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School of Engineering and Science
Undergraduate Handbook
Biology

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1 Biology at IUB

1.1 Concept

Students of Biology at IUB receive an education that covers all modern aspects of this continuously challenging and fascinating discipline. The profile of the major is characterized by a broad range of courses. Cross-disciplinary in nature and taught in-depth, they are offered in the first year of study and provide the foundation for greater specialization in years two and three. The transdisciplinary approach allows students to develop skills that help them solve problems in areas remote from their own majors. Students, thus, learn to adapt their knowledge and expertise to a variety of tasks. This is seen as a valuable asset in a student's future career. Since only after the first year of study students have to decide their major(s), a considerable flexibility is built into the system, something that is not commonplace at most state universities of Germany.So far the number of students in the undergraduate program in Biology has been within the expected range. Medical doctors and professors are involved in the teaching and give special lectures and seminars. The undergraduate curriculum is regularly checked for actuality, timeliness, and social relevance. A considerable amount of postgraduate work is taking place and a formalized postgraduate program is in progress. An Advisory Board of eminent and internationally known biologists is regularly advising the faculty on each program thus taking care that students receive up-to-date information in both lecture and practical courses. Since most course descriptions and lecture notes are available in electronic form, changes and updates are readily accessible. The undergraduate program in Biology is oriented towards an education that has the finger on the pulse of scientific developments. It, therefore, allows students to become experts in their fields of study and to apply their practical know-how in a variety of ways. It is with this goal in mind that our students are required to take practical laboratory exercises in conjunction with lecture courses right from the start in their first year of study. The attendance of seminars and journal clubs in years two and three is designed to help the student be in touch with the latest discoveries and scientific methods and develop a critical, yet open, mind in all matters of scientific inquiry.

In addition to the focus on plant, animal, and microbial biology, comparative physiology, ecology and evolution, the curriculum includes basic courses in mathematics, physics, and chemistry. Advanced students may take courses in molecular microbiology, microanatomy, molecular biophysics, neurobiology, NMR spectroscopy, etc., and be involved in ongoing research at IUB. Laboratory courses are seen as essential components of the curriculum and research represents a vibrant facet of IUB activities.

Research is an essential part of IUB. Due to the ideal student to faculty ratio, students will be given the possibility to participate in real research work even during bachelor education. Faculty is working in exciting areas of modern biology, for example: genetics, molecular biology, ecotoxicology, marine microbiology, microbes as plant pathogens, chronobiology, sensory physiology, behavior, neurobiology, and neuroscience.

1.2 Career Options

Studying biology at IUB enables students to understand biological systems from both the structural, functional as well as from the physiological side. State-of-the-art methods are used for

education and research. In addition, the transdisciplinary education offered at IUB increases the number of possibilities for a later career in the different academic and non-academic fields of life sciences.

For more details see http://www.iu-bremen.de/school/ses/programs/00377/. www.iu-bremen.de finds itself in a relaunch phase. Not all program information is presently on this website.

2 Modules: Biology

For greater transparency of the logics and as guidance for the (prospective) student, we have structured the respective major programs in terms of modules. A module is defined as a combination of courses (lectures, lab units or other types of courses) interconnected by the same learning goals (Lernziel). Before listing the individual courses and describing their contents, these modules are presented and characterized by the skills and abilities that the student is expected to acquire. But irrespective of this overarching modular structure, the learning progress will be documented with credit points and grades attributed to the individual courses or lab units. This facilitates the control of the student's progress through the student as well as the university on a semester basis, while the modules may extend over a year or, in exceptional cases, even over longer periods. Only the core content of a major program is suited for modularisation. The freely choosable Home School electives and transdisciplinary courses fall outside this structure.

Credits are defined in terms of IUB credit points which will be phased out at the end of the Academic Year 2004/2005. ECTS credit points are obtained by multiplication with a factor 1.5.

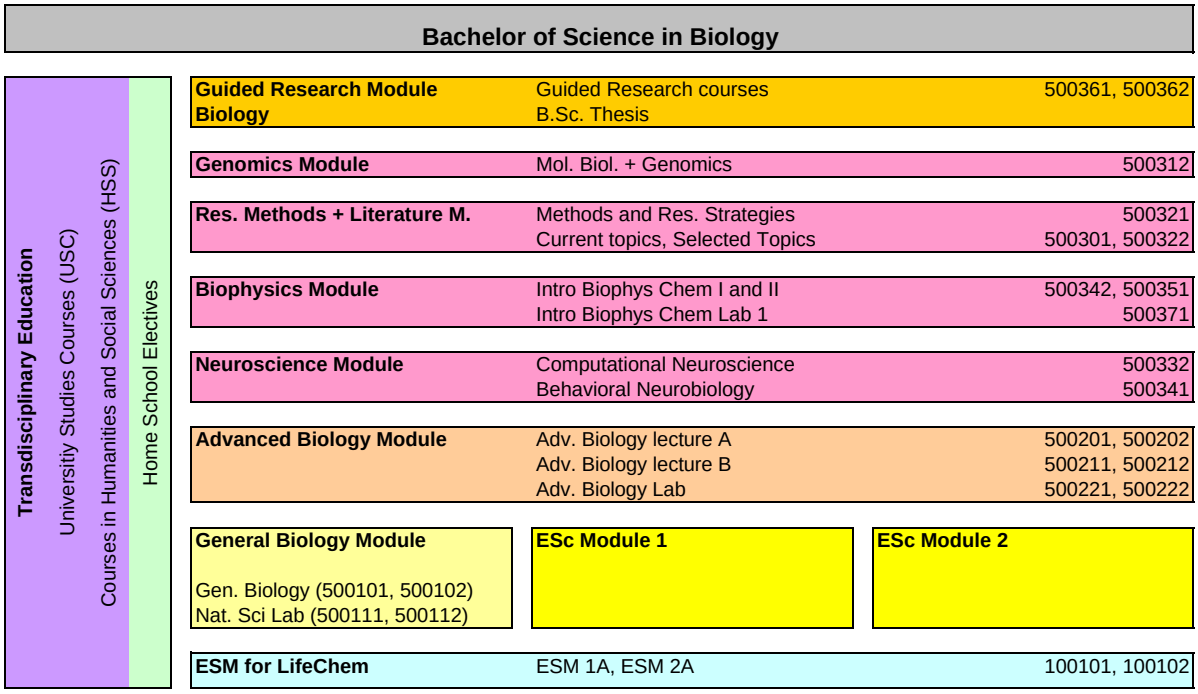

Figure 1: Biology Module Structure

Subsequently the individual modules are being defined with respect to learning goals and acquired competencies. The listed course numbers constitute a reference to the individual courses and the descriptions of their contents.

2.1 General Science

Home School Electives and transdisciplinary courses are not listed as modules.

120110 – ESM FOR THE LIFE SCIENCES AND CHEMISTRY

Short Name: ESM for LifeChem
Semester: 1 – 2
Credit Points: 6 IUB (12 ECTS)

General Information Students of Biochemistry and Cell Biology, Biochemical Engineering, Bioinformatics and Computational Biology, Biology, Chemistry, and Geosciences and Astrophysics with specialization area Geology/Geochemistry are required to take only two Engineering and Science Mathematics courses: *ESM 1A– Single Variable Calculus* and *ESM 2A– Linear Algebra, Probability, and Statistics* during their first two semesters of study.

Learning goals

- Basic skills in differential and integral calculus, linear algebra, probability, and statistics
- Problem solving skills
- Training in abstract reasoning and symbolic manipulation
- Ability to turn real-world problems into a concise mathematical question
- Ability to interpret mathematical statements back into the problem domain

Courses
120101 ESM 1A – Single Variable Calculus
120102 ESM 2A – Linear Algebra, Probability, Statistics

xxx – NATURAL SCIENCE MODULES

Short Name: ModGenSES
Semester: 1 – 2
Credit Points: 18 IUB (27 ECTS)

General Information This includes the additional first year general science modules that consist of the general lectures and associated lab units which are required from all students majoring in the School of Engineering and Science.

Learning goals

- This should offer the student an introduction into other sciences offered within the School of Engineering and Science (SES).

Courses
4 general engineering and science lectures (3 IUB (4.5 ECTS) credits each)
4 Natural Science Lab Units associated with the above lectures (3 IUB (4.5 ECTS) 2.25 credits each)

2.2 Biology Major

500100 – General Biology Module

Short Name: ModGenBio
Semester: 1 – 2
Credit Points: 9 IUB (13.5 ECTS)

General Information In this module, the general Biology lectures are attended in parallel to the Biology lab course over a period of 2 semesters.

Learning goals

- The secret of Biology is to understand the relations between structures and functions, from sub-molecular interactions to large-scale ecosystems. Thus, when studying the science of life, it is of utmost importance to understand the basic features and processes of living organisms, e.g., cell structure, gross anatomy of different plants and animals, and various physiological properties. Following this principle, students of Biology will get both theoretical and practical instructions which enables them to use this knowledge in advanced Biology courses, and in the various Biology related disciplines offered at IUB. The lectures cover all aspects of plant and animal Biology while the laboratory courses are the practical counterpart. Following the general concept of Biology, the students learn to observe and to describe what they see, e.g. by preparing drawings and protocols.
  The course contents of each lecture and lab combination are complementary. Therefore, the students get the chance to directly transfer theoretical knowledge from the lecture to the lab experiments.
- Furthermore, the students learn how to summarize, graphically depict, and statistically analyze their results in a form similar to a scientific publication.
- Besides learning to use basic computer programs such as Excel and Word while preparing these, the students also learn how to cite and to deal with copyright issues.

Courses
500101 General Biology I
500102 General Biology II
500111 Natural Science Lab Unit Bio I
500112 Natural Science Lab Unit Bio II

500200 – Advanced Biology Module

Short Name: AdvBIO
Semester: 3 – 4
Credit Points: 10.5 IUB (15.75 ECTS)

General Information In this module, four lectures and two integrated lab courses are combined.

Learning goals

- In the lecture, which precedes the lab course, the theoretical aspects of the complex machinery of the cell are taught. The interactive lecture asks as to how an experiment should be constructed to give a conclusive answer to a hypothesis or theory.
- By this, the students gain knowledge in classical and modern experimental approaches of biology.

Courses

500201 Advanced Biology A I
500202 Advanced Biology AII
500211 Advanced Biology B I
500212 Advanced Biology B II
500221 Advanced Biology Lab I
500222 Advanced Biology Lab II

500300 – CURRENT TOPICS

Short Name: ModCurTop
Semester: 5 – 6
Credit Points: 6 IUB (9 ECTS)

General Information These two consecutive seminars give the students an overview about current scientific developments and discoveries in the Life Sciences, both from the more organismic, and from the molecular point of view.

Learning goals

- The goal of this module is to learn how scientific information is processed, both from the active (authors') and from the passive (readers') sides. Recent articles from diffent scientific journals are read and analyzed by the students and presented to their peers so that both the scientific and communicative tool boxes are optimized.

Courses

500301 Current Topics in Life Science I - Biology and Ecology
500302 Current Topics in Life Science II - Molecular Life Sci

500330 – NEUROSCIENCE MODULE

Short Name: ModNeuro
Semester: 5 – 6
Credit Points: 6 IUB (12 ECTS)

General Information In this module, two lectures are combined.

Learning goals

- In the lectures, modern aspects of Computational Neuroscience and Behavioral Neurobiology are taught. The students will learn how experiments are planned and performed to gain deeper knowledge in the interaction of neurons, starting from simple paradigms to complex behavioral responses and learning processes.
- By joining the lectures, students will get information in a vast array of resaerch methods and experimental results which are of key importance in this expanding area of science.

Courses

500341 Behavioral Neurobiology
500332 Computational Neuroscience

500320 – RESEARCH METHODS AND LITERATURE SEMINAR

Short Name: ModBioResMethLit
Semester: 5 – 6
Credit Points: 6 IUB (9 ECTS)

General Information In this module, students will be introduced to scientific methods, strategies, and publishing.

Learning goals

- Science is the creation and propagation of knowledge. Over centuries, methods of scientific research and research strategies have changed, while the way how the knowledge was published and passed to the next generations has changed, too. In order to perform scientific research of high quality, several rules and limitations have to be obeyed. The lectures/seminars will enable the students to identify and extract relevant information form scientific publications, to identify flaws and hidden pitfalls, and they will learn how to present complex publications to their peers in an oral platform presentation.

Courses

500321 Methods and Research Strategies
500322 Selected Topics in Biology

500360 – GUIDED RESEARCH BIOLOGY

Short Name: ModGRBio
Semester: 5 – 6
Credit Points: 9 IUB (13.5 ECTS)

General Information Lab rotations. Within these courses the students start to work in the research laboratories. One to four different research labs may be visited during the two semesters.

Learning goals

- During each guided research rotation, they learn to work independently on one project related to the research groups' topic.
- They get an overview of the state-of-the-art techniques used and learn how to approach experimental problems beyond the limitations of the previous lab course settings.
- They learn to take over responsibility for themselves as well as for group-tasks and to organize their time in an efficient way.
- At the end of each lab rotation, the students have to write a report that trains them for writing their B.Sc. thesis which contains experimental results from all 4 guided research rotations.

Courses

500361 Guided Research Bio I
500362 Guided Research Bio II

500310 – Molecular Biology and Genomics Module

Short Name: ModMolBio&Genomics
Semester: 6
Credit Points: 3 IUB (4.5 ECTS)

General Information One independent lecture.

Learning goals

- This module is introducing the student to the nature of the genetic code, organization of genetic material in chromosomes, molecular mechanisms of genetic variation and stability, transcriptional regulation and assembly of genetic programs underlying development, growth and morphogenesis, human genetic diseases and genome analysis, transcriptomics and functional genomics.
- The students will acquire knowledge on and understanding of the relationships between the genes and traits in cellular growth, differentiation, evolution and disease and become familiar with applications of genome analysis.

Courses

500312 Molecular Biology and Genomics

500350 – Biophysics Module

Short Name: ModBioPhys
Semester: 5 - 6
Credit Points: 7.5 IUB (11.25 ECTS)

General Information In this module, two lectures and one lab unit are combined.

Learning goals

- The focus of the lectures is to understand the thermodynamics and kinetics of structure formation and association of biomolecules as well as basic properties of biological membranes.
- The lectures will also provide a comprehensive overview about all modern aspects of research methods and tools to gain insight into this area of science which is the basis for understanding the most fundamental principles of interaction of molecules in biological systems.

Courses

500351 Introduction to Biophysical Chemistry I
500342 Introduction to Biophysical Chemistry II
500371 Introduction to Biophysical Chemistry Lab I

3 Requirements for a B.Sc. in Biology

University Requirements

To obtain a B.Sc. degree at IUB a minimum of 120 IUB (180 ECTS) credit points must be earned over a period of 6 semesters.

- 96 IUB (144 ECTS) credits must be earned in the School of Engineering and Science.
- 24 IUB (36 ECTS) credits must be earned through transdisciplinary courses, comprised of
  - 3-5 courses in the School of Humanities and Social Sciences (**HSS**),
  - 3-5 University Study Courses (**USC**).

University requirements outside of the school of the major are type-coded “u” in the recommended course plans below.

School Requirements

In the School of Engineering and Science, all students must take

- Three general lectures (18 IUB (27 ECTS) credits), including those prescribed by the major, or appropriate equivalents.
- Three matching laboratory units (9 IUB (13.5 ECTS) credits), including those prescribed by the major, or appropriate equivalents.

School requirements outside of the major are type-coded “s” in the recommended course plans below.

Requirements of the Major

Students choose the following courses (96 IUB (144 ECTS) credits) out of the following:

- **Year 1 level courses**:
  - Engineering and Science Mathematics I/II (120101 or 120103, and 120102 or 120104, 6 IUB (9 ECTS) credits credits),
  - General Biology I/II (500101, 500102, 6 IUB (9 ECTS) credits) plus
  - Natural Science Lab Units (NatSciLabs) Biology (500111, 500112, 3 IUB (4.5 ECTS) credits).

- **Year 2 level courses**:
  - Advanced Biology A I/II (500201, 500202, 6 IUB (9 ECTS) credits),
  - Advanced Biology B I/II (500211, 500212, 6 IUB (9 ECTS) credits), and
  - Lab Course Advanced Biology I/II (500221, 500222, 9 IUB (13.5 ECTS) credits).

- **Year 3 level courses**:
  - 18 IUB (27 ECTS) credits of year 3 level Life Sciences lecture courses. Mandatory courses are:

    - in the fifth semester:
        - Methods and Research Strategies in the Life Sciences (500321, 3 IUB (4.5 ECTS) credits) and
        - Current Topics in Life Science I - Biology and Ecology (500301, 3 IUB (4.5 ECTS) credits),
    - in the sixth semester:
        - Selected Topics in Biology, (500322, 3 IUB (4.5 ECTS) credits)
        - Molecular Biology and Genomics (500312, 3 IUB (4.5 ECTS) 4.5 credits).
  - Practical Work: Guided Research in Biology consists out of four research lab rotations (numbered 1 – 4). One research lab rotation (no. 1) can be replaced by the Organic Chemistry Second-Year lab course, and one research lab rotation (no. 3) can be replaced by the Integrated Chemistry Second-Year lab courses (400331, 400222, 9 IUB (13.5 ECTS) credits).

- **Additional Courses:**
  - two first year ESc subjects (12 IUB (18 ECTS) credits) plus
  - associated NatSciLabs (6 IUB (9 ECTS) credits).

4 Recommended Course Plan

Year 1 Courses	**Fall**	**C**	**T**	**Spring**	**C**	**T**
ESc Mathematics I/II [1]	120101	*3*	m	120102	*3*	m
General Biology I/II	500101	*3*	m	500102	*3*	m
NatSciLab Biology I/II	500111	*1.5*	m	500112	*1.5*	m
First year courses in ESc subject		*3*	s		*3*	s
Associated NatSciLabs		*1.5*	s		*1.5*	s
First year courses in second ESc subject		*3*	s		*3*	s
Associated NatSciLabs		*1.5*	s		*1.5*	s
Two courses in the School of HSS		*3*	u		*3*	u
One University Studies Course					*3*	u
Running Total / *Semester Total*	19.5	*19.5*		42	*15*	

Year 2 Courses	**Fall**	**C**	**T**	**Spring**	**C**	**T**
Advanced Biology A I/II	500201	*3*	m	500202	*3*	m
Advanced Biology B I/II	500211	*3*	m	500212	*3*	m
Lab Course Advanced Biology I/II	500221	*4.5*	m	500222	*4.5*	m
First ESc Subject Course		*3*	e		*3*	e
Second ESc Subject Course		*3*	e		*3*	e
One Course in the School of HSS		*3*	u			
One University Studies Course					*3*	u
Running Total / *Semester Total*	62.5	*19.5*		81	*19.5*	

Year 3 Courses	**Fall**	**C**	**T**	**Spring**	**C**	**T**
Methods and Research Strategies	500321	*3*	m			
Current Topics in the Life Sciences I	500301	*3*	m			
Selected Topics in Biology				500322	*3*	m
Molecular Biology and Genomics				500312	*3*	m
Specialized Biology Courses [2]		*3*	m		*3*	m
Biology Laboratory/Guided Research	500361	*4.5*	m	500362	*4.5*	m
One Course in the School of ESc					*3*	e
One Course in the School of HSS		*3*	u			
Two University Studies Courses		*3*	u		*3*	u
Running Total / *Semester Total*	100.5	*19.5*		120	*19.5*	

C = IUB credit points, T=type (m=mandatory, e=elective, s=school requirement, u=university)

Credits are still defined in terms of IUB credit points. ECTS credit points are obtained by multiplication with a factor 1.5.

Notes:

1. Biology students will normally take version A (120101 and 120102) of first year Engineering and Science Mathematics.

2. In the fall semester, take the seminar Current Topics in Life Science I – Biology and Ecology, Methods and Research Strategies in the Life Sciences, and Entomology. In the Fall semester, take the seminar Current Topics in Life Science II – Molecular Life Science, Molecular Biology and Genomics, and Entomology.

5 Courses: Biology

5.1 First Year of Study

500101 – General Biology I

Short Name: GenBio I
Type: Lecture
Semester: 1
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: Yes

Course contents The course presents an integrated view of biology and aims to provide an understanding of the major environmental challenges common to all organisms. Largely based on organisms and organ systems, the course will confront the students with biodiversity and tackle questions related to respiration, internal transport, osmoregulation, reproduction, etc. The course is expected to generate in the students an on-going interest in the biology of organisms.

500111 – Natural Science Lab Unit Biology I

Short Name: NatSciLab Bio I
Type: Lab
Semester: 1
Credit Points: 1.5 IUB (2.25 ECTS)
Prerequisites: None
Corequisites: 500101
Tutotial: No

Course contents The vast array of plant and animal species reflects the ways by which adaptations to environmental factors took place. Especially with respect to morphology, physiology, and in case of animals, also sensory systems, and behavior, a tremendous variety of specializations is present. This course will describe the principles of botanical and zoological systems, focusing on the relationship between structure and function. Different plant and animal species are discussed in detail to illustrate these close connections. The lab course will complement the lecture by practical work on selected specimens/organs. The course instructors will provide detailed descriptions of the experiments.

500102 – General Biology II

Short Name: GenBio II
Type: Lecture
Semester: 2
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: 500101
Corequisites: None
Tutotial: No

Course contents The course is a continuation of the first Semester, but in this semester the emphasis is on evolution and ecology. How did organisms evolve? How can they adapt to and cope with different habitats? The course will examine selected ecosystems and deal with a variety of interspecies interactions. The course will confront the students with questions of competition, selective forces, food webs, and nutrient cycles.

500112 – Natural Science Lab Unit Biology II

Short Name: NatSciLab Bio II
Type: Lab
Semester: 2
Credit Points: 1.5 IUB (2.25 ECTS)
Prerequisites: 500101
Corequisites: 500102
Tutotial: No

Course contents This course is a continuation of the first semester's course during which basic anatomical and structural features of plants and animals were investigated. The focus of this course is more on the physiological level, i.e., how organisms function in relation to environmental challenges. The main goal is therefore to understand the basic physiological principles of plants and animals. During the course, experiments will be performed in the following fields: photosynthesis, neurophysiology, behavior, salt balance, circulation, endocrine function.

5.2 Second Year of Study

500201 – Advanced Biology A I (Senses and Behavior)

Short Name: AdvBio A I
Type: Lecture
Semester: 3
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: 500101 or 500102
Corequisites: None
Tutotial: No

Course contents The aim of the course is to present an integrated view of animal (and human) behaviour. The course commences with a comparative study of the structure and function of sense organs, emphasizing that an understanding of an animal's behaviour is impossible without a detailed knowledge of the sense organs. Various aspects of intra- and interspecific behaviours, e.g., orientation, feeding, territoriality, courtship, etc. are then explained, before predominantly ecological aspects (e.g., competition, parasitism, pest control, etc.) wrap up the course.

500211 – Advanced Biology B I (Microbiology and Molecular Biology)

Short Name: AdvBio B I
Type: Lecture
Semester: 3
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: 500102
Corequisites: None
Tutotial: No

Course contents This course is designed to build up on the content of the General Biology I/II courses (500101, 500102) and to deepen the knowledge of physiological phenomena at the molecular level. Besides a detailed view into general microbiology and microbial ecology, the course deals with molecular aspects of evolution, microbiology, and plant cell biology and physiology. Therefore, special emphasis will be given to environmental, microbial, and "green" biology. This includes exciting insights into molecular aspects of the interactions between living organisms, such as symbiosis, infectious diseases, and global element cycles. While three units within the fall semester will cover the fields of Molecular Evolution, General Microbiology (incl. bacteria, protists, and fungi), and Microbial Ecology (incl. element cycles, symbiosis, and pathology), the three units of the spring semester will bring insights into Molecular Biology of Plant Cells, Plant Eco-physiology, and Plant and Microbial Genetics. Additionally, all units will highlight how we can explore our knowledge of microbial and plant molecular biology at the level of biotechnology.

500221 – Advanced Biology Lab Course I

Short Name: AdvLabBio I
Type: Lab
Semester: 3
Credit Points: 4.5 IUB (6.75 ECTS)
Prerequisites: 500201 or 500211
Corequisites: None
Tutotial: No

Course contents This is the major-specific mandatory lab course for Biology majors in their second year. Lab course units include selected experiments from neurobiology and microbiology. The course will be continued in the fourth semester with experiments from behavioral neurobiology, microbiology, and cell biology.

- Introductory Unit
  During the first weeks, students will be introduced to the theoretical methodology of the chemical and biochemical sciences. Lectures and hands-on exercises will include chemical and biological safety, note-taking in the laboratory and the writing of lab protocols but also the various techniques used to obtain scientifically valid information on a particular topic from the literature and the databases on the internet. A brief introduction to computing in the chemical and biochemical sciences, to image analysis, and to animal model systems will also be given.

- Microbiology Uni
  In the Microbiology unit, Lab Course participants will learn how and where microbes live, how they utilize nutrients, and how we can identify them based on their phenotypes and genotypes. Students will isolate bacteria from different natural and man-made sources,respectively, and will use pure cultures of these micro-organisms to conduct physiological experiments and to classify them phylogenetically.

- Neurobiology and Sensory Physiology lab unit
  How does the human brain use environmental as well as internal (somatic) sensory information to guide perception, cognition and behavior? We explore this question through experiments that demonstrate principles of sensory (auditory, visual) transduction as well as fundamental mechanisms of perception in the human brain. Tutorial components during the unit offer an opportunity to discuss in more detail material from corresponding lectures and to become acquainted with the latest research trends in sensory neuroscience.

500202 – Advanced Biology A II (Organismic Ecology)

Short Name: AdvBio A II
Type: Lecture
Semester: 4
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: No

Course contents The aim of the course is to present an integrated view of animal (and human) behaviour. The course commences with a comparative study of the structure and function of sense organs, emphasizing that an understanding of an animal's behaviour is impossible without a detailed knowledge of the sense organs. Various aspects of intra- and interspecific behaviours, e.g., orientation, feeding, territoriality, courtship, etc. are then explained, before predominantly ecological aspects (e.g., competition, parasitism, pest control, etc.) wrap up the course.

500212 – Advanced Biology B II (Ecophysiology and Molecular Genetics)

Short Name: AdvBio B II
Type: Lecture
Semester: 4
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: 500201
Corequisites: None
Tutotial: No

Course contents This course is designed to build up on the content of the General Biology I/II courses and to deepen the knowledge of physiological phenomena at the molecular level. Besides a detailed view into general microbiology and microbial ecology, the course deals with molecular aspects of evolution, microbiology, and plant cell biology and physiology. Therefore, special emphasis will be given to environmental, microbial, and ”green” biology. This includes exciting insights into molecular aspects of the interactions between living organisms, such as symbiosis, infectious diseases, and global element cycles. While three units within the fall semester will cover the fields of Molecular Evolution, General Microbiology (incl. bacteria, protists, and fungi), and Microbial Ecology (incl. element cycles, symbiosis, and pathology), the three units of the spring semester will bring insights into Molecular Biology of Plant Cells, Plant Eco-physiology, and Plant and Microbial Genetics. Additionally, all units will highlight how we can explore our knowledge of microbial and plant molecular biology at the level of biotechnology.

500222 – Advanced Biology Laboratory Course II

Short Name: AdvBioLab II
Type: Lab
Semester: 4
Credit Points: 4.5 IUB (6.75 ECTS)
Prerequisites: None
Corequisites: 500202 or 500212x
Tutotial: No

Course contents This course continues the major-specific mandatory lab course for Biology majors in their second year. Sensory Physiology Unit. Contents to be announced. Behavioral Neurobiology Unit. This laboratory course will introduce the student to experimental approaches used in behavioral neurobiology to analyze animal behavior. Through student-led projects, all major aspects of research in this area will be covered, including experimental design, performance of behavioral observations and experiments, data analysis, and write-up of scientific reports. Microbiology and Cell Biology Unit. The use of easy-to-monitor reporter genes is an important and integral component of modern lab work in microbiology and cell biology. The gene for green fluorescent protein (GFP) will be used in this unit to determine gene expression and to localize protein fusions in prokaryotic and eukaryotic cells. For this, the GFP gene will be cloned in bacteria using PCR and its expression will be studied in mammalian cell cultures using fluorescence microscopy.

5.3 Third Year of Study

500301 – Current Topics in Life Science I - Biology and Ecology

Short Name: CTLifeSci I
Type: Seminar
Semester: 5
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: No

Course contents This seminar will focus on recent developments in various research areas within biology. At the end of this course, the student will have learned how to find, analyze, and present relevant published information.

500321 – Methods and Research Strategies in the Life Sciences

Short Name: MRLifeSci
Type: Lecture
Semester: 5
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: No

Course contents In this lecture, faculty from the Life Sciences at IUB will in turn present characteristic methods and strategies used to obtain scientific information in their fields, with the aim of increasing students' understanding of the scientific thought process in general, and the methodology that is specific to each discipline. Typically, the approach will be centered around the solution of specific problems.

500331 – Entomology (Insects, Spiders, and kin)

Short Name: Entomology
Type: Lecture
Semester: 5
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: 500101
Corequisites: None
Tutotial: No

Course contents The course will deal with insects, spiders, and other largely terrestrial arthropods. Many of these invertebrate animals play important roles in the ecosystem, be it as pollinators of plants, agricultural pests, vectors of disease, or a food source for bigger animals. The emphasis in this course is on understanding these relationships. But in order to be

able to do that the student has to grasp the complexity of arthropod life forms, has to know the behaviour of these animals, and has to understand how they function.

500341 – Behavioural Neurobiology

Short Name: BehNeuroBio
Type: Lecture
Semester: 5
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: 500201, 500202
Corequisites: None
Tutotial: No

Course contents This course will introduce the student to the fascinating field of neuroethology. By combining ethological and neurobiological approaches, this rapidly growing research direction aims to understand how the central nervous system controls the behavior of animals. The lecture course will cover all major aspects of neuroethology, including its history; tools and concepts of neuroethology; spatial orientation; sensory processing of behaviorally relevant information; neural control of motor output; sensori-motor integration; modulation of central activity; navigation; communication; and learning and memory.

500351 – Introduction to Biophysical Chemistry I

Short Name: IntroBiophysChem I
Type: Lecture
Semester: 5
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: No

Course contents Interactions between molecules, such as antibody-antigen, enzyme-substrates, receptor-membrane are the base of biological processes. This course introduces current theoretical and experimental tools to quantify such interaction between biomolecules. We begin with a molecular view to introduce the relevant forces and interaction necessary to understand and perform molecular modeling. In a second part we follow a more macroscopic thermodynamic view: substrate binding or partitioning, cooperative effects, transport across membranes to name a few keywords. The third part is devoted to kinetic phenomena and the necessary experimental techniques as relaxation theory, correlation spectroscopy, stopped flow.

500361, 500362 – Guided Research Biology I/II

Short Name: GRBio I, GRBio II
Type: Research
Semester: 5 – 6
Credit Points: 4.5 IUB (6.75 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: No

Course contents This lab course intends to intensely train students in laboratory practice on a given research project of the Instructor's group. It is an integrated part of the lab rotations each student has to attend during the 3rd year education. Two lab rotations per each semester of the 3rd year will give the students the opportunity to visit four different research laboratories of the various life sciences disciplines participating (see above for a list of participating PI's) in this course structure. All individual lab rotations will finally be written up in a thesis to prove the student's ability of performing independent research. Scheduling has to be decided between the Students and the individual Instructors of the particular lab rotations. The Instructors of Record of the BC+CB, Bio, BI+CB, and BCE 3rd year lab courses I and II will have to organize for accommodation of each student within the research laboratories preferably of their first choices. However, this needs to be done in a way to allow equal and appropriate distribution of all students between the various research groups. Students will indicate their preferences, and the Instructors of Record will decide on the order of lab rotations during the 3rd year. To enable the students with the necessary information on which lab to choose, an information evening will be organized at the end of the 4th semester. Students are urged to attend.

500371 – Lab Course Introduction to Biophysical Chemistry

Short Name: IntroBiophys Lab I
Type: Lab
Semester: 5
Credit Points: 1.5 IUB (2.25 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: NOne

Course contents This course provide training on standard tools to quantify interaction of biomolecules by physical means and thought to motivate the use of methods provided in the biophysical chemistry course. We are addressing the question how drugs manage to enter the cell (e.g. bacteria) in order to exert their activity. In particular, we will learn how to quantify drug partitioning into membranes, to observe the effect of bound drugs in the phase behavior of membranes, to distinguish different pathways of drugs through membranes and eventually to follow even single molecules crossing the barrier.

500302 – Current Topics in Life Science II - Molecular Life Science

Short Name: CTLifeSci I
Type: Seminar
Semester: 6
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: No

Course contents This course is meant to introduce students to a range of current research topics in Advanced Biochemistry, Molecular Cell Biology, Molecular Genetics, Biophysics, and Molecular Microbiology through directed reading of the primary literature and actively attending all seminars. Primary literature is meant as original research articles from current issues of the leading scientific journals, such as Nature, Science, Cell, EMBO Journal, Molecular Cell Biology, and others. At each time of class, students will meet with a faculty member to discuss one or more papers authored by scientists/laboratories which lead the respective field of research. Active participation of the students will be in form of detailed scientific presentations of the published experiments and their background and conclusions, respectively, followed by an in-depth discussion with all students and the faculty member(s).
Since state-of-the-art science lives from communication among scientists, the prime purpose of this seminar series is to enable students to communicate advanced scientific topics. Furthermore, this course is devoted to the development of presentation skills and to an in-depth understanding of what is so exciting about current life science research.
Topics to be dealt with will be chosen based on comprehensiveness, actuality, and the individual scientific interests of students and faculty alike.

500312 – Molecular Biology and Genomics

Short Name: MolBio&Genomics
Type: Lecture
Semester: 6
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: 500201 or 500211
Corequisites: None
Tutotial: No

Course contents This course is thought as an introduction to contemporary genetics starting from chromosomal theory of inheritance to molecular genetics and genomics. The purpose of the course is to gain understanding of the relationships between the genes and traits in growth, differentiation, development, evolution and disease.

500332 – Computational Neuroscience

Short Name: CompNeuroscience
Type: Lecture
Semester: 6
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: No

Course contents The course will cover methods and knowledge for addressing structure - function relationships at different scales of the nervous system through mathematical analyses and computational modeling. Lectures will review neurobiological concepts and currently available data as well as mathematical approaches for representing neural systems. Complementary lab session will provide an opportunity to become familiar with widely used neural modeling packages and to carry out individual course projects.

500322 – Selected Topics in Biology

Short Name: SelTopicsBio
Type: Seminar
Semester: 6
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: No

Course contents A wide range of biological topics that are of interest to students as well as teacher(s) will be used as the basis for this course. The course will contain a component that is aimed at improving the students' written and oral presentation skills. Towards this end some instructions will be given on how to effectively write scientific essays and papers and how to present research data at conferences.

500342 – Introduction to Biophysical Chemistry II

Short Name: IntroBiophysChem II
Type: Lecture
Semester: 6
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: 500351
Corequisites: None
Tutotial: No

Course contents Focus of this course is to understand the thermodynamics and kinetics of structure formation and association of biomolecules. The course is also intended to give a comprehensive overview on experimental methods to measure thermodynamic contributions

and how to investigate the kinetics of biological processes at various time scales: Thermodynamics of association, cooperative effects, helix-coil-transition, experimental tools to quantify binding: Biacore (surface plasmons), isothermal calorimetry, differential scanning calorimetry, Optical tools: circular dichroism, fluorescence, ultracentrifugation, equilibrium dialysis, model systems for membranes: lipid monolayer, liposomes, supported bilayer, fast kinetic measurements: stopped flow, fluorescence correlation spectroscopy, intermediates, transition state theory, diffusion limitation

520322 – Immunology

Short Name: Immunology
Type: Lecture
Semester: 6
Credit Points: 3 IUB (4.5 ECTS)
Prerequisites: None
Corequisites: None
Tutotial: No

Course contents An advanced course that gives:

- a throrough basic training in immunology through the weekly review of one chapter from the textbook, ”Immunobiology” (Janeway et al.). Students will be asked to read and prepare the chapter, and discuss it in the first class each week based on the instructor’s questions (tutorial-style).
- a cutting-edge knowledge of some select new developments in immunology through the weekly presentation and discussion of one paper from an area corresponding to that week’ s textbook chapter. Presentations will be of high quality because of comprehensive preparation (see below). Transferable skills that will be taught:
- Presentation of complex scientific contents: Students will learn to understand, and to present in 30 minutes, the contents of a research paper. They will meet with the professor beforehand to prepare their presentations, and they will receive feedback on their presentation style afterwards from professor and class.
- Critical assessment of research papers: students will learn to read research papers and judge whether the conclusions are supported by the data.
- Communication and discussion of scientific data: students will learn to use coherent scientific logic in discussing scientific results and theories. The course will also be useful to beginning graduate students with an interest in immunology, biomedicine, and related fields.