838- 2843, ziegelm (at) chemie.uni-hamburg.de				
Instructors:	Dr. Patrick Ziegelmüller				
Language	German				
Intended learning objectives:	The students master the work with proteins and DNA in the laboratory. They can purify and analyse proteins, find interaction partners, sequence and recombinantly express. Students can analyse, sequence, clone and manipulate DNA. They can also make antibodies and use them as a tool in the lab.				
Contents	The lecture Biochemical Analysis presents modern methods for protein purification and analysis, recombinant DNA technologies and expression systems. In the exercises, the contents of the lecture are deepened in practical questions. The module is rounded off by an interactive wiki on the learning platform OLAT, which is created by the students themselves.				
Course types and forms of instruction:	• L: Biochemical Analysis • E: Methods of Biochemistry and Molecular Biology • P: Biochemical Internship				2 SEM./HRS 2 SEM./HRS 5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Biochemical Analysis		*28*	*28*	
	• E: Methods of Biochemistry and Molecular Biology		*28*	*28*	
	• P: Biochemical Internship		*70*	*70*	
	Total Workload	12	126	126	*108*
Coursework and examinations:	*Formal requirements for examinations:* A regular editing of the wiki *examinations:* The written exam (90 minutes) is about the contents of the lecture and the exercise (graded 100%).				
Duration	one semester				
Module frequency:	Each semester				
Literature:					
	Lehninger Biochemie, D. Nelson, M. Cox, aktuelle Auflage, Springer Verlag Biochemie, J. M. Berg, L.Stryer, J. L. Tymoczkom, aktuelle Auflage, Spektrum Verlag Lehrbuch der Biochemie, aktuelle Auflage, D. J. Voet, J. G. Voet, C. W. Pratt, Wiley-VCH Sowie Bioanalytik, F. Lottspeich, J. Engels, A. Simeon, aktuelle Auflage, Spektrum Verlag				

Title:	**Biogeochemistry of Wetlands**				
Symbol:	BBIO-WPW-46				
Semester:	Wintersemester				
Module type:	• compulsory elective module				
Formal requirements for participation:	Obligatory: none Recommended: basic knowledge of R Studio				
Executive professor:	Prof. Dr. Kai Jensen, Tel.: 42816 576, kai.jensen (at) uni-hamburg.de				
Lecturer:	Clarisse Gösele Julian Mittmann-Götsch				
Language:	English				
Educational concept:	Students have basic knowledge in general biogeochemical parameters in wetlands, as well as their interaction. In the practical part of the module, students are introduced to measurement methods and laboratory analyses of the parameters. In addition, students have an insight into the computer-based evaluation of data.				
Content:	Introduction to salt marshes and biogeochemical parameters (pH, redox, carbon content, ^{13}C signatures, microbial biomass, CH_4 emissions). Explanation of data processing and statistical methods (correlations, regressions, anova).				
Courses:	• L Biogeochemistry of Wetlands • P Methods in Biogeochemistry				1 Sem/hrs 5 Sem/hrs
Workload:		CP	P (in h)	S (in h)	PV (in h)
	• L Biogeochemistry of Wetlands • P Methods in Biogeochemistry		14 70	33 33	30
	Total workload	6	84	66	30
Grading framework (possibly including examinations):	Formal requirements for examinations: none Examinations: Presentation (graded, 50%) and protocol (graded, 50%)				
Duration:	One semester				
Frequency of occurence:	Annual				
Literature:	Reddy, K. R., & DeLaune, R. D. (2008). Biogeochemistry of Wetlands: Science and Applications. CRC Press Taylor & Francis Group, LLC. Schlesinger, W. H. & Bernhardt, E. S. (2013). Biogeochemistry: An Analysis of Global Change. Academic Press – Elsevier. Leps, J. & Smilauer, P. (2020). Biostatistics with R: An Introductory Guide for Field Biologists. Cambridge University Press. Additional literature might be given during the course.				

Title:	**Biology of Algae**
Module number:	BBIO-WPW-13
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Dieter Hanelt, Phone: 42816 372, dieter.hanelt(at) uni-hamburg(dot)de
Instructors:	Prof. Dr. Dieter Hanelt
language	German
Intended learning objectives:	The students are able to recognize the most important species of algae, to assign them to the botanical terminology and to address the evolution of aquatic plants. They will learn the ecophysiological adaptation of plants to their aquatic habitat and the industrial use of algae. This will enable students to compete in the field of modern aquaculture. By this module, the students gain knowledge about how the aquatic ecosystem is affected by climatic and oceanographic factors, so that they can also work in the field of climate research and coastal or marine protection.
Contents	Understanding the variety of aquatic plants as well as their taxonomy, ecophysiology and economic importance. Development of the organisms (phylogenesis), presentation of the theory of endosymbiosis, the variety of life cycles, and the development from the haploid to the advanced diploid life cycle. Understanding of the aquatic ecosystem as an essential factor in relation to global climate change and the coastal zone as a unique ecosystem deserving natural protection.
Course types and forms of instruction:	• L: Biology of Algae — 2 SEM./HRS • P: Marine Botanical Excursion — 6 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Biology of Algae		*28*	*62*	
• P: Marine Botanical Excursion		*140*		*40*
Total Workload	*9*	*168*	*62*	*40*

Coursework and examinations:	*Formal requirements for examinations:* Written or oral examination on the topics of the lecture. *Examinations:* Independent preparation of an experiment/demonstration and its presentation in front of the classmates (graded, 34%), Excursion: Quality of the assembly of a herbarium (graded, 33%), Presentation of a seminar talk (graded, 33%).
Duration	one semester
Module frequency:	annual
Literature:	van den Hoek: Algae. Thieme, Stuttgart. Lüning, K.: Seaweeds: Their Environment, Biogeography and Ecophysiology. Wiley, New York Strasburger, E.: Handbook of Botany, Spektrum Hurd et al. Seaweed Ecology and Physiology, Cambridge University Press Kirk, J.T.O., Osmund, J.T.: Light and photosynthesis in aquatic ecosystems. Cambridge Univ. Press.

Title:	**Biology of Algae (3 ECTS)**
Module number:	BBIO-WPW-13
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Dieter Hanelt, Phone: 42816 372, dieter.hanelt (at) uni-hamburg.de
Instructors:	Prof. Dr. Dieter Hanelt
language	German
Intended learning objectives:	The students are able to recognize the most important species of algae, to assign them to the botanical terminology and to address the evolution of aquatic plants. They will learn the ecophysiological adaptation of plants to their aquatic habitat and the industrial use of algae. This will enable students to compete in the field of modern aquaculture. By this module, the students gain knowledge about how the aquatic ecosystem is affected by climatic and oceanographic factors, so that they can also work in the field of climate research and coastal or marine protection.
Contents	Understanding the variety of aquatic plants as well as their taxonomy, ecophysiology and economic importance. Development of the organisms (phylogenesis), presentation of the theory of endosymbiosis, the variety of life cycles, and the development from the haploid to the advanced diploid life cycle. Understanding of the aquatic ecosystem as an essential factor in relation to global climate change and the coastal zone as a unique ecosystem deserving natural protection.
Course types and forms of instruction:	• L: Biology of Algae — 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Biology of Algae		*28*	*42*	*20*
Total Workload	*3*	*28*	*42*	*20*

Coursework and examinations:	*Formal requirements for examinations:* none *Examinations:* Written examination (100%)
Duration	one semester
Module frequency:	annual
Literature:	van den Hoek: Algae. Thieme, Stuttgart. Lüning, K.: Seaweeds: Their Environment, Biogeography and Ecophysiology. Wiley, New York Strasburger, E.: Handbook of Botany, Spektrum Hurd et al. Seaweed Ecology and Physiology, Cambridge University Press Kirk, J.T.O., Osmund, J.T.: Light and photosynthesis in aquatic ecosystems. Cambridge Univ. Press.

Title:	**Biology of Plant Parasites**				
Module number:	BBIO-WPW-65				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module recommended for the fifth semester.				
Prerequisites for participation:	Successful completion of the modules in the first four semesters is recommended				
Module coordinator:	Prof. Dr. Dominik Begerow, phone 42816 260, dominik.begerow (at) uni-hamburg.de				
Instructors:	Prof. Dr. Dominik Begerow Dr. Martin Kemler				
Language	German				
Intended learning objectives:	Students are able to understand the life cycle of smut fungi and the infection process; have experience in carrying out infection experiments and fungal mating experiments; organize themselves in small groups; are confident in the necessary methods and have the ability to critically question and discuss the results; write scientific protocols.				
Contents	Introduction to the biology of smut fungi with a special focus on the life cycle and infection. Current topics in infection biology; basic mycological techniques; microscopy; molecular identification of mating genes; mating and infection experiments.				
Course types and forms of instruction:	• L: Biology of Plant Parasites • S: Plant Parasites • P: Methods of Phytopathology				1 SEM./HRS 1 SEM./HRS 4 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Biology of Plant Parasites		14	28	
	• S: Plant Parasites		14	14	*20*
	• P: Methods of Phytopathology		68	32	*80*
	Total Workload	9	96	74	*100*
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the Seminar and practical course *examinations:* Talk (pass/fail), Protocol (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**The Cell I - read, understand, discuss (3 ECTS)**
Module number:	BBIO-WPW-82
Semester:	Winter or summer
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	The modules The Cell I, II and III can be taken independently of each other and in any order. Successful completion of the module Fundamentals of Cell Biology and Biochemistry is strongly recommended!
Module coordinator:	Prof. Dr. Arp Schnittger, Phone: 42816 502, arp.schnittger (at) uni-hamburg.de
Instructors:	Dr. Maren Heese, Prof. Dr. Arp Schnittger
language	German
Intended learning objectives:	Students have an overview of the molecular processes of a cell and are familiar with the internal organization of the cell. The students can place detailed information on the topic of cell biology in larger contexts and understand current research questions.
Contents	Using the book "Molecular Biology of the Cell" by Bruce Alberts, a coherent overview of cell biology will be developed and any existing gaps will be filled. In this module (The Cell I), the basic genetic mechanisms will be covered in depth (DNA, chromosomes and genomes; replication, repair and recombination; from DNA to protein; control of gene expression).
Course types and forms of instruction:	• S: The Cell I - read, understand, discuss — 2 SEM./HRS

Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: The Cell I - read, understand, discuss		*28*	*42*	*20*
	Total Workload	*3*	*28*	*42*	*20*

Coursework and examinations:	*Formal requirements for examinations:* Book reading, active participation in the seminar (questions/answers and contributions to the discussion) *Examinations:* Presentation and written elaboration (graded, 100%)
Duration	one semester
Module frequency:	Alternating with the two modules The Cell II and The Cell III
Literature:	Molekularbiologie der Zelle 6. Auflage, 5. April 2017 von Ulrich Schäfer (Herausgeber), Bruce Alberts (Autor), Alexander Johnson (Autor), Julian Lewis (Autor), David Morgan (Autor), Martin Raff (Autor), Keith Roberts (Autor), Peter Walter (Autor), Bärbel Häcker (Übersetzer), Claudia Horstmann (Übersetzer), Alexandra Prowald (Übersetzer)

Title:	**The Cell II - read, understand, discuss (3 ECTS)**
Module number:	BBIO-WPW-83
Semester:	Winter or summer
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	The modules The Cell I, II and III can be taken independently of each other and in any order. Successful completion of the module Fundamentals of Cell Biology and Biochemistry is strongly recommended!
Module coordinator:	Prof. Dr. Arp Schnittger, Phone: 42816 502, arp.schnittger (at) uni-hamburg.de
Instructors:	Dr. Maren Heese, Prof. Dr. Arp Schnittger
language	German
Intended learning objectives:	Students have an overview of the molecular processes of a cell and are familiar with the internal organization of the cell. The students can place detailed information on the topic of cell biology in larger contexts and understand current research questions.
Contents	Based on the book "Molecular Biology of the Cell" by Bruce Alberts, a coherent overview of cell biology will be developed and, if necessary, existing gaps will be filled. In this module (The Cell II) we deal with the internal organization of the cell and cells in their social environment (cell signal transmission; cell cycle; cell death; development of multicellular organisms).
Course types and forms of instruction:	• S: The Cell II - read, understand, discuss — 2 SEM./HRS

Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: The Cell II - read, understand, discuss		*28*	*42*	*20*
	Total Workload	*3*	*28*	*42*	*20*

Coursework and examinations:	*Formal requirements for examinations:* Book reading, active participation in the seminar (questions/answers and contributions to the discussion) *Examinations:* Presentation and written elaboration (graded, 100%)
Duration	one semester
Module frequency:	Alternating with the two modules The Cell I and The Cell III
Literature:	Molekularbiologie der Zelle 6. Auflage, 5. April 2017 von Ulrich Schäfer (Herausgeber), Bruce Alberts (Autor), Alexander Johnson (Autor), Julian Lewis (Autor), David Morgan (Autor), Martin Raff (Autor), Keith Roberts (Autor), Peter Walter (Autor), Bärbel Häcker (Übersetzer), Claudia Horstmann (Übersetzer), Alexandra Prowald (Übersetzer)

Title:	**The Cell III - read, understand, discuss (3 ECTS)**
Module number:	BBIO-WPW-86
Semester:	Winter or summer
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	The modules The Cell I, II and III can be taken independently of each other and in any order. Successful completion of the module Fundamentals of Cell Biology and Biochemistry is strongly recommended!
Module coordinator:	Prof. Dr. Arp Schnittger, Phone: 42816 502, arp.schnittger (at) uni-hamburg.de
Instructors:	Dr. Maren Heese, Prof. Dr. Arp Schnittger
language	German
Intended learning objectives:	Students have an overview of the molecular processes of a cell and are familiar with the internal organization of the cell. The students can place detailed information on the topic of cell biology in larger contexts and understand current research questions.
Contents	Based on the book "Molecular Biology of the Cell" by Bruce Alberts, a coherent overview of cell biology will be developed and, if necessary, existing gaps will be filled. In this module (The Cell III) we deal with the internal organization of the cell and cells in their social environment (cell compartments and protein sorting; intracellular membrane traffic; the cytoskeleton; cell connections; cancer).
Course types and forms of instruction:	• S: The Cell III - read, understand, discuss — 2 SEM./HRS

Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: The Cell III - read, understand, discuss		*28*	*42*	*20*
	Total Workload	*3*	*28*	*42*	*20*

Coursework and examinations:	*Formal requirements for examinations:* Book reading, active participation in the seminar (questions/answers and contributions to the discussion) *Examinations:* Presentation and written elaboration (graded, 100%)
Duration	one semester
Module frequency:	Alternating with the two modules The Cell I and The Cell II
Literature:	Molekularbiologie der Zelle 6. Auflage, 5. April 2017 von Ulrich Schäfer (Herausgeber), Bruce Alberts (Autor), Alexander Johnson (Autor), Julian Lewis (Autor), David Morgan (Autor), Martin Raff (Autor), Keith Roberts (Autor), Peter Walter (Autor), Bärbel Häcker (Übersetzer), Claudia Horstmann (Übersetzer), Alexandra Prowald (Übersetzer)

Title:	**Diversity and Evolution of Molluscs**				
Module number:	BBIO-WPW-55				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Berhard Hausdorf, Tel.: 238317-617, b.hausdorf (at) leibniz-lib.de				
Instructors:	Prof. Dr. Bernhard Hausdorf,				
Language	German (on demand English)				
Intended learning objectives:	The students have knowledge of native land and freshwater molluscs and possess the ability to survey and assess mollusc communities, as well as the ability to work taxonomically. They also have knowledge of the basics of molecular phylogeny and can compute and evaluate molecular trees.				
Contents	Systematics of native land and freshwater molluscs, collecting techniques, preparation, determination. Foundations of molecular phylogeny, computation and evaluation of molecular trees.				
Course types and forms of instruction:	• L: Diversity, Evolution and Ecology of Molluscs • S: Evolution, Diversity and Ecology of Molluscs • P: Systematic and Ecology of Molluscs				1 SEM./HRS 1 SEM./HRS 3 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Diversity, Evolution and Ecology of Molluscs		*14*	*15*	*15*
	• S: Evolution, Diversity and Ecology of Molluscs		*14*	-	*30*
	• P: Systematic and Ecology of Molluscs		*42*	*45*	*20*
	Total Workload	*6*	*70*	*45*	*65*
Coursework and examinations:	*Formal requirements for examinations:* Active participation, presentation. *Examinations:* Oral examination (graded, 100%) on the content of the lecture and practical course, in which at least sufficient knowledge of the contents of the module is shown.				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Introduction to the Model Organism *C. elegans* for the Study of Cellular and Molecular Biology Issues in the Life Sciences**
Module number:	BBIO-WPW-64
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Successful completion of the modules, "Cell Biology and Biochemistry", "General Genetics and Molecular Biology", and "Developmental Biology".
Module coordinator:	Prof. Dr. Baris Tursun; Phone: 42838 3857; baris.tursun (at) uni-hamburg.de
Instructors:	Prof. Dr. Baris Tursun
Language	German (on demand English)
Intended learning objectives:	Students have gained insight into working with the nematode (nematode) *Caenorhabditis elegans*, as a model organism in modern life sciences. They have gained basic technical knowledge and practical skills such as: Working on binoculars, transposing *C. elegans*, mating and crossing animals (genetics), RNA interference (RNAi) to knock out genes, PCR genotyping of modified genes (e.g. mutations or CRISPR/Cas9 editing).
Contents	Reprogramming of cells and epigenetic mechanisms. Use of *C. elegans* as a model organism for molecular and cell biological questions. In the course, worms are picked and mated at the binocular for cross-breeding of animals (genetics). RNA interference (RNAi) involves knocking down genes (RNAi knockdown) and reprogramming cells, which are analyzed on the fluorescence microscope. Genotyping of modified genes (e.g. mutations or CRISPR/Cas9 editing) and RNAi molecules using PCR will be learned and applied.
Course types and forms of instruction:	• L: Introduction to the Model Organism *C. elegans* and Cellular and Molecular Biology Techniques — 1 SEM./HRS • P: Practical Course to learn Basic and Molecular Biology Techniques with *C. elegans* — 5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction to the Model Organism *C. elegans* and Cellular and Molecular Biology Techniques		*14*	*8*	*8*
• P: Practical Course to learn Basic and Molecular Biology Techniques with *C. elegans*		*70*	*60*	*20*
Total Workload	*6*	*84*	*68*	*28*

Coursework and examinations:	*Formal requirements for examinations:* Active participation, presentation. *Examinations:* Internship completion (protocol graded, 75%) and written exam (graded, 25%), which must demonstrate at least sufficient knowledge of the content of each of the courses.
Duration	one semester
Module frequency:	annual
Literature:	http://www.wormbook.org/chapters/www_celegansintro/celegansintro.html - sowie weiterführende Online-Kapitel im ‚Wormbook' (z.B. RNAi).

	Alberts et al., Molekularbiologie der Zelle, Wiley-VCH Verlag, Weinheim. In der jeweils aktuellen Auflage (derzeit 6.). Jochen Graw.: Genetik. Springer-Spektrum Verlag, Heidelberg. In der jeweils aktuellen Auflage (derzeit 7.).

Title:	**Introduction to Estuary Research**				
Module number:	BMARSYS-26				
Semester:	summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Justus van Beusekom; Justus.van.Beusekom (at) uni-hamburg.de				
Instructors:	Dr. Justus van Beusekom				
Language	German				
Intended learning objectives:	Students have a deeper insight into biological and biogeochemical processes in estuaries and the effects of human interventions on these processes. They know different sampling techniques for zooplankton and phyto-plankton, water samples and sediment and can determine turnover rates (respiration, primary production, nitrogen turnover in sediments). They know the most important plankton species. They can evaluate ship data from autonomous measuring systems (underway-data). Through the module, students gain knowledge of how estuarine ecosystems are affected by human intervention and climatic factors, so that they can also work in the field of coastal or marine protection.				
Contents	Ship excursion with sampling. Chemical analyses. Species identification of the dominant plankton species with microscopes. Experiments with water and sediment samples. Evaluation of measured data. Evaluation of long-term data. Presentations of the results. Seminar presentations of selected topics.				
Course types and forms of instruction:	• L: Introduction to Estuary Research • P: Introduction to Estuary Research				1 SEM./HRS 2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Estuary Research		*14*	*14*	*14*
	• P: Introduction to Estuary Research		*28*	*28*	*82*
	Total Workload	*6*	42	42	96
Coursework and examinations:	*Formal requirements for examinations:* Active participation, presentation. *Examinations:* Internship completion (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Introduction to Human Biology**				
Module number:	BBIO-WPW-30				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Thomas M. Kaiser, Phone: 238317-623, thomas.kaiser (at) uni-hamburg.de				
Instructors:	Prof. jun. Dr. Esther Diekhof Prof. Dr. Thomas M. Kaiser				
Language	German				
Intended learning objectives:	Students will have basic insight into the human nervous system, and will be able to relate its functional systems to the fundamentals of learning and memory. Students acquire knowledge of the functional anatomy of the human brain and have the ability to understand and classify behavioral and brain imaging findings from cognitive neuroscience. Students will have a basic understanding of human evolution. Know the fossil record, can place it in time and geography, and are up to date on the key innovations of hominization the spatio-temporal patterns of migration and gene flow. They also know the basic working methods of paleoanthropology, paleogenetics, and paleoecology and their impact on knowledge gain.				
Contents	Cell biology, neurobiology, neuroanatomy, behavioral biology of man, evolution of man and your ecological and geographical parameters. Chronology and interpretation of the fossil record.				
Course types and forms of instruction:	• L: Introduction to Human Biology				2 SEM./HRS
Workload (module components and total):	• L: Introduction to Human Biology	*credits*	P (hrs) *28*	S(hrs) *30*	EP (hrs) *32*
	Total Workload	*3*	*28*	*30*	*32*
Coursework and examinations:	*Formal requirements for examinations:* Participation in the lecture is strongly recommended *examinations:* Written examination (100%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Biologie - Campbell, Reece - Pearson, Kapitel 2, 5, 6, 7, 11, 44, 48, 49 Gazzaniga et al. 2002 Cognitive Neuroscience: The Biology of the Mind. 2nd Edition Jurmain, R., et al. (2008): Introduction to Physical Anthropology. 11th ed. Thomson Neurowissenschaften - Kandel - Spektrum, Kapitel II, III, IV, IX Roberts, A. Die Anfänge der Menschheit, Dorling Kindersley				

Title:	**Introduction to Medical Chemistry**				
Module number:	CHE 356				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	Recommended: Introductory events in chemistry and biochemistry				
Module coordinator:	Prof. Dr. Hans-Jürgen Duchstein, duchstein (at) chemie.uni-hamburg.de				
Instructors:	Prof. Dr. Hans-Jürgen Duchstein Dr. Thomas Lemcke				
Language	German				
Intended learning objectives:	The students acquire knowledge of basic concepts used in medical chemistry, possibilities of interaction between the active substance and the biological target structure, classification of the pharmaceutical classes of active ingredients, process of drug development.				
Contents	A brief introduction to medicinal chemistry will be given. In the process, applied working techniques are presented and selected examples are used to develop principles and procedures. Topics are: basics of drug effect; Type of attack for drugs; Interactions between drugs and biological systems; Agonists - antagonists; Principles of drug development; Examples of important drug classes and target structures.				
Course types and forms of instruction:	• L: Introduction to Medical Chemistry				2 SEM./HRS
Workload (module components and total):	• L: Introduction to Medical Chemistry	*credits*	P (hrs) *28*	S(hrs) *42*	EP (hrs) *20*
	Total Workload	*3*	*28*	*42*	*20*
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written Examination (100%).				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Introduction to Lichenology**				
Module number:	BBIO-WPW-21				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	Successful participation in the module "Biodiversity of Plants" is recommended				
Module coordinator:	Dr. Matthias Schultz, Phone 42816 694, matthias.schultz (at) uni-hamburg.de				
Instructors:	Dr. Matthias Schultz				
Language	German				
Intended learning objectives:	The students have acquired basic and in-depth knowledge in anatomy and morphology, biology as well as systematics, phylogeny and classification of lichens (Lichenes) [lecture]. They learn to recognize and determine frequent lichens in Hamburg, Germany and Central Europe. [practical course] Applied aspects such as standardized methods of lichen mapping, bioindication, nature and species protection are dealt with in practical field exercises				
Contents	Morphology, biology, systematics and phylogeny of lichen-forming Ascomyceten (lichens, lichens)				
Course types and forms of instruction:	• L: Introduction to Lichenology • P: Identification of Lichens • E: Introduction to Lichen Mapping				1 SEM./HRS 1 SEM./HRS 0,5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Lichenology		*14*	*28*	*50*
	• P: Identification of Lichens		*14*	*28*	
	• E: Introduction to Lichen Mapping		*7*	*7*	*25*
	Total Workload	*6*	*35*	*70*	*75*
Coursework and examinations:	*Formal requirements for examinations:* Active participation. *examinations:* Seminar lecture with presentation of a scientific publication (75%), identification of 20 lichens (25%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Introduction to Psychobiology**				
Module number:	BBIO-WPW-88				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Esther Diekhof, Phone: 42838 3931, E-Mail: esther.diekhof (at) uni-hamburg.de				
Instructors:	Dr. Esther Diekhof Dr. Clemens Wülfing				
language	German				
Intended learning objectives:	The students have a basic insight into the human nervous system and can assign its functional systems to the basics of learning and memory, attention, social cognition and emotions. The students acquire knowledge of the functional anatomy of the human brain and have the ability to understand and classify behavioral biology and brain imaging findings from cognitive neuroscience. The students also acquire knowledge of how the human hormone system works and the influence of hormones on neuronal processes and behavior (e.g. using the example of motivation, social cognition and stress). The students acquire knowledge of the human immune system and the basics of psychoneuroimmunology and can assign the molecular and cellular basics to the innate and adaptive immune system as well as the corresponding immune reactions and lymphatic organs.				
Contents	Cell biology, neurobiology, neuroanatomy, human behavioral biology, molecular and cellular immunology, lymphatic organs, psychoneuroimmunology, microbiome, cognitive neuroscience, neuroendocrinology				
Course types and forms of instruction:	• Introduction to Psychobiology				2 SEM./HRS
Workload (module components and total):	• Introduction to Psychobiology	*credits*	P (hrs) *28*	S(hrs) *30*	EP (hrs) *32*
	Total Workload	*3*	*28*	*30*	*32*
Coursework and examinations:	Formal requirements for examinations: Participation at the lecture is recommended examinations: Written Examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Biologie - Campbell, Reece - Pearson, Kapitel 2, 5, 6, 7, 11, 44, 48, 49 Gazzaniga et al. 2002 Cognitive Neuroscience: The Biology of the Mind. 2nd Edition				

Title:	**Introduction to Machine Learning for Biologists**
Module number:	BMARSYS-24
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	None
Module coordinator:	Prof. Dr. Christian Möllmann, Phone.: 42838 6620, christian.moellmann(at)uni-hamburg.de
Instructors:	Dr. Jens Floeter
Language	German
Intended learning objectives:	Students have an in-depth understanding of the state of knowledge and research topics in fisheries science. They have explicit knowledge of the effects of overfishing and climate change on commercial fish stocks and marine food webs. Furthermore, students know the current literature on the topic of social-ecological systems analysis in the field of exploited marine ecosystems.
Contents	Definition of overfishing; climate influence on productivity (recruitment and growth) and geographic distribution of exploited fish stocks; relevance of climate change to modern ecosystem-based fisheries management; vulnerability analyses; ecosystem indicators; conflicts in fisheries management; participatory modeling; interactions among ecological, societal, and economic system components.
Course types and forms of instruction:	• L: Introduction to Machine Learning for Biologists — 2 SEM./HRS • S: Current Case Studies of Machine Learning in Biology — 1 SEM./HRS • E: Introduction to Machine Learning for Biologists — 5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction to Machine Learning for Biologists		*28*	*28*	*28*
• S: Current Case Studies of Machine Learning in Biology		*14*	*14*	*10*
• E: Introduction to Machine Learning for Biologists		*70*	*68*	*10*
Total Workload	*9*	*112*	*110*	*48*

Coursework and examinations:	*Formal requirements for examinations:* Active participation in the excercise *examinations:* Final excercise (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	François Chollet: Deep Learning mit Python und Keras: Das Praxis-Handbuch vom Entwickler der Keras-Bibliothek. MITP, 2018, ISBN 978-3-95845-838-3

Title:	**Application of Mass Spectrometry in Molecular Biology**				
Module number:	BBIO-WPW-72				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	The modules "General and Inorganic Chemistry", "Experimental Physics", "General Genetics and Molecular Biology", "Plant Physiology" and "Microbiology" must be successfully completed. All compulsory modules recommended by the fourth semester, 1-4 should be completed.				
Module coordinator:	Prof. Dr. Julia Kehr, Phone: 42816 312, julia.kehr (at) uni-hamburg.de				
Instructors:	Prof. Dr. Julia Kehr				
Language	German				
Intended learning objectives:	Mass spectrometry is a modern analytical method that is becoming increasingly important in many areas of biological research. The students have learned methods of mass spectrometric analysis and data evaluation, are able to apply them and are familiar with the manifold possible applications of mass spectrometric methods in molecular biology.				
Contents	Various mass spectrometric methods are learned and applied. A focus is on the study of proteins, which are identified and characterized. This includes sample preparation, protein separation, proteolytic cleavage, measurements by mass spectrometry and data analysis for the identification of proteins and analysis of modifications. As part of the experiment and finally, all approaches and the results obtained will be thoroughly discussed, analysed and evaluated.				
Course types and forms of instruction:	• L: Analytical Methods • P: Practical Course in Molecular Biology and Analytics				1 SEM./HRS 4,5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Analytical Methods		*12*	*30*	*20*
	• P: Practical Course in Molecular Biology and Analytics		*68*	*50*	-
	Total Workload	*6*	*80*	*80*	*20*
Coursework and examinations:	*Formal requirements for examinations:* Active participation. *examinations:* Oral examination (100%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Hubert Rehm: Der Experimentator: Proteinbiochemie/Proteomics (German Edition). Herbert Budzikiewicz, Mathias Schäfer: Massenspektrometrie: Eine Einführung.				

Title:	**Human Evolution - Current Topics**				
Module number:	BBIO-WPW-73				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Thomas M. Kaiser, Phone: 238317-623, thomas.kaiser (at) uni-hamburg.de				
Instructors:	Prof. Dr. Thomas M. Kaiser				
Language	German/English				
Intended learning objectives:	Students will read highest ranking original papers form recent years and prepare a presentation. in palaeoanthropology and archaeozoology. They will thus improve their ability to read original literature and present a current research topic.				
Contents	The seminar will discuss a variety of current research approaches in palaeoanthropology and archeozoology. On the basis of highest ranking publications in international journals the current research results of the discipline are presented. Subsequent discussions will provide the conceptual and methodological foundations needed to reconstruct the historical process of human evolution. Current and historical hypotheses and models of the key events of hominization as well as the current debate will be illustrated. The seminar should also give suggestions and assist you in developing your own research interests.				
Course types and forms of instruction:	• S: Human Evolution - Current Topics				2 SEM./HRS
Workload (module components and total):	• S: Human Evolution - Current Topics	*credits*	P (hrs) *28*	S(hrs) *52*	EP (hrs) *10*
	Total Workload	*3*	*28*	*52*	*10*
Coursework and examinations:	*Formal requirements for examinations:* Active Participation *examinations:* Presentation (100%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Functional Biology in Plants**
Module number:	BBIO-WPW-81
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Successful participation in the modules "Plant Physiology" and "General Genetics and Molecular Biology" is recommended.
Module coordinator:	PD Dr. Sabine Lüthje, Phone: 42816-340, sabine.luethje (at) uni-hamburg.de
Instructors:	PD Dr. Sabine Lüthje
Language	German
Intended learning objectives:	Students acquire in-depth knowledge of current topics in functional biology with a focus on plant development, oxidative stress, and the structure and function of redox systems. They master basic biochemical and physiological methods to study molecular mechanisms in plant development and oxidative stress. They are able to evaluate their research results, present them in a professional manner and deliver them in the form of a presentation.
Contents	Methods for studying the adaptation and molecular mechanisms of the stress response of plants are learned. Different model organisms and crops are used. To analyze developmental changes or the stress response, different methods of functional biology such as phenotyping, imaging PAM, in vivo staining of redox reactions, microassays, proteome approaches and in silico structural analyses etc. are applied.
Course types and forms of instruction:	• S: Current Topics in Functional Biology — 1 SEM./HRS • P: Functional Biology — 5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• S: Current Topics in Functional Biology		*14*	*20*	*28*
• P: Functional Biology		*70*	*100*	*38*
Total Workload	*9*	*84*	*120*	*66*

Coursework and examinations:	*Formal requirements for examinations:* Regular attendance and active participation in seminar and practical course *examinations:* Oral Examination (100%).
Duration	one semester
Module frequency:	annual
Literature:	Schulze, Beck, Müller-Hohenstein, Pflanzenökologie, Spektrum Taiz and Zeiger, Plant Physiology, Sinauer Associates

Title:	**History of Biology**				
Module number:	GdN-LA Bio 3				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Stefan Kirschner, Phone: 42838-2785, stefan.kirschner (at) uni-hamburg.de				
Instructors:	Prof. Dr. Stefan Kirschner				
Language	German				
Intended learning objectives:	Students are able to recognize the dependence of biological thought and the progress of science on societal, philosophical, religious, economic, political and other factors. They are capable of chronologically classifying important biological theories, models and insights into the history of ideas.				
Contents	The subject of the lecture is the historical development of biological concepts, theories and research from early civilizations to the 20th century. In general, also problem-historical and time-spanning aspects are treated, such as the transformation of the attitudes of man towards the living environment.				
Course types and forms of instruction:	• L: History of Biology				2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: History of Biology		*28*	*40*	*22*
	Total Workload	*3*	*28*	*40*	*22*
Coursework and examinations:	*Formal requirements for examinations:* Participation in the lecture is strongly recommended *examinations:* Presentation (100%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Höxtermann, E.; Hilger, H. H. (Hrsg.) (2007): Lebenswissen. Eine Einführung in die Geschichte der Biologie. Rangsdorf. Jahn, I. (Hrsg.) (2004): Geschichte der Biologie. 3. Aufl. Hamburg: Nikol,(Als CD-ROM erschienen bei Directmedia Publishing, ISBN: 3-89853-538-X.)				

Title:	**Mathematical Foundations of Plant Physiology**
Module number:	BBIO-WPW-87
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	None, successful completion of „Data Science“ and „Plant Physiology“ is recommended
Module coordinator:	Prof. Dr. Philipp Porada, Phone: 42816577 , philipp.porada (at)uni-hamburg(dot)de
Instructors:	Prof. Dr. Philipp Porada
language	German
Intended learning objectives:	The students have basic knowledge of the quantitative description of important physiological processes in plants using mathematical equations. The focus here is on the exchange of carbon and water with the environment. They can apply this knowledge to numerically calculate the dynamic response of plants to environmental factors using computer software and thus predict the growth of the organisms. The students can independently develop their own solutions for physiological processes and implement them numerically.
Contents	Basics for the quantitative representation of physiological processes (photosynthesis, respiration, transpiration, growth, etc.) as a function of environmental factors (light, water, temperature, etc.). Numerical solution of the associated differential equations to predict the dynamics of plant processes; programming in Matlab/Octave
Course types and forms of instruction:	• L Mathematical Description of Physiological Processes — 1 SEM./HRS • E Programming with Matlab/Octave — 1 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L Mathematical Description of Physiological Processes		*14*	*20*	*11*
• E Programming with Matlab/Octave		*14*	*20*	*11*
Total Workload	*3*	*28*	*40*	*22*

Coursework and examinations:	Formal requirements for examinations: Independent solution of exercises examinations: Homework (independent development and implementation of a calculation of vegetation processes on a chosen topic, graded, 100%)
Duration	one semester, block course
Module frequency:	annual
Literature:	

Title:	**Introduction to Behavioural Ecology**				
Module number:	BBIO-WPW-22				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Jutta Schneider, Phone: 42838 3878, jutta.schneider (at) uni-hamburg.de				
Instructors:	Prof. Dr. Jutta Schneider				
language	German				
Intended learning objectives:	Students deepen their understanding of evolutionary hypotheses and their verification through experiments. They are familiar with the application of the economy principle in behavioural science. They have gained knowledge of the most important subareas and selected model studies in behavioural ecology.				
Contents	Testing hypotheses in behavioural ecology; proximate & ultimate issues; Basics of decision in animals; Predator and prey strategies; signals; Choice of partner; Social behaviour.				
Course types and forms of instruction:	• L: Introduction to Behavioural Ecology • S: Case studies in Behavioural Ecology • E: Practical Tests of the Economy Principle				1 SEM./HRS 1 SEM./HRS 2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to Behavioural Ecology		*14*	*21*	*10*
	• S: Case studies in Behavioural Ecology		*14*	*31*	-
	• E: Practical Tests of the Economy Principle		*28*	*62*	-
	Total Workload	*6*	*56*	*114*	*10*
Coursework and examinations:	*Formal requirements for examinations:* Active participation, Presentation, Protocol. *examinations:* Written or Oral examination (graded, 100%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Kappeler P.: Verhaltensbiologie. Springer, Berlin. In der jeweils aktuellen Auflage Dugatkin L.E.: Model Systems in Behavioral Ecology. Princeton University Press. In der jeweils aktuellen Auflage				

Title:	**Introduction to Behavioural Ecology (3CP)**				
Module number:	BBIO-WPW-22a				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Jutta Schneider, Phone: 42838 3878, jutta.schneider (at) uni-hamburg.de				
Instructors:	Prof. Dr. Jutta Schneider				
language	German				
Intended learning objectives:	Students deepen their understanding of evolutionary hypotheses and their verification through experiments. They are familiar with the application of the economy principle in behavioural science.				
Contents	Testing hypotheses in behavioural ecology; proximate & ultimate issues; Basics of decision in animals; Predator and prey strategies; signals; Choice of partner; Social behaviour.				
Course types and forms of instruction:	• L: Introduction to Behavioural Ecology				1 SEM./HRS
Workload (module components and total):	• L: Introduction to Behavioural Ecology	*credits*	P (hrs) *14*	S(hrs) *46*	EP (hrs) *30*
	Total Workload	*3*	*14*	*46*	*30*
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written examination (graded, 100%).				
Duration	one semester				
Module frequency:	annual				
Literature:	Kappeler P.: Verhaltensbiologie. Springer, Berlin. In der jeweils aktuellen Auflage Dugatkin L.E.: Model Systems in Behavioral Ecology. Princeton University Press. In der jeweils aktuellen Auflage				

Title:	**Fundamental Concepts in Ecology**				
Module number:	BBIO-WPW-39				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Kathrin Dausmann, Tel.: 42838 3864, kathrin.dausmann (at) uni-hamburg.de				
Instructors:	Prof. Kathrin Dausmann Dr. Julian Glos				
language	German				
Intended learning objectives:	Students have learned and evaluated basic concepts of evolution and ecology. Students are familiar with the critical analysis of ecological concepts, and they can classify and critically evaluate current research in theory and practice within these concepts.				
Contents	Basic concepts of ecology from Darwin to the present are discussed and evaluated. Both historical and contemporary work on each topic will be analyzed and classified. There is a practical exercise for each topic. Possible topics include: Evolution, sexual selection, island biogeography, feeding ecology, optimal foraging, ecological niche, ecosystem services, climate change, phenotypic plasticity.				
Course types and forms of instruction:	• L: Fundamental Concepts in Ecology • E: Fundamental Concepts in Ecology				1 SEM./HRS 2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Fundamental Concepts in Ecology		*16*	*34*	
	• E: Fundamental Concepts in Ecology		*40*	*46*	*44*
	Total Workload	*6*	*56*	*80*	*44*
Coursework and examinations:	*Formal requirements for examinations:* Active participation in the seminar incl. seminar presentation (not graded) *examinations:* Written examination (graded, 100%).				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Basics in Limnology**
Module number:	BBIO-WPW-66
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	PD Dr. Dörthe Müller-Navarra, Phone: 42838 653, doerthe.mueller-navarra(at)uni-hamburg.de
Instructors:	PD Dr. Dörthe Müller-Navarra
Language	German
Intended learning objectives:	Students possess the general foundations for understanding inland aquatic ecosystems, knowledge of terminology and concepts of aquatic ecology, and have insight into the applications.
Contents	Introduction to the basics, concepts and applications of limnology. There is a focus on the introduction of technical terms and concepts. The following topics are covered: formation of inland waters, characteristics of water, water balance, radiation conditions, heat balance and stratification, water movement; Cohabitation in lakes and rivers, aquatic cycles, successions, human use of waters, e.g. as a drinking water resource and wastewater treatment.
Course types and forms of instruction:	• L: Introduction to Limnology 3 SEM./HRS • Ex: Hydrobiological Excursions 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction to Limnology		*42*	*41*	*41*
• Ex: Hydrobiological Excursions		*28*	*28*	-
Total Workload	*6*	*70*	*69*	*41*

Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Partial examinations: Weekly written and possibly oral exams on the lecture material in the first semester half. The written examinations are graded (this results in the module grade). Anyone who does not come up with a minimum score will be individually tested orally. In the exam there is the opportunity to explain something that is not understood. Presentation in the 2nd semester half, which is not graded.
Duration	one semester
Module frequency:	annual
Literature:	Schwoerbel, J., und Brendelberger, H.: Einführung in die Limnologie. Spektrum Akademischer Verlage. In der jeweils aktuellen Auflage Lampert, W., und Summer, U.: Limnoökologie. Thieme In der jeweils aktuellen Auflage Wetzel, R.G.: Limnology. Sauders Collge Publishing. In der jeweils aktuellen Auflage Ruttner, F.: Grundriß der Limnologie. Walter de Gruyter & Co. In der jeweils aktuellen Auflage

Title:	**Methods of Field Ecology**				
Module number:	BBIO-WPW-28				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	Successful completion of the module "Ecology" is required.				
Module coordinator:	Prof. Dr. Kai Jensen, Phone: 42816 576, kai.jensen (at) uni-hamburg.de				
Instructors:	Dr. Veit Hennig Prof. Dr. Kai Jensen				
Language	German				
Intended learning objectives:	The students gain security in the application of field ecological methods of animal and plant ecology. They learn to work independently as a basis for carrying out bachelor theses.				
Contents	Introduction to methods of field ecology, recording and evaluation of site parameters, animal and plant populations, communities. Experimental design.				
Course types and forms of instruction:	• L: Methods of Field Ecology • P: Applied Methods of Field Ecology				1 SEM./HRS 4,5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Methods of Field Ecology		*14*	*10*	*21*
	• P: Applied Methods of Field Ecology		*63*	*72*	-
	Total Workload	*6*	*77*	*82*	*21*
Coursework and examinations:	Formal requirements for examinations: Active participation, presentation and protocol examinations: Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Tremp, H.: Aufnahme und Analyse vegetationsökologischer Daten. In der jeweils aktuellen Auflage				

Title:	**Molecular Methods for Microbiology Researches**				
Module number:	BBIO-WPW-15				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Christel Vollstedt, Phone: 42816 443, christel.vollstedt (at) uni-hamburg (dot) de, Dr. Gabriele Timmermannn Phone:42816 436, gabriele.timmermann(at) uni-hamburg (dot).de				
Instructors:	Dr. Christel Vollstedt Dr. Gabriele Timmermann				
Language	German				
Intended learning objectives:	The students have an overview of the current molecular biology techniques used in microbiology. They can assign and apply these independently to the different questions. They are skilled in dealing with the necessary equipment and materials.				
Contents	The students should learn the safe and independent application of molecular biology techniques in microbiology.				
Course types and forms of instruction:	• S: Molecular Methods for Microbiology Researches • P: Molecular Methods for Microbiology Researches				1 SEM./HRS 5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Molecular Methods for Microbiology Researches		*14*	*24*	
	• P: Molecular Methods for Microbiology Researches		*70*	*32*	*40*
	Total Workload	*6*	*84*	*56*	*40*
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Oral examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Methods of Plant Pathology with Viruses**				
Module number:	BBIO-WPW-58				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	PD Dr. Cornelia Heinze, Phone. 42816 592, cornelia.heinze (at) uni-hamburg.de				
Instructors:	PD Dr. Cornelia Heinze				
Language	German				
Intended learning objectives:	The students master the common methods for the diagnosis and characterization of pathogens and can evaluate the results. They know the meaning of Koch's postulates and can also understand them experimentally.				
Contents	Introduction to the diagnosis of pathogens using the example of phytopathogenic viruses. In the course techniques are taught in order to be able to conclude from a symptom on the pathogen type and to be able to further characterize accordingly. Biological and electron-optical methods for rough estimation serve this purpose. Further differentiation is performed with nucleic acid-based (RT-PCR, hybridization) and serological methods (Western blot, ELISA, Geldiffusion). Knowledge about the purification of biomolecules is provided for a final characterization.				
Course types and forms of instruction:	• S: Methods of Plant Pathology with Viruses • P: Methods of Plant Pathology with Viruses				1 SEM./HRS 3 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Methods of Plant Pathology with Viruses		*14*	*26*	*20*
	• P: Methods of Plant Pathology with Viruses		*42*	*78*	-
	Total Workload	*6*	*56*	*104*	*20*
Coursework and examinations:	Formal requirements for examinations: Active participation, Protocol examinations: Written or Oral examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Drews, Adam, Heinze: Molekulare Pflanzenvirologie.; Agrios: Plant Pathology. Lieberei & Reisdorff: Nutzpflanzenkunde. Thieme, Stuttgart. In der jeweils aktuellen Auflage				

Title:	**Molecular Biological Basics in Marine Biology**				
Module number:	BMARSYS-27a				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Elisa Schaum, Phone: 42838 6625, elisa.schaum (at) uni-hamburg.de				
Instructors:	Dr. Luisa Listmann Prof. Dr. Elisa Schaum				
Language	German				
Intended learning objectives:	Students have an in-depth insight into relevant molecular biological methods in marine sciences. They have explicit knowledge about the biological basics as well as the application of the most common methods, e.g. PCR/qPCR, whole genome sequencing, metabarcoding and know for which questions they are to be applied.				
Contents	Methods in marine sciences, PCR/qPCR, whole genome sequencing, metabarcoding.				
Course types and forms of instruction:	• S: Molecular Biological Basics in Marine Biology				2 SEM./HRS
Workload (module components and total):	• S: Molecular Biological Basics in Marine Biology	*credits*	P (hrs) *28*	S(hrs) *28*	EP (hrs) *34*
	Total Workload	3	28	28	34
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Talk (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	To be announced at the beginning of the course.				

Title:	**Molecular Analysis of Plant Gene Families**
Module number:	BBIO-WPW-02
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Successful completion of the modules "Microbiology" and "General Genetics and Molecular Biology" is strongly recommended
Module coordinator:	Dr. Reinhold Brettschneider, Phone: 42816 384, reinhold.brettschneider (at) uni-hamburg.de
Instructors:	Dr. Reinhold Brettschneider
Language	German
Intended learning objectives:	The students understand the basic conception and strategy for the development of experimental solutions in molecular-biological questions and can independently design simple experiments. Are familiar with important methods of molecular biology, possess the ability to independently research and present. You are familiar with current literature. The ability to independently develop molecular genetic experiments is strengthened.
Contents	Techniques and working methods of molecular biology are to be developed practically. Using a gene family of maize consisting of seven members, various molecular methods are used to clone specific regions of the genes. Based on these sequences, strategies for the production of gene-specific probes are independently developed and implemented with the aid of bioinformatics tools. The produced but are analysed in Southern blot experiments for their specificity. The expression patterns of the individual members of the gene family should then be comparatively examined and evaluated by RT-PCR analyses.
Course types and forms of instruction:	• S: Cloning and Molecular Analysis of Plant Gene Families — 1 SEM./HRS • P: Cloning and Molecular Analysis of Plant Gene Families — 4,5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• S: Cloning and Molecular Analysis of Plant Gene Families		*14*	*21*	*10*
• P: Cloning and Molecular Analysis of Plant Gene Families		*63*	*72*	-
Total Workload	*6*	*77*	*93*	*10*

Coursework and examinations:	Formal requirements for examinations: Active participation, Protocol, Presentation examinations: Written or Oral examination (graded; 100%)
Duration	one semester
Module frequency:	annual
Literature:	Melzer et al. (1999). FPF1 modulates the competence to flowering in Arabidopsis. Plant J 18: 395-405. Kania et al. (1997). FPF1 promotes flowering in Arabidopsis. Plant Cell 9:1327ff

Title:	**Molecular Evolutionary Biology**
Module number:	BBIO-WPW-74
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Successful completion of the modules "Cell Biology and Biochemistry", "General Genetics and Molecular Biology" and "Animal Physiology" is required
Module coordinator:	Prof. Dr. Susanne Dobler, Phone: 42838 4288, susanne.dobler (at) uni-hamburg.de
Instructors:	Prof. Dr. Susanne Dobler
Language	German
Intended learning objectives:	The students are introduced into molecular mechanisms that may create evolutionary novelties and analyse their effects in case studies. The students gain insights into targeted transcriptome analysis to identify ecological adaptations of insects at the molecular level, and learn strategies to test the adaptive value of genetic changes through expression analysis and physiological assays.
Contents	Introduction to the theory of genetic mechanisms of evolutionary change. Specifically the origin of adaptations strategies of insects to their ecological niche, e.g. toxic substances in their host plants are analysed. In silico analysis of gene sequences involved in these adaptations, experiments for expression in cell culture and for functional characterization of genes, e.g. for detoxification of plant substances, by enzyme assays, RT-PCR or other methods
Course types and forms of instruction:	• S: Molecular Evolutionary Biology 1 SEM./HRS • P: Molecular Evolutionary Biology 5 SEM./HRS

Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Molecular Evolutionary Biology		*14*	*46*	*10*
	• P: Molecular Evolutionary Biology		*70*	*30*	*10*
	Total Workload	*6*	*84*	*76*	*20*

Coursework and examinations:	Formal requirements for examinations: Active participation, Presentation examinations: Oral examination (graded; 80%) and Talk (graded, 20%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the module

Title:	**Molecular Methods in Animal Physiology**
Module number:	BBIO-WPW-42
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Successful completion of the modules "Animal Physiology" and "Developmental Biologie" is required
Module coordinator:	Dr Andrej Fabrizius, Tel.: 42838 5646, andrej.fabrizius(at)uni-hamburg.de
Instructors:	Prof. Dr. Thorsten Burmester Dr Andrej Fabrizius,
Language	German
Intended learning objectives:	The students acquire knowledge of general concepts and skills in the application of molecular methods of comparative metabolic physiology of the animals.
Contents	To learn basic protein biochemical and molecular biological techniques of comparative metabolic physiology of animals, the expression and evolution of exemplarily selected proteins is learned in theory and practically tested in the laboratory.
Course types and forms of instruction:	• S: Molecular Methods in Animal Physiology — 1 SEM./HRS • P: Molecular Methods in Animal Physiology — 5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• S: Molecular Methods in Animal Physiology		*14*	*8*	*8*
• P: Molecular Methods in Animal Physiology		*70*	*60*	*20*
Total Workload	*6*	*84*	*68*	*28*

Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Protocol (graded; 80%) and presentation (graded; 20%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the module

Title:	**Molecular Plant Physiology - genetic, protein biochemical and microscopic analyses**
Module number:	BBIO-WPW-04
Semester:	Summer
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Successful completion of the modules "Plant Physiology" and " General Genetics and Molecular Biology " is strongly recommended
Module coordinator:	Dr. Magdalena Weingartner, Phone; 42816-562, magdalena.weingartner (at) uni-hamburg.de Prof. Dr. Stefan Hoth, Phone: 42816-582, stefan.hoth (at) uni-hamburg.de
Instructors:	Prof. Dr. Stefan Hoth Dr. Magdalena Weingartner
Language	German
Intended learning objectives:	The students have acquired up-to-date and in-depth knowledge of modern plant-specific, cell and molecular biology topics (plant biochemistry, molecular developmental and stress physiology). The students master basic molecular biology techniques as well as biochemical, cell biological and microscopic methods to study the molecular physiology of plant tissues and cells. They are able to log and interpret their own research results correctly. In addition, they can discuss and present the data obtained in connection with current research reports.
Contents	To learn basic cell biological, molecular biology and protein biochemical methods in plant physiology, the role of hormones in plant development processes and stress responses in the model plant Arabidopsis and in crops will be investigated. For this purpose, mutant and transgenic lines are used, which are not or only partially able to respond to the signal effect of hormones. Molecular biological techniques are used to quantify gene expression changes (such as RNA isolation, cDNA synthesis and real-time RT-PCR, reporter gene analyses) as well as cell biological methods using state-of-the-art microscopy equipment (e.g., fluorescence microscopy and confocal laser scanning microscopy). The transformation of plant tissue and the detection of a transgene are performed.
Course types and forms of instruction:	• S: Advanced Consideration and Current Topics of Molecular Plant Physiology — 1 SEM./HRS • P: Molecular Plant Physiology — 5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• S: Advanced Consideration and Current Topics of Molecular Plant Physiology		*14*	*20*	*28*
• P: Molecular Plant Physiology		*70*	*100*	*38*
Total Workload	*9*	*84*	*120*	*66*

Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Oral examination (graded; 70%), protocol (graded; 10%) and presentation (graded; 20%)
Duration	one semester
Module frequency:	annual
Literature:	Taiz and Zeiger: Plant Physiology. Sinauer Associates. In der jeweils aktuellen Auflage

	More will be accounced at the beginning of the module

Title:	**Molecular Cell Biology**
Module number:	BBIO-WPW-77
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Molecular biology knowledge from the modules designated for the first four semesters is assumed.
Module coordinator:	Prof. Dr. Sigrun Reumann, Tel.: 42816 743, sigrun.reumann (at) uni-hamburg.de
Instructors:	Prof. Dr. Sigrun Reumann
Language	German
Intended learning objectives:	The students have acquired up-to-date and in-depth knowledge of modern plant-specific, cell and molecular biology topics (plant biochemistry, molecular developmental and stress physiology). The students master basic molecular biology techniques as well as biochemical, cell biological and microscopic methods to study the molecular physiology of plant tissues and cells. They are able to log and interpret their own research results correctly. In addition, they can discuss and present the data obtained in connection with current research reports.
Contents	To learn basic cell biological, molecular biology and protein biochemical methods in plant physiology, the role of hormones in plant development processes and stress responses in the model plant Arabidopsis and in crops will be investigated. For this purpose, mutant and transgenic lines are used, which are not or only partially able to respond to the signal effect of hormones. Molecular biological techniques are used to quantify gene expression changes (such as RNA isolation, cDNA synthesis and real-time RT-PCR, reporter gene analyses) as well as cell biological methods using state-of-the-art microscopy equipment (e.g., fluorescence microscopy and confocal laser scanning microscopy). The transformation of plant tissue and the detection of a transgene are performed.
Course types and forms of instruction:	• V: Introduction to Molecular Cell Biology — 1 SEM./HRS • P+S: Molecular Cell Biology — 5 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• V: Introduction to Molecular Cell Biology		*14*	*18*	*20*
• P+S: Molecular Cell Biology		*70*	*58*	
Total Workload	*6*	*84*	*76*	*20*

Coursework and examinations:	Formal requirements for examinations: Active participation, approved protocol examinations: Oral examination (graded; 100%)
Duration	one semester
Module frequency:	annual
Literature:	To be accounced at the beginning of the module

Title:	**Morphology and Dissection of Selected Vertebrate Taxa**
Module number:	BBIO-WPW-60
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	Participation at the practical course “Function and Diversity in the Animal Kingdom”
Module coordinator:	Dr. Oliver Hallas, Phone: 42838 3928, oliver.hallas (at) uni-hamburg (dot) de
Instructors:	Dr. Oliver Hallas Dr. Jakob Hallermann
Language	German
Intended learning objectives:	The students have advanced knowledge in preparation and scientific drawing. Introduction to the functional morphological and comparative anatomical consideration of organs, organ systems and physique with special consideration of the way of life and evolution of the treated vertebrate groups.
Contents	In this module, students should gain in-depth knowledge of the morphology and biology of selected vertebrate animal groups through theoretical introductions, their own lectures and independent preparation under supervision. In the foreground are taxa that were not or only theoretically treated in the internship " Function and Diversity in the Animal Kingdom", such as: As lampreys, urodeles, turtles, snakes, sharks, birds etc.
Course types and forms of instruction:	• P: Morphology and Dissection of Selected Vertebrate Taxa — 6 SEM./HRS

Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• P: Morphology and Dissection of Selected Vertebrate Taxa		*84*	*74*	*22*
	Total Workload	*6*	*84*	*74*	*22*

Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Written or Oral examination (graded; 100%)
Duration	one semester
Module frequency:	biannual
Literature:	Kardong, Kenneth V. (2019): Vertebrates: comparative anatomy, function, evolution. 8th ed. McGraw-Hill Education, 790 Seiten. Liem, K. F. (2001): Functional anatomy of the vertebrates : an evolutionary perspective. 3rd ed., Cengage Learning, 703 S. Pough, F. H. (2019): Vertebrate life. 10th ed. Sinauer Associates, 552 S. Romer, A. S. & Parsons, Th. S. (1991): Vergleichende Anatomie der Wirbeltiere. 5., neubearb. und erw. Aufl. Parey. 624 S. Westheide, W. & Rieger, G. (2015): Wirbel- oder Schädeltiere. 3. Aufl. Springer Spektrum, 711 S.

Title:	**Semi-natural Habitats of Hamburg**				
Module number:	BBIO-WPW-49				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Kai Jensen, Tel.: 42816-576, kai.jensen (at) uni-hamburg.de				
Instructors:	Dr. Nikola Lenzewski				
Language	Deutsch/Englisch				
Intended learning objectives:	The students have an overview of the geological history of formation and the still existing near-natural habitats of Hamburg. They are able to survey abiotic parameters in the field, to describe and compare the vegetation of different habitats.				
Contents	- Geological history of origin and soils of Hamburg - Special features of the urban habitat (climate, sealing, soil conditions) - Aquatic habitats in the urban environment - Forests and woody structures in the urban environment - Moors and heaths in the urban environment - Grassland and arable land in the urban environment				
Course types and forms of instruction:	• S: Semi-natural Habitats of Hamburg • P: Field Course to semi-natural Habitats of Hamburg				1 SEM./HRS 4 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Semi-natural Habitats of Hamburg		*12*	*30*	*30*
	• P: Field Course to semi-natural Habitats of Hamburg		*56*	*22*	*30*
	Total Workload	6	68	52	60
Coursework and examinations:	Formal requirements for examinations: Active participation, presentation examinations: Protocol (graded; 50%), Talk (graded; 50%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Conservation Biology**				
Module number:	BBIO-WPW-78				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	Successful participation in the module "Ecology"(BSc. Biology, admission until WiSe 2015/16) or "Ecology and Biostatistics" (BSc. Biology, admission from WiSe 2016/17) is strongly recommended.				
Module coordinator:	Dr. Veit Hennig, Tel.: 42838 4235, veit.hennig (at) uni-hamburg.de				
Instructors:	Dr. Veit Hennig				
Language	German				
Intended learning objectives:	The students have an overview of the biological basics of species and biotope protection as well as tools and measures under nature conservation law. Through selected examples, the students have in-depth basic knowledge of species and biotope conservation. Students will be able to discuss conservation-related topics in a qualified manner.				
Contents	What is conservation biology - Biodiversity and biodiversity hotspots - Value of biodiversity - Threats to biodiversity: fragmentation, invasive species, overexploitation... extinction, local extinction, problems of small populations - Population and species conservation: applied population biology Population and species conservation: applied population genetics - Prioritization: what should be protected? - Legal tools of species protection - protected areas and protected area design (SLOSS debate, corridors) - nature conservation outside protected areas - nature conservation in cultural landscapes - nature conservation and agriculture - legal tools of biotope protection, FFH directive, impact regulation.				
Course types and forms of instruction:	• S: Conservation Biology				2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Conservation Biology		*28*	*28*	*34*
	Total Workload	3	28	32	30
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Talk (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Neurobiology**				
Module number:	BBIO-WPW-43				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Christian Lohr, Phone: 42838 5924, christian.lohr (at) uni-hamburg.de				
Instructors:	Prof. Dr. Christian Lohr				
Language	German				
Intended learning objectives:	The students acquire knowledge of general concepts and skills in the application of cell biological methods of neurobiology.				
Contents	Electrophysiological examinations of neurons and synaptic transmission. Staining and visualization of individual neurons.				
Course types and forms of instruction:	• S: Current Topics of Cellular Neurobiology • P: Neurohistology				1 SEM./HRS 5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Current Topics of Cellular Neurobiology		*14*	*8*	*8*
	• P: Neurohistology		*70*	*60*	*20*
	Total Workload	*6*	*84*	*68*	*28*
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Protocol (graded; 80%) and presentation (graded; 20%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Biology of Crop plants**				
Module number:	BIO-NF-MLEMI-01				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Christoph Reisdorff, Tel.: 42816 573, christoph.reisdorff (at) uni-hamburg.de				
Instructors:	Dr. Christoph Reisdorff				
Language	German				
Intended learning objectives:	Students know the life cycles of selected, important crops, their ecology and origin. They have knowledge of the utilized structures of crops and the biosynthetic pathways of the valuable ingredients. They have gained an insight into the cultivation, harvesting, economic importance and resulting problem areas of selected crops.				
Contents	Crop plants are presented according to the classification of their use or their ingredients (stimulants, oil-providing, carbohydrate-providing, ... plants) and past, present and possible future problem areas are discussed. Levels of consideration: - Origin, history and current significance - Allocation of the utilized parts to the basic angiosperm structure (root, shoot, leaf, flower, fruit), morphogenesis, utilization-relevant metamorphoses and quantitative variations - Ecology, cultivation, harvesting - Ingredient characteristics, processing - Problem areas (diseases, genetic diversity, ...)				
Course types and forms of instruction:	• L: Biology of Crop plants				2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Biology of Crop plants		*28*	*46*	*16*
	Total Workload	*3*	*28*	*46*	*16*
Coursework and examinations:	Formal requirements for examinations: participation examinations: Written or Oral examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Nutzpflanzenbiologie; France, Lieberei, Reisdorff, Thieme				

Title:	**Ecology of Tidal Flats**				
Module number:	BBIO-WPW-51				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Andreas Schmidt-Rhaesa, Phone: 238317-638, andreas.schmidt-rhaesa(at)uni-hamburg.de				
Instructors:	Prof. Dr. Andreas Schmidt-Rhaesa				
Language	German				
Intended learning objectives:	The students are able to formulate scientific questions, to design, execute and, if necessary, to modify appropriate experiments. They have acquired knowledge of the diversity and ecology of organisms in the Wadden Sea area.				
Contents	Knowledge of marine invertebrates - Ecology of the Wadden Sea - Fundamentals of marine biology - Implementation of multi-day field experiments - Independent planning and modification of experiments - Multiple interim reports and final report - Written protocol in the form of a scientific publication				
Course types and forms of instruction:	• P: Ecology of Tidal Flats				6 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• P: Ecology of Tidal Flats		*84*	*68*	*28*
	Total Workload	*6*	*84*	*68*	*28*
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Protocol (graded; 60%), Presentation (graded; 40%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Is given in the course				

Title:	**Ecology of the Baltic Sea**				
Module number:	BBIO-WPW-57				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Veit Hennig, Phone: 42838 4235, veit.hennig (at) uni-hamburg.de				
Instructors:	Dr. Veit Hennig				
Language	German				
Intended learning objectives:	The students have an overview of ecology, species groups and biotic communities of the Baltic Sea and are able to carry out the planning and execution of quantitative ecological investigations under water, independently.				
Contents	The module teaches fundamentals of Baltic ecology in theory and practice. The focus is on the communities of the sublittoral and the abiotic framework parameters, which are also recorded in the internship. For this purpose, qualitative and semi-quantitative methods with the special features of underwater detection are being tested.				
Course types and forms of instruction:	• S: Ecology of the Baltic Sea - Communities of the Littoral • P: Communities of the Littoral				2 SEM./HRS 6 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Ecology of the Baltic Sea - Communities of the Littoral		*28*	*40*	*22*
	• P: Communities of the Littoral		*84*	*96*	-
	Total Workload	*9*	*112*	*136*	*22*
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Written examination (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Is given in the course				

Title:	**Mechanisms of Plant Adaption**
Module number:	BBIO-WPW-06
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	The successful completion of the modules "Ecology" and " Plant Physiology" is required.
Module coordinator:	Dr. Christoph Reisdorff, Phone: 42816 573, christoph.reisdorff (at) uni-hamburg.de
Instructors:	Prof. Dr. Kai Jensen Dr. Christoph Reisdorff
Language	German
Intended learning objectives:	The students have an insight into the confrontation of plants with changing environmental conditions. They have learned important methods of eco-physiology and can safely handle measuring instruments. They have knowledge of data management and the application of statistical methods.
Contents	Introduction to the theory of plant adaptation mechanisms. Experiments on light adaptation of photosynthesis, cold stress, hypoxia and anoxia, temperature and light adaptation of germination; Adaptations to hydrochory and anemochory.
Course types and forms of instruction:	• S: Mechanisms of Plant Adaption — 1 SEM./HRS • P: Mechanisms of Plant Adaption — 5 SEM./HRS

Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• S: Mechanisms of Plant Adaption		*14*	*86*	*10*
	• P: Mechanisms of Plant Adaption		*70*		-
	Total Workload	*6*	*84*	*86*	*10*

Coursework and examinations:	Formal requirements for examinations: Active participation, Protocol and Presentation examinations: Oral examination (graded; 100%)
Duration	one semester
Module frequency:	irregular
Literature:	Gurevitch, Scheiner, Fox: The Ecology of Plants. Sinauer. In der jeweils aktuellen Auflage Gibson: Methods in comparative Plant Population Ecology. Oxford University Press. In der jeweils aktuellen Auflage Schulze, Beck, Müller-Hohenstein: Pflanzenökologie. Spektrum, Akad. Verl., Heidelberg. In der jeweils aktuellen Auflage Lambers, Chapin, Pons: Plant Physiological Ecology, Springer. In der jeweils aktuellen Auflage Larcher: Ökophysiologie der Pflanzen. Ulmer, Stuttgart. In der jeweils aktuellen Auflage

Title:	**Macrofungi in the Field and under the Microscope**
Module number:	BBIO-WPW-76
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	PD Dr. Cornelia Heinze, Phone: 42816 227, cornelia.heinze (at) uni-hamburg.de
Instructors:	PD Dr. Cornelia Heinze
Language	German
Intended learning objectives:	The students got to know the most important macroscopic and microscopic structures of cap fungi as well as their different staining methods. Students are able to apply this knowledge when determining self-collected material with various dichotomous and synoptic (digital) identification keys. You can select the most important genera and some common food and toadstools up to the species level. The students have knowledge of ecology, environmental protection and legal issues as well as mushroom toxins to the extent required in the examination of the fungal expert of the German Society of Mycology (DGfM).
Contents	Learn the biodiversity of mushrooms and their taxonomy. Gathering material and knowledge of the different ecosystems in which fungi can occur. Independent application of determination keys. Photographic documentation in the field as well as of macro- and micro-preparations. Creation of a collection documentation.
Course types and forms of instruction:	• L: Introduction to Macrofungi 0,5 SEM./HRS • E: Identification of Macrofungi using Scientific Identification Procedures 2 SEM./HRS • P: Field Course 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Introduction to Macrofungi		*14*	*20*	*14*
• E: Identification of Macrofungi using Scientific Identification Procedures		*28*	*20*	*10*
• P: Field Cours		*28*	*12*	*20*
Total Workload	*6*	*84*	*52*	*44*

Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Completion of the exam (detailed documentation of the findings, graded 100%)
Duration	one semester
Module frequency:	annual
Literature:	

Title:	**Plankton and Climate**
Module number:	BMARSYS-25
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Inga Hense, Phone: 42838 6641, inga.hense(at)uni-hamburg.de
Instructors:	Prof. Dr. Inga Hense Dr. Rolf Koppelmann Prof. Dr. Elisa Schaum
Language	German
Intended learning objectives:	Students know the effect of climate on plankton organisms and populations and their importance for the function of marine ecosystems and marine matter fluxes. They are also familiar with current topics and problems of planktology in the context of climate research.
Contents	Definition of climate, climate cycles, and climate change; climate gases and their cycles; relevance of climate to the ocean; contribution of plankton to climate change (e.g., carbon pumps); plankton as indicators of climate change (e.g., "regime shifts"); climate engineering (e.g., iron fertilization, "CO2 dumping"); ocean acidification.
Course types and forms of instruction:	• L: Marine plankton and climate change — 1 SEM./HRS • S: Current literature on the influence of climate on marine plankton — 1 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Marine plankton and climate change		*14*	*14*	*60*
• S: Current literature on the influence of climate on marine plankton		*14*	*28*	*50*
Total Workload	*6*	*28*	*42*	*110*

Coursework and examinations:	Formal requirements for examinations: Active participation, presentation examinations: Written examination (graded; 100%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the module

Title:	**Population Genetics**				
Module number:	BBIO-WPW-68				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Kathrin Otte, Phone: 42838 3933, kathrin.otte (at) uni-hamburg.de				
Instructors:	Prof. Dr. Kathrin Otte				
Language	German				
Intended learning objectives:	Students understand the importance of population genetic approaches for problems in evolutionary biology, ecology and nature conservation. They are familiar with experimental approaches and their implementation as well as the basic evaluation procedures.				
Contents	Basic terms of population genetic concepts, sampling of a natural water flea population in the Hamburg area, population genetic and phenotypic characterization of water flea samples in the laboratory.				
Course types and forms of instruction:	• L: Introduction to population genetics • Practical course population genetics				1 SEM./HRS 5 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L: Introduction to population genetics		14	18	10
	• Practical course population genetics		70	58	10
	Total Workload	6	84	76	20
Coursework and examinations:	Formal requirements for examinations: Active participation in the practical course examinations: Protocol (graded; 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

Title:	**Professional Treatment of Scientific Data**				
Module number:	BBIO-17-k				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	PD Dr. Sabine Lüthje, Phone: 42816 340 sabine.luethje (at) uni-hamburg.de PD Dr. Hartwig Lüthen, Phone: 42816 337 hartwig.luethen (at) uni-hamburg.de				
Instructors:	PD, Dr. Hartwig Lüthen PD Dr. Sabine Lüthje				
Language	German				
Intended learning objectives:	The students possess or consolidate basic key competences and general occupational skills, skills and application of software in particular in the field of the production of publication-capable graphics and illustrations incl. Theoretical background on the subject of image processing.				
Contents	Preparation of numerical experimental data, basic knowledge of image processing in the context of biological imaging techniques. Critical handling of relevant PC programs.				
Course types and forms of instruction:	• E: Professional Treatment of Scientific Data				2 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• E: Professional Treatment of Scientific Data		*28*	*102*	*50*
	Total Workload	*6*	*28*	*102*	*50*
Coursework and examinations:	Formal requirements for examinations: none examinations: Oral examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:					

Title:	**Psychoendocrinology**				
Module number:	BBIO-WPW-33				
Semester:	Summer				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Esther Diekhof, Tel.: 42838 3931, esther.diekhof(at)uni-hamburg(dot)de				
Instructors:	Prof. Dr. Esther Diekhof				
Language	German				
Intended learning objectives:	Students have a basic understanding of endocrinological processes such as the synthesis of various hormones in the human organism or the interactions of hormones and behavior. Furthermore, the students know different methods for collecting personal data and can evaluate these data statistically. Finally, students acquire basic knowledge in the use of IBM SPSS software.				
Contents	Theoretical introduction to human psychoendocrinology. Practical exercises on different methods of data collection and introduction to statistical analysis with SPSS.				
Course types and forms of instruction:	• V: Introduction to Psychoendocrinology • S: Fundamentals in Human Endocrinology • P: Empirical Methods in Data Collection und Analysis				1 SEM./HRS 2 SEM./HRS 3 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• V: Introduction to Psychoendocrinology		*14*	*28*	
	• S: Fundamentals in Human Endocrinology		*14*	*28*	*34*
	• P: Empirical Methods in Data Collection und Analysis		*42*	*20*	
	Total Workload	*6*	*70*	*76*	*34*
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: Presentation with written elaboration (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Janczyk, M. & Pfister, R.(2013) Inferenzstatistik verstehen. Von A wie Signifikanztest bis Z wie Konfidenzintervall. Springer Spektrum Lamprecht, J. (1999) Biologische Forschung. Von der Planung bis zur Publikation. Filander Verlag				

Title:	**Jurisprudence and Toxicology**
Module number:	CHE 018
Semester:	Winter
Applicability, type of module, and curricular area	• Compulsory elective module
Prerequisites for participation:	none
Module coordinator:	Dr. F. Meyberg
Instructors:	Dr. F. Meyberg
Language	German
Intended learning objectives:	Acquisition of proof of competence according to § 5 *ChemVerbotsV*, acquisition of legal bases, which are indispensable for the practice in the study and profession as well as of basic knowledge in the field of toxicology.
Contents	General jurisprudence, hazardous substances law, phytosanitary / biocide law, general and special toxicology including understanding of mechanisms of action of toxic substances Jurisprudence: • Basis from the general right • legal hierarchy • Current European and German chemicals and hazardous substances legislation • Basic knowledge of other related legal norms • Toxicological terms and regulations in hazardous substances law • Legal rules and tools for the classification and labeling of hazardous substances, risk assessment and hazard prevention. • Current examples of the properties and effects of some hazardous, significant substances and groups of substances Toxicology: • Toxicokinetics • metabolism • Carcinogenesis • Damage mechanisms
Course types and forms of instruction:	• L: Rechtskunde für Chemiker — 1 SEM./HRS • L: Toxikologie für Chemiker — 1 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L: Rechtskunde für Chemiker		14	21	10
• L: Toxikologie für Chemiker		14	21	10
Total Workload	3	28	42	20

Coursework and examinations:	Formal requirements for examinations: none examinations: Written examination (graded; 100%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the module

Title:	**Present Science to Understand – Research and scientific Collections**				
Module number:	BBIO-WPW-19				
Semester:	Winter				
Applicability, type of module, and curricular area	• Compulsory elective module				
Prerequisites for participation:	none				
Module coordinator:	Dr. Petra Schwarz, Phone: 42816 583, petra.schwarz (at) uni-hamburg.de				
Instructors:	Dr. Petra Schwarz				
Language	German				
Intended learning objectives:	Students are able to develop questions from current scientific topics and a concept for public presentation via exhibition. The aim is to get to know plantbiological research and its presentation to the outside in the sense of scientific communication in three-dimensional room.				
Contents	The module is carried out in the form of a project. Starting point are subjects of current research. After introduction we will agree on topics and further work n working groups. The following project steps of the working groups are repeatedly fed back into plenary presentations and discussions to all participants in order to ensure the networking of the focal points. At the end the participants should formulate their own contribution to the communication of scientific content for public presentation via exhibition unit “window into science” to realize in Loki Schmidt Haus, useful plants museum.				
Course types and forms of instruction:	• V/S Present Science to Understand				5 SEM./HRS
Workload (module components and total):	• V/S Present Science to Understand	*credits*	P (hrs) *70*	S(hrs) *80*	EP (hrs) *30*
	Total Workload	*6*	*70*	*80*	*30*
Coursework and examinations:	Formal requirements for examinations: Active participation examinations: presentation (20%) project completion (graded; 80%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the module				

compulsory elective and elective modules (see "Applicability, type of module, and curricular area" in the module description

Title:	**Introduction to forest science and bioresource utilization**				
Module number:	BBIO-WPW-100				
Semester:	Winter				
Applicability, type of module, and curricular area	• Bachelor of Biology compulsory elective module • compulsory if majoring in Forest Science and Bioresource Utilization				
Prerequisites for participation:	none				
Module coordinator:	Prof. Dr. Ina C. Meier, Phone 040 822459 203, E-Mail: ina.meier (at) uni-hamburg.de				
Instructors:	Prof. Dr. Linnea Hesse Prof. Dr. Ina C. Meier Dr. Katrin Schwarz				
language	German or English				
Intended learning objectives:	Students have basic knowledge of forest growth and understand the role of forests in climate and environmental protection. Students learn about the various functions of the morphological properties of wood and other bioresources and how these properties can be used bionically. They are fundamentally informed about the special features of wood as a material and learn about the complexity of this sustainable raw material in technological processes. They are able to fundamentally classify the effects of the use of the bioresource forest on nature and society.				
Contents	Introduction to forest science. Introduction to the diversity of forest biomes and forest utilization types on earth and a brief overview of Central European forest habitats. Importance of forests in the global climate system. Learning from nature for technology: introduction to bionics and functional morphology of wood and other bioresources. Presentation of typical methods in bionics and wood physics (imaging, CAO, SKO, biomechanics, CT, MRI). Understanding of the interdisciplinary transfer of knowledge in bionics. Wood as a raw material and material in traditional and modern chemical and mechanical technologies. Knowledge in the field of wood and fiber materials, production of paper and paper and packaging, textile fiber production, medical wound material, production of chemicals and pyrolysis products, sawmill products and wood-based material production for construction and furniture products; and other everyday items.				
Course types and forms of instruction:	• L Introduction to forest sciences and bioresource utilization				2 SEM./HRS
Workload (module components and total):	• L Introduction to forest sciences and bioresource utilization	*credits*	P (hrs) *28*	S(hrs) *47*	EP (hrs) *15*
	Total Workload	*3*	*28*	*47*	*15*
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:*				

	Written examination (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the course

Title:	**Fundamentals of Forest Ecology**
Module number:	BBIO-WPW-101
Semester:	Winter
Applicability, type of module, and curricular area	• Bachelor of Biology compulsory elective module • preferential admission of students with a focus on Forest Science and Bioresource Utilization
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Ina C. Meier, Phone 040 822459 203, E-Mail: ina.meier (at) uni-hamburg.de
Instructors:	Prof. Dr. Ina C. Meier
language	German or English
Intended learning objectives:	Students acquire basic ecological knowledge and are able to establish links between the various sub-areas (ecophysiology, autecology, synecology and ecosystem research) and understand ecological relationships. In the literature seminar, students have learned to transfer the lecture topics to current examples from forest research and can illustrate and discuss them in context. Students can understand ecological relationships and critically classify new findings in the reaction of forests to global change.
Contents	The basics of the interaction of plants with their biotic and abiotic environment are taught. In addition to the most important ecological principles, the carbon, water and nutrient balance of plants is discussed in relation to environmental conditions (autecology). Another topic is the interactions with symbionts and competitors (synecology). The literature seminar takes up the basic principles of the interaction of plants with their biotic and abiotic environment and applies them to current examples of the reaction of trees and forests to global change.
Course types and forms of instruction:	• L Fundamentals of Forest Ecology — 2 SEM./HRS • S Ecology of Forests under Global Change — 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L Fundamentals of Forest Ecology		*28*	*47*	*15*
• S Ecology of Forests under Global Change		*28*	*47*	*15*
Total Workload	*6*	*56*	*94*	*30*

Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written examination (graded, 100%) and Talk (pass or fail)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the course

Title:	**Structure and properties of commercial timbers**
Module number:	BBIO-WPW-102
Semester:	Winter
Applicability, type of module, and curricular area	• Bachelor of Biology **elective module** • preferential admission of students with a focus on Forest Science and Bioresource Utilization
Prerequisites for participation:	none
Module coordinator:	PD Dr. Gerald Koch, Phone. 040 73962410, E-mail gerald.koch (at) thuenen.de
Instructors:	PD Dr. Gerald Koch
language	German or English
Intended learning objectives:	The students have fundamental knowledge of wood anatomy (including the anatomy of bamboo and palms) and can distinguish commercially relevant domestic and tropical wood species based on macroscopic structural features. They can also define and practically assess important relationships between wood structure (growth characteristics) and wood properties. Additionally, they obtain relevant and actual market information on the nomenclature, distribution, and utilization of important economic tree species and are familiar with laws and conservation guidelines (CITES) that must be considered in international wood trade.
Contents	Fundamental knowledges about the structure and properties of economic tree species and monocotyledons (bamboo and palms) are provided. The main contents are focused on the diagnostic anatomical features for wood species identification and the assessment of wood properties and quality (structure/property relationships). Practical exercises with digital identification programs (App macroHOLZdata / CITESwoodID) and demonstration of wood samples deepen these contents. Additionally, the utilization of the most important internationally traded timbers (domestic and tropical) is presented, and current guidelines concerning species conservation (CITES) and the legality verification of woods (European Deforestation Regulation) are introduced.
Course types and forms of instruction:	• S Structure and properties of commercial timbers — 2 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• S Structure and properties of commercial timbers		*28*	*52*	*10*
Total Workload	*3*	*28*	*52*	*10*

Coursework and examinations:	*Formal requirements for examinations:* Active participation in the seminar *examinations:* Talk (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the course

Title:	**Functional Morphology and Biomimetics of Renewable Resources**
Module number:	BBIO-WPW-104
Semester:	Winter
Applicability, type of module, and curricular area	• Bachelor of Biology compulsory elective module • preferential admission of students with a focus on Forest Science and Bioresource Utilization
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Linnea Hesse, Tel. 040 73962-645, E-mail linnea.hesse (at) uni-hamburg.de
Instructors:	Prof. Dr. Linnea Hesse
language	German or English
Intended learning objectives:	The students can - define and explain the terms bionics, biomechanics, biotechnology, technical biology as well as biomimetics and bio-inspiration, - define the various specialist areas of bionics, - name examples from bionics and integrate knowledge from various disciplines (morphology, anatomy, biomechanics, physics, chemistry) in order to explain the process from biological model to technical application, - explain terms such as mechanical stresses and strains, - learn various methods of bionics (biomechanics, imaging, histology, etc.), - use experiments to study functional morphological processes in plants, and - learn about abstraction processes and the transfer of plant functions into technical products by means of experiments.
Contents	Basic knowledge of functional morphology and bionics is imparted, especially on bioresources such as wood and monocotyledons. The focus is on learning the terminology and specialist areas of bionics. A deeper understanding of bionic process chains (bionic top-down and bottom-up) and bionic examples is taught. Insights into modern bionic methods are presented. The acquired knowledge is deepened through supporting practicals.
Course types and forms of instruction:	• L Functional Morphology and Biomimetics of Renewable Resources — 1 SEM./HRS • P Biomimetics — 3 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L Functional Morphology and Biomimetics of Renewable Resources		*14*	*34*	*10*
• P Biomimetics		*42*	*60*	*20*
Total Workload	*6*	*56*	*94*	*30*

Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written examination (graded, 100%)
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the course

Title:	**Special Chemistry of Wood**				
Module number:	BBIO-WPW-105				
Semester:	Winter				
Applicability, type of module, and curricular area	• Bachelor of Biology compulsory elective module • preferential admission of students with a focus on Forest Science and Bioresource Utilization				
Prerequisites for participation:	none				
Module coordinator:	Dr. Katrin Schwarz, Tel: 040-822 459 207, e-mail: katrin.schwarz (at) uni-hamburg.de				
Instructors:	Dr. Katrin Schwarz				
language	German				
Intended learning objectives:	The students have basic knowledge of the basic chemical components in lignocelluloses.				
Contents	Lignocelluloses as composite polymers: chemistry and biochemistry of lignocellulose scaffolds, such as carbohydrates and cellulose, hemicelluloses and lignins; biochemistry of lignification. Further components and their classification in lignocelluloses: starch, fats, resins, extractives, etc. Relationships between the structure and properties of the various classes of compounds, their functions in wood, but also their technological significance, use and characterisation. Interdisciplinary connections with cross-references to the biology and physics of lignocelluloses.				
Course types and forms of instruction:	• L Special Chemistry of Wood				4 SEM./HRS
Workload (module components and total):		*credits*	P (hrs)	S(hrs)	EP (hrs)
	• L Special Chemistry of Wood		*56*	*88*	*36*
	Total Workload	*6*	*56*	*88*	*36*
Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written examination (graded, 100%)				
Duration	one semester				
Module frequency:	annual				
Literature:	Will be announced at the beginning of the course				

Title:	**Chemical Technology of Wood**
Module number:	BBIO-WPW-106
Semester:	Winter
Applicability, type of module, and curricular area	• Bachelor of Biology compulsory elective module • preferential admission of students with a focus on Forest Science and Bioresource Utilization
Prerequisites for participation:	none
Module coordinator:	Prof. Dr. Bodo Saake, Tel: 040-822 459 206, e-mail: bodo.saake (at) uni-hamburg.de
Instructors:	Prof. Dr. Bodo Saake Dr. Katrin Schwarz
language	German
Intended learning objectives:	Students have basic knowledge of fibre production technology and its use in end products. Various raw materials (types of wood, such as coniferous and deciduous woods, and annual plants) are discussed. The most important processes for the production of various fibres are explained and the processing of waste paper is discussed. By successfully completing the seminar and practical course, students will have acquired in-depth knowledge of the most important processes and will be able to link these to the production properties.
Contents	The module includes the following topics: Preparation of wood and annual plants, influence of raw materials, wood pulp production, pulp production from wood (NH/LH) and annual plants, waste paper recycling, paper and cardboard production, environmental aspects. The students' knowledge is deepened and linked theoretically and practically in seminars and practicals. Pulping processes are dealt with using various raw materials. The flotation deinking of waste paper as the most important process in the recycling of valuable raw materials is compared with the production of virgin fibre materials. In the seminar, students will work in groups to develop and experimentally implement solutions to questions relating to the topics mentioned. The results will be presented, discussed and compared.
Course types and forms of instruction:	• L Chemical Technology of Wood — 2 SEM./HRS • S Chemical Technology of Wood — 1 SEM./HRS • P Practical Exercises in the lab — 1 SEM./HRS

Workload (module components and total):	*credits*	P (hrs)	S(hrs)	EP (hrs)
• L Chemical Technology of Wood		*28*	*44*	*18*
• S Chemical Technology of Wood		*14*	*22*	*9*
• P Practical Exercises in the lab		*14*	*22*	*9*
Total Workload	*6*	*56*	*88*	*36*

Coursework and examinations:	*Formal requirements for examinations:* none *examinations:* Written examination (graded, 100%). Active participation in the seminar is assessed by an independent scientific presentation (pass or fail). The laboratory exercises are confirmed with a protocol (pass or fail).
Duration	one semester
Module frequency:	annual
Literature:	Will be announced at the beginning of the course