

# Short guide to our study courses for interested Erasmus students

## Including a list of english Study courses in the Faculty of Biology, University of Duisburg-Essen

The faculty of biology offers four Bachelor and five Master programs:

- Bachelor and Master Medicine Biology
- Bachelor and Master Biology
- Bachelor in Aquatic Biology
- Bachelor in molecular biology
- Master Biodiversity
- Master Transnational Ecosystem based Water Management (TWM)
- Master Environmental Toxicology

Erasmus students are allowed to choose courses of each of the programs. Advanced Bachelor students (in the third year of studies) can also choose Master courses.

Laboratory courses might be restricted. But can be opened if places are available and students did study fundamental courses in the discipline before.

Winter terms start in October and end in February (some exams or practical lab courses are in March!!!)

Summer terms start in April and end in July (some exams or practical lab courses are in August!!!)

If not mentioned differently, courses will be weekly for 2 to 4 hours (depending on the course).

Following, we listed all courses offered in English, as most Erasmusstudents are interested in English courses.

Of course we offer more courses, however the others are all taught in German. An overview about all courses can be found here:

[www.lsf.uni-due.de](http://www.lsf.uni-due.de)

Please have a look in the folders for the study programm (Studiengang Bachelor Biologie, Studiengang Master Biologie, Studiengang Medizinische Biologie (Bachelor), Studiengang Medizinische Biologie (Master), Studiengang Environmental Toxicology, Studiengang TWM. Please have a look on

the upper right side of the webpage. Here is indicated if you are in the database for the winter or the summer term. If you want to switch, please click on the current term.

In this database you will also find all information about the exact dates and rooms of the specific courses (also for the English courses listed in the table below).

## Winter Term

Course name	Kind of course	Hours per week	Credits	Kind of exams	Study program	Topics
Population Genetics	Lecture and seminar	3	5	Exam and presentation	Bachelor Biology/ Aquatic Biology	In the lecture basics of the classical and modern Population genetics are taught. Topics are: Parameter of genetic diversity; allele and genotype frequencies, law of Hardy Weinberg; mutations and drift equilibrium; population structure, population demography, linkage disequilibrium, positive and negative selection; neutral theory; quantitative genetics; coalescent theory; Maximum likelihood and Bayesian statistics, genetics in nature protection; phylogeography
Microscopic methods to observe protist grazing	Lecture and labcourse	6 (in a block course)	10	Written exam and you have to attend all lab days	Bachelor Biology/ Aquatic Biology	Students collect phagotrophic protists in the field and learn how to operate a light microscope to observe the collected protists. Using light microscopy, students learn to identify the large groups of phagotrophic protists. Various cultivation techniques will be used to keep protists alive in the laboratory. -The students learn how to feed protists with bacteria and how to calculate growth rates from

						<p>the number of bacteria eaten by the protists and the change in abundances.</p> <p>-Students learn various microscopic techniques (e.g. DIC, fluorescence microscopy).</p>
Biophysics and Computational Biochemistry (start in winter 2020)	2 Lectures and one exercise	5	11	Written examination	Bachelor molecular biology	<p>Biophysics: In this lecture fundamental physical principles regulating all living systems will be made easy to understand and will be applied to some important examples from nature. The laws of equilibrium thermodynamics and statistical mechanics will be introduced and used as tools for the qualitative and semi-quantitative understanding of biomolecules, two-state systems and reaction networks.</p> <p>Lecture Computational Biochemistry: this part of the course will rely on the introduction and application of computational biochemistry methods to understand biomolecular processes like protein-protein interactions, protein ligand interactions and enzymatic reactions.</p> <p>Exercise: The course will be integrated with interactive exercises on each topic and additional online material. The solutions to the exercises will be analyzed and discussed together during the exercise's sessions.</p>
Bionanotechnologie	Labcourse (block course in march)	6	10	Short tests, lab work is graded, seminar talk incl. 20 min discussion	Bachelor molecular biology	<p>The course will introduce the historical background of DNA nanotechnology and the design rules of the two main strategies: the multi-stranded approach and the scaffolded-DNA origami approach. The students will learn</p>

						<p>to design the four-way junction and four types of DNA origami structures, as well as how basic hybridization and base stacking interactions can be manipulated to organize the DNA in large – even micrometer large – structures still maintaining spatial order at the nanometer level. They will then modify one structure at selected positions to obtain a desired pattern of proteins. The structures will be assembled in the laboratory, analyzed by agarose-gel electrophoresis, spectroscopy and atomic force microscopy. The students will also learn different types of purification procedures of DNA origami structures, namely, ultracentrifugation, gel extraction, PEG precipitation and bead-based separation. The students will finally experience the effect of different experimental conditions (like temperature, salts type and concentration) on the quality and yield of the target structures. During the practical course, current literature on the field will be provided and discussed, and used as basis for the preparation of the seminar.</p>
Biological research at a computer	Labcourse	6	10	Talk about a project which will be conducted in the course. Assay about the conducted	Installed in all biology Bachelor programs	<p>Why would a biologist program computers? How do you program a computer? Basic programming structures Mathematical foundations for the modelling of concrete biological problems (e.g. spread of infections, movement of cells, etc.): difference equations, differential equations, linear algebra,</p>

				project.		simulations, optimization, clustering Contents of the internship: Practical practice of the contents of the lecture: editors and other tools; programming with R; application to biological problems (small projects, also in groups)
Modern Biomedicine	Lecture	1	1	No exam	Master MedBio	This is a lecture done by all lecturers of the medical biological institute (everybody does one lecture). Topics: basics of immunology, DNA regulation and organization, immune system, pathogenetics of the blood system, modelling of biological data. Some topics might be offered in german.
Biochemistry: Structure and Function of biomolecules	lecture	2	3	Written exam, It is also possible only to visit the lecture and have an oral exam	Master MedBio/ Master EnviTox	Introduction into spectroscopy of biopolymers, NMR-Spectroscopy, X-Ray spectroscopy, organization, dynamics and modifications of biopolymers, design of Active Pharmaceutical Ingredients
Analytical Methods for the determination of molecular structures	Seminar	2 block course in March	3	Presentation (course only in combination with lecture in Biochemistry)	Master MedBio	Winter Protein expression, NMR on proteins, crystallization and X-Ray spectroscopy, fluorescence spectroscopy, infrared spectroscopy
Biophysical chemistry	Practical course	2 block course in March	2	(course only in combination with lecture and Seminar in Biochemistry)	Master MedBio	Practical course where the above mentioned techniques are trained.
Molecular Cell biology	Lecture	2	3	Written exam,	Master	Structure and function of biomembranes,

					MedBio/ Master Bio	cytoskeleton, DNA replication and repair, cell division
Seminar of molecular cell biology	Seminar	2	3	presentation	Master MedBio/ Master Bio	Actual themes of the literature of cell biology
Practical course of cell biology	Practical course	2 block course in march	2		Master MedBio	Laboratory course
Aspects of environmental research	lecture	1	1	none	Master EnviTox	Several Prof. are presenting actual scientific problems in the field of Environmental toxicology
Biogeochemical cycles	lecture	2	3	Written exam	Master EnviTox	Metabolic capacities of microorganisms; microbial transformations in carbon, nitrogen and sulphur cycling; risks for human health
Geochemistry of soil and sediment	Lecture and Seminar	3	5		Master EnviTox	Soils and sediments, Pollutant mobility, Rubbish and waste, Dust
Water chemistry	Lecture and Seminar	3	5	Case study and written exam	Master EnviTox	Sorption processes, Non-aqueous phase liquids Reaction kinetics, Transformations
Bioinformatics	Lecture and exercises	3	5	Written exam	Master EnviTox	Relevant biological basics; data intensive problems and methods in biology; analytical methods in biology and the data generated by these methods; biological databases; methods for processing and analysing biological data, and for prediction and modelling
Uptake and metabolisms	Seminar	2	3	Oral presentation and report	Master EnviTox	Uptake, bioaccumulation and elimination processes of organic compounds, metals and air pollutants, phase I reactions, phase II reactions,

				(Science Slam)		cytochrome P450 family, Ah receptor, DNA damage and its repair, metal binding proteins, endocrine disruption, effects on pigments, respiration and photosynthesis, effect mechanisms of e.g. polychlorinated biphenyls, dioxins, halogenated hydrocarbons, pesticides, air pollutants
Environmental Microbiology	Lecture and Seminar	3	5	Written exam	Master EnviTox	Drinking water microbiology: bank filtration, groundwater - Microbiology of drinking water treatment - Microbiology of waste and waste water treatment - Sediment – microbiology - Bioremediation - Introduction to biotechnology

## Summer Term

Course name	Kind of course	Hours per week	Credits	Kind of exams	Study program	Topics
Bioinformatics	Lecture and Exercise	2	3	Written exam	Bachelor Biology, Bachelor medical Biology	<p>What is Bioinformatics? Some computer science basics: logic, algorithms, data structures. Introduction to programming. Biological ontologies and databases. Sequential alignments (local, global, multiple). Pattern search (e.g. BLAST variants). Structure and function prediction (e.g. secondary structure of proteins and RNA, tertiary structure). Hidden Markov models. Analysis of gene expression data. Analysis and description of biological networks.</p> <p>Methods: Database queries (text and sequence databases), Boolean logic, sequence alignments and sequence pattern search, machine learning (e.g. Hidden Markov), interactive visualization and modeling of biomolecular structures.</p>
Mathematical models for molecular biology (start in summer 2020)	Lecture and Exercises	2	4	Written exam	Bachelor molecular Biology	<p>VO: In the lectures, the students will learn the basic mathematical models used in modern biology. After a general introduction to the topic, a classification of the models will be presented according to current literature. Different models will be explained, mathematically described in a simple way and applied to realistic biological scenarios. A first section will be dedicated to the study of populations, either of single species or</p>



						<p>interacting species. Here, the exponential growth/decay model as well as the predator-prey model will be described in detail. A second section will deal with general principles of biochemical reactions, introducing the fundamental concepts of steady state, quasi steady-state, bifurcation and phase plane trajectories. More in-deep treatment of enzyme kinetics and mathematical models on cooperativity will be also given in a different section. The course will end with an overview on biological oscillators and switches, with a description of feedback control mechanisms, genetic networks, cell cycle models and biological spatial patterns.</p> <p>UB: In the exercise session, the students will see practical applications of the models visited during the lectures. Numerical examples of classical biological problems (e.g. enzyme-substrate interactions, bacterial growth, phosphorylation-dependent events ...) will be analyzed and discussed together. Computer-aided simulations are foreseen to facilitate the treatment of more complex mathematical problems and allow a rapid visualization of the results obtained by changing defined parameters.</p>
Molecular biology for aquatic biologists (starting in Summer	Lecture and Exercise	5	8	Written exam and protocol	Bachelor Aquatic Biology	<p>1. introduction to the cell</p> <ul style="list-style-type: none"> <li>- Cells and Genomes</li> <li>- Cell Chemistry and Bioenergetics</li> </ul>

2021)						<ul style="list-style-type: none"> <li>- proteins</li> </ul> <p>2. basic genetic mechanisms</p> <ul style="list-style-type: none"> <li>- DNA, chromosomes and genomes</li> <li>- Replication, repair and recombination of DNA</li> <li>- How cells read the genome: from DNA to protein</li> <li>- Control of gene expression</li> </ul> <p>3. the internal organization of the cell</p> <ul style="list-style-type: none"> <li>- The structure of the membrane</li> <li>- Membrane transport of small molecules and electrical potentials</li> </ul> <p>4. methods for the investigation of molecules and cells</p> <p>In the exercise part, the following laboratory techniques are taught in particular: DNA/RNA extraction and quantification; polymerase chain reaction (with variants), primer construction, restriction digestion, cloning, sequencing (Sanger, high-throughput sequencing). Data are analyzed on the computer. An introduction to sequence analysis programs and the use of R for analysis will be given.</p>
Scientific writing	Lecture and seminar	2	3	Written Exam	Master MedBio	What is a scientific publication, how is it structured, how do I write a scientific paper
Datapresentation	Lecture/seminar	1	2	Homework	Master MedBio	How to deal with data? How can it be analysed (statistically), how can it be visualized?
Biomolecular	Lecture/Excercises	4	6	Project work	Master	Molekular Visualisation. Modelling of simple

Modelling					MedBio/ Master Bio	force fields, Kontinuum (Poisson-Boltzmann)- and gridmodels. Molekuldynamics, stochastic Optimisation. QSAR. Docking and Design.
Mathematical Models in Biology	Lecture/Seminar	4	6	Presentation	Master MedBio/ Master Bio/ Master Biodiversity	Quantitative Modelation in biological Systems, e.g.. - Quantitative Modelation of Evolution and Biodiversity - Dynamic Phenomenons (z.B. Infections) with linear and non-linear Models, linear Algebra, etc OpenSource-Software for mathematical modelling
Molecular and cellular Biophysics	Lecture/Seminar	4	6	Written exam	Master MedBio/ Master Bio/	The students will learn to see biological phenomena under a more general physical perspective. Fundamental physical principles regulating all living systems will be made easy to understand and will be applied to some important examples from nature.
Methods in cancer research	Lecture/seminar	4	6	Written exam	Master MedBio/ Master Bio/	Principle of scientific research methods, quantitative analysis of data, cell based analysis, survey of cells and cell organells using modern microscopy methods (confocale, spinning disc, TIRF), use of fluorescence proteins and photoconversion, manipulation of proteins within cells (RNAi, Photoactivation, genomics (transcriptomics), epigenetic and its relevance in cancer science, proteomics, high content and high throughput screening, viral vector systems, animal models

Hydrogeology and Application	lecture and seminar, exercises	4	4	a) oral presentation of the results 40%; b) written hydro-geological report 60%	Master TWM	A fundamental understanding of the principles in hydrogeology (clastic, fractured and karst aquifers).
Water Quality Modelling	lecture, exercises, lab	2	3	Written examination	Master TWM	Fields of hydraulic applications – overviews, flow in channel, sediment transport, hydromechanical models, hydraulic engineering research
Ecology and Protection of Freshwater Ecosystems and Aquatic Organisms	seminar, data evaluation, exercises	4	5	Written examination, homework, oral presentation	Master TWM	Typology of freshwater ecosystems, impacts of different perturbations on aquatic ecosystems, river and lake assessment according to national and international regulations, the organism groups addressed by the Water Framework Directive
Hydrobiological Field Trips <i>(only if places are available)</i>	field trips	2	2	Written summary of contents, participation in at least six half-day field trips	Master TWM	One ecosystem type or restoration measure/field trip. Examples: - Hydromorphology and community composition of near natural and degraded lowland streams - Hydromorphology and community composition of near natural and degraded mountain streams - Stressors on large rivers (Rhine, Ruhr): flood protection, water power generation, reservoirs - Fish migration devices
Water Pollution	lecture, exercises, lab. work	2	2	Oral exam (30–45 min/group)	Master TWM	Determination of traces of organic compounds in water (gas Chromatography, mass

				50 %, report of the experiments 50 %		spectrometer HPLC) Evaluation of contamination, connection to water framework directive
Water-borne Diseases	seminar	2	2	Oral presentation, homework	Master TWM	Water borne diseases (Bacterial, viral , protozoan, “worms”, insects as vectors for parasites, diarrhoeal diseases, chemical water pollution, water-based diseases, waterrelated diseases) Ecological consequences, freshwater habitat management, prevention of water-borne diseases
Hydroclimatology and sustainable Water Management	lecture, seminar, exercises	2	2	Oral presentations, solving arithmetic problems, homework	Master TWM	General climatology, Measuring hydroclimatic atmospheric and terrestrial components <ul style="list-style-type: none"> <li>· Precipitation, runoff processes and streamflow</li> <li>· Hydroclimate spatial and temporal variations</li> <li>· Floods and droughts, irrigation of land</li> <li>· Sources of irrigation water, geographical distribution of irrigation demand</li> <li>· Types and efficiency of irrigation, problems of irrigation</li> </ul>
Basics in Hydraulic Planning and Facility Design	lecture, field trips	2	3	a) Written examination b) Exercises	Master TWM	relationships between hydraulics, hydrology, water resource management and hydraulic engineering; design of hydraulic structures and upgrade of existing facilities (in particular, methods of watercourse construction as well as weirs and dams); concepts of flood control.
Waste Water Treatment	lecture, exercises, lab. work	1,5	2	Written examination (50 %),	Master TWM	Sources and composition of wastewater, basic biological processes, activated sludge plants, trickling filters, nitrification, denitrification, P-

				laboratory report (50 %)		elimination, anaerobic processes, sludge treatment, mass balances
River Basin Management	(guest) lecture, seminar	2	3	Oral examination, written examination, reports	Master TWM	River basin characteristics, human pressure analysis, measure scenarios ("best practice"), public participation, monitoring, transboundary basins, administrative competencies in river basin management
Water, Sanitation and Health	lecture	2	3	Written exam	Master TWM	<ol style="list-style-type: none"> <li>1) Water, sanitation and health – global situation</li> <li>2) Transmission routes and reservoirs of water-related pathogens</li> <li>3) Classical and emerging waterborne pathogens – bacteria</li> <li>4) Waterborne pathogens – viruses</li> <li>5) Waterborne pathogens – protozoa</li> <li>6) Vector-borne diseases associated with water</li> <li>7) Water-related disease caused by cyanobacteria and algae</li> <li>8) Hygienic aspects of catchment and source water quality</li> <li>9) Hygienic aspects of water treatment, disinfection and water distribution</li> <li>10) The indicator concept</li> <li>11) Risk assessment</li> </ol>
Applied Analytical Chemistry	Lecture and seminar	3	5	Written exam	Master EnviTox	Concrete knowledge transfer with regard to the chemical and analytical preparation of samples (material and environmental samples, biological samples): Handling of samples and analytical methodology with respect to the most

						important instrumental techniques of atomic, isotopic and molecular analysis.
Environmental analytics	Practical lab course	7	5	Reports on experimental work and method fundamentals plus Colloquium	Master EnviTox	Performance of environmental analytical methods with modern instrumental techniques covering the whole analytical process consisting of sample retrieval and preparation, measurement (qualitative and quantitative), and data evaluation. Error and uncertainty analysis will be an integral part of the evaluation step. Instrumental methods covered may include separation techniques (HPLC, GC), spectroscopic techniques, electroanalytical techniques and hyphenated methods applied to environmentally relevant problems
Ecotoxicology	Lecture and Seminar	3	4	Written examination and oral presentation	Master EnviTox	Biotic stressors: Viral (incl. viroids), bacterial (incl. mollicutes) and fungal diseases, parasites, herbivory, insects, nematodes, snails, aphids, etc. abiotic stressors: light, high and low temperatures, frost, hail, wind, lightning, nutrients, heavy metals, air pollutant, particles. Pathogen attack, infection, resistance, defense, detoxification; types of diseases
Applied methods in (eco-)toxicology	Practical lab course and Seminar	6	6	Oral presentation and written examination	Master EnviTox	fundamentals on acute and chronic toxicity tests - biomarkers - biological monitoring of ecosystems in theory and praxis - bioaccumulation and bioavailability of xenobiotics in aquatic systems

						- toxicological tests using aquatic and terrestrial organisms
Celltoxicity	Practical lab course and Seminar (Block course in August/september)	4	5	Oral Examination, Oral presentation	Master EnviTox	- fundamentals on toxicity tests in vitro - cell biology, cellular toxicity