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University of Duisburg-Essen

Module Handbook

Master course

Environmental Toxicology

(EnviTox)

Year 2021/2022

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Introduction

The Module Handbook aims at providing a general overview on the Master Programme, its modules and courses. The document also provides additional information on registration and assessment procedures, such as guidelines, forms and recommendations. Since the content is subject to frequent changes in curricula and procedures, **please always check the relevant websites for actual information. This includes deviations from the course descriptions announced by individual teachers during the term.**

Aims of the Master Program Environmental Toxicology (EnviTox)

Environmental Toxicology (EnviTox) is an integrated interdisciplinary master's degree Programme in the sector of European monitoring and assessment of Xenobiotics and other anthropogenic emitted elements offered by the University of Duisburg-Essen.

EnviTox focuses on Biology, Chemistry and environmental sciences, therefore students with a bachelor's degree in biology, Chemistry or Ecology and similar fields of study are welcome to apply for EnviTox.

The aims and learning targets of the study program are provided in the following table:

Study aims for the Master Program EnviTox

Superior Aims of the study program	Learning outcomes	Target oriented module
Ability of systematic representation of complex relations in the topics pollutant dispersal, uptake of pollutants by plants and animals and effects of pollutants on those organism	<p>Graduated EnviTox students:</p> <ul style="list-style-type: none"> - Use their knowlegde of biological and chemical processes to evaluate the behavior of harmful substances in different environmental matrices - Analyze the uptake and metabolism of harmful substances in cells and organism (plants and animals) - Have an overview about actual reseach topics in specific disciplines and can interpret results critically due to a scientific background knowledge - They can address and evaluate ethical questions relevant to society and give new impulses, especially to topics related to „diversity“, „sustainability“ and “resource protection”. 	<p>Modules 2,3,4,6</p> <p>Modules 3,4,6</p> <p>Modules 1,5,6,7,8</p> <p>Modules 4,7,8,9</p>
Evaluation and Integration of research and test results in the context of european environmental legislation	<p>Graduated EnviTox students:</p> <ul style="list-style-type: none"> - Know the european legislation regarding topics relevant to ecotoxicology - Use this knowledge to asses and integrate new research and test results 	Module 7

<p>Address, evaluate and present classical and new problems in the field of environmental toxicology and put them into the given research context</p>	<p>Graduated EnviTox students:</p> <ul style="list-style-type: none"> - Know different modern methods and techniques to quantify pollutants and xenobiotics in different environmental compartments and for the detection of effects in cells, organisms and ecosystems - can critically interpret the results of the above mentioned methods in context of the given research hypothesis - are able to autonomously handle those methods in the laboratory and field work - evaluate, interpret research results and put them into an ecotoxicological context - present results in oral and written form to different stakeholders 	<p>Modules 2,5,6,8,9</p> <p>Modules 5,6,8,9</p> <p>Modules 5,6,8,9</p> <p>Modules 5,6,8,9</p> <p>Modules 5,6,8,9</p>
<p>Ability to work in a leading position in the industry/governmental agency/NGO and/or to accomplish a phd thesis</p>	<p>Graduated EnviTox students:</p> <ul style="list-style-type: none"> - develop autonomous research questions and hypotheses - plan research projects under limited time and resources - conduct research projects with suitable methods, work in research teams, evaluate results, interpret results critically, and put results into an ecotoxicological and ethical context - present results in oral and written presentations to different stakeholders - stellen Ergebnisse in mündlicher und schriftlicher Form adressatenbezogen vor 	<p>All modules, but especially Module 9</p>

Study contents

The study course EnviTox consists of a more theoretical first study year and a more practical second study year.

The curriculum consists of a total of nine modules, one of which representing a 16-week internship and the final module being the six-month Master Thesis.

The twelve modules are grouped into different focuses. In “**Fundamentals**” students are introduced into the field of EnviTox (Module “Aspects of environmental research”), they gain fundamental knowledge of the movement of elements in environmental compartments (Environmental chemistry), get an inside into important molecular biological sciences (biochemistry and bioinformatics) and learn how to monitor chemical substances in different matrices (Environmental analytics).

The focus “**Effects**” summarizes the effects of pollutants on different organisms. The module “biological interaction” covers the role of microbes in drinking water supply and waste water treatment, explains how pollutants are uptaken by plants and animals and how we can use population structures of different keygroups to monitor the ecological state of

ecosystems. The module “Effects on biological functions” directly deals with the effects of xenobiotics and other pollutants on cells, plants and animals. Additional competencies related to the presentation of information, teamwork, information technologies and strategies to solve problems will be integrated in the courses with an emphasis on multidisciplinary.

During the practical year “**Applied Environmental Toxicology**” focuses on the European legislation regarding the use of Xenobiotics and the implementation of monitoring, assessment and risk managing by the industry and other stakeholders. Furthermore, in 16-week internship students are encouraged to get first working experiences in an industrial, administrative, advisory or scientific setting in Germany or abroad.

The Master Programme will close with the Master Thesis on current questions in Environmental Toxicology.

Curriculum Master EnviTox

First term	Lecturer	hpw	Credits
Aspects of environmental research			4
Aspects of environmental research	various	1	1
Biochemistry: structure and function of biomolecules	Bayer	2	3
Environmental chemistry			8
Biogeochemical cycles	Kuttler	2	3
Contaminants: Sources and Pathways	Ruchter	3	5
Water chemistry			5
Water chemistry	Schmidt	3	5
Chemometrics and Statistics			5
Chemometrics and Statistics			5
Environmental Microbiology			5
Environmental Microbiology	Probst, Meckenstock	3	5
Ecotoxicology (continued in 2nd term)			13
Ecotoxicology I: Uptake and metabolisms	Zimmermann, Pfanzen	3	4
Second term	Lecturer	hpw	Credits
Environmental analytics			10
Applied Analytical Chemistry	Schmitz	3	5
Environmental analytics	Telgheder	7	5
Ecology and Protection of Freshwater Ecosystems			5
Ecology and Protection of Freshwater Ecosystems and Aquatic Organisms	Hering, Birk, Kail	4	5
Ecotoxicology (continued from 1st term)			13
Ecotoxicology II: Effects	Pfanzen, Zimmermann	3	4
Applied methods in (eco-)toxicology	Wittmann, Zimmermann	6	6
Cellular toxicity			5
Cellular toxicity	Johannes, Ruchter	4	5
Third Term	Lecturer	hpw	Credits
European Environmental Legislation			8
Introduction to EU-environmental legislation	Giersig, Koch	2	3
Assessment of Chemicals under REACH	Giersig, Koch	3	5
Internship			22
Fourth term			
Master Thesis			30

Module Descriptions

Module Name	Abbreviation Module
Aspects of environmental research	EnviTox-MA-1
Responsible for the Module	Faculty
N. Ruchter	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology	Master

Designated Semester	Duration of Module	Module Type (P/WP/W)	Credits
First term	One term	P	4

Prerequisites according to examination regulations	Recommended Prerequisites
none	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
1.1	Aspects of environmental research	VO	1	30 h
1.2	Biochemistry: structure and function of biomolecules	VO	2	90 h
Sum (Compulsory and Supplementary Courses)			3	120 h

Learning targets of the Module
<ul style="list-style-type: none"> - Students get an inside about current relevant research topics in the field of Environmental Toxicology - They reflect the aim of their studies courses. - Students can interpret results critically due to their scientific background knowledge <p>Hler fehlen die Learning targets von Biochemistry...</p>
Associated Key Qualifications
-

Module examinations to gain grades	
Written exam in course 2.2	
Contribution of the Module Grade for the Final Grade	none

Master-EnviTox-9

Module Name		Abbreviation Module	
Aspects of environmental research		EnviTox-MA-1	
Course Name		Abbreviation Course	
Aspects of environmental research		1.1	
Lecturer		Division	Module Type (C/S)
several		Biology and Chemistry	C

Designated Semester	Frequency	Language	no. Students/Course
First Term	WS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
1	15 h	15 h	30 h

Education Methodology
Lecture
Learning targets
– Students get an inside about current relevant research topics in the field of Environmental Toxicology and reflect the aim of their studies. They are able to analyse results.
Contents
– Actual scientific questions, used methods and results of relevant field in Environmental Toxicology, regarding the distribution, uptake, metabolism and effects of xenobiotics.
Examination
-/-none
Literature
▪ Will be presented during the lecture
Further Information on the course (e.g. contact days,)
none

Module Name	Abbreviation Module
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Aspects of environmental research		EnviTox-MA-1	
Course Name		Abbreviation Course	
Biochemistry: structure and function of biomolecules		1.2	
Lecturer		Division	Module Type (C/S)
several		Biology and Chemistry	C

Designated Semester	Frequency	Language	no. Students/Course
First Term	WS	english	50

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
2	30 h	60 h	90 h

Education Methodology
Lecture
Learning targets
Students are able to apply and assess modern structure determination methods. They understand the processes of protein-protein interaction and relevance of conformational and structural rearrangements in proteins. They have an understanding of biophysical and biochemical processes to evaluate the behaviour of pollutants in the environment.
Contents
Methods: Crystallizing of proteins, structure determination by X-ray analysis, nmr of biomolecules (principles of nmr, spectra, assignment, labelling strategies), fluorescence spectroscopy (FRET, anisotropy), IR-spectroscopy, Structure and function of proteins: membrane receptors, GPCR and G-binding proteins, signal transduction cascades, second messengers
Examination
Written exam (Duration of the written exam will be announced at the beginning of the lecture. Duration min. 45 and max. 180 min)
Literature
- Biophysical Chemistry (Part II), Cantor and Schimmel, Freeman and Company 1980 - Physical Biochemistry, van Holde et al., Prentize Hall 1998 - Wirkstoffdesign, Böhm et al., Spektrum Verlag 2002 - Bioanalytik, Lottspeich, Spektrum Verlag 1998 - X-ray crystallography of biological macromolecules, A. Messerschmidt and R. Huber, Encyclopedia of Analytical Chemistry, R.A.Meyers (Ed) p 6061-6107, John Wiley & Sons Ltd. Chichester 2000
Further Information on the course (e.g. contact days,)
none

Module Name	Abbreviation Module
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Master-EnviTox-11

Environmental chemistry	EnviTox-MA-2
Responsible for the Module	Faculty
Dr. Nadine Ruchter	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology, Master Water Science	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
First Term	One term	C	8

Prerequisites according to examination regulations	Recommended Prerequisites
none	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
2.1	Biogeochemical Cycles	VO	2	90 h
2.2	Contaminants: Sources and Pathways	ÜB	3	150 h
Sum (Compulsory and Supplementary Courses)			5	240 h

Learning targets of the Module	
<ul style="list-style-type: none"> – Students have an understanding of chemical and biochemical processes in soil, air and water systems. – They have an overview about transformation and transport processes affecting the mobility and toxicological relevance of pollutants in soil and water systems. – Students are able to use their knowledge of biological and chemical processes to evaluate the behaviour of harmful substances in different environmental matrices. – They know different modern methods and techniques to quantify pollutants and xenobiotics in different environmental compartments. 	
Module examinations to gain grades	
Oral Exam for courses 2.1 und 2.2	
Contribution of the Module Grade for the Final Grade	8/119

Module Name		Abbreviation Module	
Environmental chemistry		EnviTox-MA-2	
Course Name		Abbreviation Course	
Biogeochemical Cycles		2.1	
Lecturer		Division	Module Type (C/S)
W. Kuttler		Climatology	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
2	30 h	60 h	90 h

Education Methodology
Lecture (2 HPW)
Learning targets
Insights into the role of biogeochemical cycling: cross linking of biotic and abiotic processes in the geo- and hydrosphere.
Contents
To understand the movement of chemical elements around an ecosystem via physical and biological processes
<ul style="list-style-type: none"> I. General Overview of Biogeochemical Cycles II. The Water Cycle III. The Carbon Cycle IV. The Nitrogen Cycle V. The Phosphorus Cycle VI. The Oxygen Cycle VII. The Sulfur Cycle VIII. Aspects of biogeochemical cycles in urban systems
Examination
Oral exam together with course 2.2

Literature
<ul style="list-style-type: none">• Global Biogeochemical Cycles (starting 2018). Editor: AGU (American Geophysical Union) (monthly published Journal) most important journal for this lecture; should be read every month.• Molles, M.C. (2016): Ecology - concepts and applications. WCB McGraw Hill, 7th edition, 640 p.• IPCC (2013): Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.• Stull, R. (2019): Practical Meteorology: An Algebra-based Survey of Atmospheric Science. 924 p. http://www.eos.ubc.ca/books/Practical_Meteorology/ very important book, free access!• For German language Readers:• Kuttler, W. (2013): Klimatologie. 2. Auflage. Ferdinand Schöningh Verlag, UTB 3099, 306 Seiten
Further Information on the course (e.g. contact days, ...)
none

Module Name		Abbreviation Module	
Environmental chemistry		EnviTox-MA-2	
Course Name		Abbreviation Course	
Contaminants: Sources and Pathways		2.2	
Lecturer	Division	Module Type (C/S)	
N. Ruchter		C	

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	45 h	105 h	150 h

Education Methodology
Flipped classroom: Online phase (1 hpw), presence exercise (2 hpw)
Learning targets
Students get to know the currently discussed contaminants, their sources and pathways. They have the ability to describe the chemistry of the contaminants, their use for human mankind. They have the ability to gain knowledge from scientific publications and present its contents. They can discuss the misuse of chemicals in a profound way and name prevention strategies.
Contents
<ul style="list-style-type: none"> - Inorganic Contaminants, Technology critical elements - Organic Contaminants I – Polycyclic Aromatic Hydrocarbons - Organic Contaminants II – Agricultural products (Pesticides, Herbicides, Insecticides, Fungizids) - Organic Contaminants III - Pharmaceuticals and Personal Care Products - Radiation - Particulate Contaminants - Nanoparticles, Microplastics - Thermal and light pollution - Sources and Pathways of Contaminants - Methods to stop/reduce contamination - Risk Assessment
Examination
Oral Exam together with course 2.1
Literature
Literature is very divers and will be given in the moodlecourse.
Further Information on the course (e.g. contact days,)
Compulsory attendance
The presence of the student in the exercise part is obligatory.

Master-EnviTox-15

Module Name	Abbreviation Module
Water Chemistry	EnviTox-MA-3
Responsible for the Module	Faculty
T.C. Schmidt	Biology

Relevance for following study programmes:	Module Level
Master EnviTox, Master Chemie, Master angewandte Informatik, Master Water Science	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
First Term	One term	C	5

Prerequisites according to examination Regulations	Recommended Prerequisites
None	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
3.1	Water Chemistry	VO	3	150 h
Sum (Compulsory and Supplementary Courses)			3	150 h

Learning targets of the Module
Students should acquire an advanced understanding of chemical processes relevant in natural and technical aqueous systems, and of conceptual models and quantitative approaches to describe these. Controls of behavior and fate of organic and inorganic contaminants will be emphasized.

Module examinations to gain grades	
Written exam and presentation of results of a case study (Duration of the exams will be announced at the beginning of the lecture. The written exam durates min. 45 and max. 180 min, the presentation between 15 and 45 min)	
Contribution of the Module Grade for the Final Grade	5/119

Module Name		Abbreviation Module	
Water Chemistry		EnviTox-MA-3	
Course Name		Abbreviation Course	
Water chemistry		3.1	
Lecturer	Division	Module Type (C/S)	
T.C. Schmidt	Analytical chemistry	C	

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	50

hours per week (SWS)	Presence	preparation, self tutoring, preparation for exam (h)	Workload
3	45 h	105 h	150 h

Education Methodology
Lecture (2 HPW) and Seminar (1 HPW)
Learning targets
Students should acquire an advanced understanding of chemical processes relevant in natural and technical aqueous systems, and of conceptual models and quantitative approaches to describe these. Controls of behavior and fate of organic and inorganic contaminants will be emphasized.
Contents
<p>Recapture of thermodynamics, chemical equilibrium and thermodynamics Useful tools: Thermodynamic cycle, Mass balance equations, Single-parameter Linear Free Energy Relationships (LFERs), Poly-parameter LFERs Solids in aquatic systems: sorption, partitioning, adsorption, ion exchange, surface complexation; linear and nonlinear sorption, sorption isotherms, role of colloids/DOM, role of inorganic surfaces, Reaction kinetics: first-order, second-order and pseudo-first-order reactions, reaction rates and half life, kinetics and thermodynamics. Transformations: nucleophilic substitution including hydrolysis, elimination, redox reactions, introduction to photolysis.</p>
Examination
Written exam and presentation of results of a case study (Duration of the exams will be announced at the beginning of the lecture. The written exam durates min. 45 and max. 180 min, the presentation between 15 and 45 min)
Literature
a) Schwarzenbach, R. P., Gschwend, P. M., Imboden, D. M. <i>Environmental Organic Chemistry</i> , 2nd ed., Wiley: Ney York, 2003. b) Jensen, J. N. <i>A Problem-Solving Approach to Aquatic Chemistry</i> , Wiley: New York, 2003. c) Brezonik, P. L., Arnold, W.A. <i>Water Chemistry</i> , Oxford University Press, Oxford, 2011

Master-EnviTox-17

Module Name	Abbreviation Module
Chemometrics and Statistics	EnviTox-MA-4
Responsible for the Module	Faculty
Gerrit Renner	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology, Master TWM	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
First term	One term	C	5

Prerequisites according to examination regulations	Recommended Prerequisites
None	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
4.1	Chemometrics and Statistics	VO/SE	3	150 h
Sum (Compulsory and Supplementary Courses)			3	150 h

Learning targets of the Module
The students get knowledge about statistics including probability calculus, random variables, interval estimates and regression analysis. They are able to use these in modern chemometric data evaluation methods. They can solve problems within a programming environment.

Module examinations to gain grades	
<i>Written exam (120min)</i>	
Contribution of the Module Grade for the Final Grade	5/119

Module Name		Abbreviation Module	
Chemometrics and Statistics		EnviTox-MA-4	
Course Name		Abbreviation Course	
Chemometrics and Statistics		4.1	
Lecturer	Division	Module Type (C/S)	
		C	

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	english	

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	45 h	105 h	150 h

Education Methodology
Lecture (2 SWS) and Seminar (1 SWS)
Learning targets
After a brief repetition of classical statistics, the students get acquainted with modern multivariate chemometric methods including factor analysis. Students will learn to grasp the underlying concepts by solving problems in a computer-based environment.
Contents
1. Introduction: Probability, special discrete and continuous distributions, limit theorems, confidence intervals, statistical tests, correlation and regression, variance analysis 2. Multivariate methods: Linear statistical models, factor analysis, cluster and discriminant analysis 3. Basic methods of time series analysis 4. Case studies
Examination
Written exam (120min)
Literature
a) Peter Dalgaard, Introductory Statistics with R, Springer 2002 b) William N. Venables, Brian D. Ripley, Modern Applied Statistics with S, Springer 2003 c) John Fox, An R and S-Plus Companion to Applied Regression, Sage Publications 2002 d) Brian Everitt, An R and S-Plus Companion to Multivariate Analysis, Springer 2004 e) J.W. Einax et al., Chemometrics in Environmental Analysis, VCH (Wiley) 1997
Further Information on the course (e.g. contact days,)
none

Master-EnviTox-19

Module Name	Abbreviation Module
Environmental Microbiology	EnviTox-MA-5
Responsible for the Module	Faculty
Prof. Dr. R. Meckenstock	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology, Master TWM	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
First term	One term	C	5

Prerequisites according to examination regulations	Recommended Prerequisites
None	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
5.1	Environmental Microbiology	VO/SE	3	150 h
Sum (Compulsory and Supplementary Courses)			3	150 h

Learning targets of the Module
The students understand the processes underlying drinking water and waste water purification by biological filtration. They obtain knowledge about the basics of sediment microbiology and bioremediation and get access to the basics of biotechnology.

Module examinations to gain grades	
<i>Written exam</i>	
Contribution of the Module Grade for the Final Grade	5/119

Module Name	Abbreviation Module
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Environmental Microbiology	EnviTox-MA-5	
Course Name	Abbreviation Course	
Environmental Microbiology	5.1	
Lecturer	Division	Module Type (C/S)
Prof. Dr. R. Meckenstock	Aquatic Microbiology	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	English	100

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	45 h	105 h	150 h

Education Methodology
Lecture (2 HPW) and Seminar (1 HPW)
Learning targets
The students understand the processes underlying drinking water and waste water purification by biological filtration. They obtain knowledge about the basics of sediment microbiology and bioremediation and get access to the basics of biotechnology.
Contents
<ul style="list-style-type: none"> - Drinking water microbiology: bank filtration, groundwater - Microbiology of drinking water treatment - Microbiology of waste and waste water treatment - Sediment – microbiology - Bioremediation - Introduction to biotechnology
Examination
<p>Written exam</p> <p>Duration of the exam will be announced at the beginning of the lecture. The written exam durates min. 45 and max. 180 min, the oral presentation is in between 10 and 30 min.</p>
Literature
<p>Brock: Biology of Microorganisms 10 th Edition 2002. Prentice Hall, ISBN 0-13-081922-0</p> <p>Doods, W.K.: Freshwater Ecology. Academic Press, San Diego, 2002, ISBN 0-12-219135-8</p> <p>Maier, Pepper, Gerba: Environmental Microbiology, Academic Press, 2000, ISBN 0-12-49750-4</p>
Further Information on the course (e.g. contact days, ...)

Module Name	Abbreviation Module
Ecotoxicology	EnviTox-MA-6
Responsible for the Module	Faculty
Dr. Sonja Zimmermann	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology, Master TWM	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
First and second term	One year	C	13

Prerequisites according to examination regulations	Recommended Prerequisites
None	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
6.1	Ecotoxicology I: Uptake and metabolisms	VO/SE	3	150 h
6.2	Ecotoxicology II: Effects	VO/SE	3	150 h
6.3	Applied methods in (eco-) toxicology	VO/PR	6	180 h
Sum (Compulsory and Supplementary Courses)			12	480 h

Learning targets of the Module
<ul style="list-style-type: none"> - Students are able to use their knowledge of biological and chemical processes to evaluate the behavior of harmful substances in different environmental. - Students know modern methods of quantitative captures of xenobiotics and of detection of effects in cells, plants and animals and are able to autonomous handle those methods in the laboratory and field work. - Students understand the opportunities and limitations of analytical methods to obtain information on effects on cells and organism. - Students can critically interpret the results of the above-mentioned methods in context of the given research hypothesis and the ecotoxicological context. - They are able to participate in scientific discussions about current topics and to assess them critically. They use their knowledge to assess and integrate new research and test results - They present results in oral and written form to different stakeholders.
Module examinations to gain grades

Oral exam for the courses 6.1, 6.2 und 6.3

Contribution of the Module Grade for the Final
Grade

13/119

Module Name		Abbreviation Module	
Ecotoxicology		EnviTox-MA-6	
Course Name		Abbreviation Course	
Ecotoxicology I: Uptake and metabolisms		6.1	
Lecturer		Division	Module Type (C/S)
H. Pfanz, B. Sures, S. Zimmermann		Applied Botany, Aquatic Ecology	C

Designated Semester	Frequency	Language	no. Students/Course
First term	WS	English	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	45 h	105 h	150 h

Education Methodology
Lecture combined with seminar
Learning targets
The students - gain insight in uptake processes, metabolic pathways and effects of xenobiotics and pollutants in living organisms - know how to find scientific literature by using different data bases - are able to present and discuss a topic in context using modern means of presentation
Contents
Uptake, bioaccumulation, biotransformation and elimination processes of organic compounds, metals and air pollutants, mechanisms of toxicity at (sub)cellular, organismic and higher organizational levels, phase I reactions, phase II reactions, cytochrome P450 family, Ah receptor, metal binding proteins, bioactivation of xenobiotics
Examination
Oral exam together with 6.2 and 6.3
Literature
Large number of journal articles and grey literature Klaassen C.D. (2008) Casarett and Doull's Toxicology -The Basic Science of Poisons, 7th edition, The McGraw-Hill Companies, Inc.
Further Information on the course (e.g. contact days,)
Compulsory attendance The presence of the student in the seminar is obligatory.

Module Name	Abbreviation Module
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Ecotoxicology	EnviTox-MA-6	
Course Name	Abbreviation Course	
Ecotoxicology II: Effects	6.2	
Lecturer	Division	Module Type (C/S)
B. Sures, H. Pfanz, S. Zimmermann	Applied Botany, Aquatic Ecology	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	english	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	42 h	78 h	120 h

Education Methodology
Seminar combined with lecture
Learning targets
The students gain insight into the multidisciplinary and complexity of ecotoxicology and get an overview of different toxicity tests as well as bioindication and biomonitoring methods. Students know modern methods of quantitative captures of xenobiotics and of detection of effects under laboratory and field conditions. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. They get an inside on current relevant research topics with local and global importance. They are able to analyse results.
Contents
Effects of selected toxic and/or environmentally relevant substances (e.g. metals, polychlorinated biphenyls, dioxins, halogenated hydrocarbons, endocrine disruptors, particles) at all levels of biological organization from cell to ecosystem. Biomarker, single and multi-species tests, acute and long-term tests, life-cycle tests, lab-to-field dilemma of toxicity tests, biological indication and monitoring,
Examination
Oral exam together with 6.1 and 6.3
Literature
Agrios GN (2004): Plant Pathology, 4 ed., Academic Press Connell D.W., Lam P., Richardson B., Wu R. (1999) Introduction to Ecotoxicology, Wiley-Blackwell Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B. (2006) Principles of Ecotoxicology, 3rd edition, CRC Press Taylor & Francis Group Wright D.A., Welbourn P. (2002) Environmental Toxicology, 1st edition, Cambridge University Press Fent K. (2007) Ökotoxikologie, 3. Auflage, Georg Thieme Verlag Landis W.G., Yu M.-H. (2003) Introduction to environmental toxicology: impacts of chemicals upon ecological systems, 3rd edition, CRC Press; Markert B.A., Breure A.M., Zechmeister H.G. (eds): Bioindicators and biomonitors. Elsevier Science B.V. Schüürmann G., Markert B.A.: Ecotoxicology, John Wiley & Sons large number of journal articles.
Further information

Compulsory attendance

The presence of the student in the seminar is obligatory. If a student arrives later than 15 minutes after the start of a course, the lecturer will list this student in the attendance list as "absent" for this date. If the student misses more than twice the whole course is failed and has to be repeated in total the next summer semester.

Module Name		Abbreviation Module	
Effects on biological functions		EnviTox-MA-6	
Course Name		Abbreviation Course	
Applied methods in (eco-)toxicology		6.3	
Lecturer		Division	Module Type (C/S)
B. Sures, H. Pfan, C. Wittmann, S. Zimmermann		Applied Botany, Aquatic Ecology	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	english	15

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
6	84 h	96 h	180 h

Education Methodology
Practical course (5 HPW) combined with seminar (1 HPW)
Learning targets
<p>The students</p> <ul style="list-style-type: none"> - get an overview of toxicological methods at all levels of biological organisation from the molecular level to whole communities and ecosystems - learn to plan, perform and evaluate toxicological tests and to use the appropriate equipment - gain information on biological effects of pollutants <p>Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. They get an inside on current relevant research topics with local and global importance. They are able to analyse results.</p>
Contents
<ul style="list-style-type: none"> - 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
Examination
Oral exam together with 6.1 and 6.2
Literature

- Connell D.W., Lam P., Richardson B., Wu R. (1999) Introduction to Ecotoxicology, Wiley-Blackwell
- Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B. (2006) Principles of Ecotoxicology, 3rd edition, CRC Press Taylor & Francis Group
- Wright D.A., Welbourn P. (2002) Environmental Toxicology, 1st edition, Cambridge University Press
- Fent K. (2007) Ökotoxikologie, 3. Auflage, Georg Thieme Verlag
- Landis W.G., Yu M.-H. (2003) Introduction to environmental toxicology: impacts of chemicals upon ecological systems, 3rd edition, CRC Press;
- Markert B.A., Breure A.M., Zechmeister H.G. (eds): Bioindicators and biomonitors. Elsevier Science B.V.
- Schüürmann G., Markert B.A.: Ecotoxicology, John Wiley & Sons
- Merian E., Anke M., Ihnat M., Stoepler, M. (eds): Elements and their Compounds in the Environment. Wiley-VCH, Weinheim

Further information

Compulsory attendance

The attendance in the lecture "Safety instructions" is absolutely obligatory before starting with the practical work.

The presence of the student in this practical course is obligatory. If a student arrives later than 15 minutes after the start of a course, the lecturer/supervisor will list this student in the attendance list as "absent" for this date. If the student misses more than twice the whole course is failed and has to be repeated in total the next summer semester.

Master-EnviTox-27

Module Name	Abbreviation Module
Cellular Toxicology	EnviTox-MA-7
Responsible for the Module	Faculty
Dr. Nadine Ruchter	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Second term	One Term	C	5

Prerequisites according to examination Regulations	Recommended Prerequisites
None	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
7.1	Cellular toxicity	SE/PR	4	150 h
Sum (Compulsory and Supplementary Courses)			4	150 h

Learning targets of the Module
<p>The students</p> <ul style="list-style-type: none"> - understand the influence of toxic agents on cellular functions and genomic damage - have an overview of toxicological cell culture methods and learn to handle cell cultures - know how to perform toxicological experiments - gain information on toxicological effects of pollutants <p>Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. They get an inside about current relevant research topics in special branches. They are able to analyse results.</p>

Module examinations to gain grades	
-/-Oral exam (15-45 minutes) (50% of the grade) and protocol (50% of the grade)	
Contribution of the Module Grade for the Final Grade	5/119

Module Name		Abbreviation Module	
Cellular Toxicology		EnviTox-MA-7	
Course Name		Abbreviation Course	
Cellular toxicity		7.1	
Lecturer		Division	Module Type (C/S)
E. Dopp, C. Johannes, N. Ruchter		Biology	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	english	15

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
4	56 h	94 h	150 h

Education Methodology
Practical course and seminar
Learning targets
<p>The students</p> <ul style="list-style-type: none"> - understand the influence of toxic agents on cellular functions and genomic damage - have an overview of toxicological cell culture methods and learn to handle cell cultures - know how to perform toxicological experiments - gain information on toxicological effects of pollutants <p>Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. They get an inside about current relevant research topics in special branches. They are able to analyse results.</p>
Contents
<ul style="list-style-type: none"> - fundamentals on toxicity tests in vitro - cell biology, cellular toxicity - Micronucleus Test - Sister Chromatid Exchange Test - Algae Test - Neutral Red Retention Test
Examination
-/Oral exam (15-45 minutes) (50% of the grade) and protocol (50% of the grade)
Literature
<ul style="list-style-type: none"> ▪ Marquardt H., Schäfer S.G. (eds): Lehrbuch der Toxikologie. Spektrum, Heidelberg ▪ Lindl T (ed): Zell- und Gewebekultur. Spektrum, Heidelberg ▪ Greim H., Deml E. (eds.): Toxikologie. Wiley-VCH, Weinheim ▪ Lodish H., Berk A., Zipursky S.L., Matsudaira P., Baltimore D., Darnell J. (eds.): Molecular cell biology. Media Connected, England ▪ Actual OECD guidelines for standardized ecotoxicological testprotocols

Further Information on the course (e.g. contact days, ...)

In order to obtain the Learning Targets of the course it is necessary to be present during the complete course. If students fail to be present for more than one day of the course, they do not have the opportunity to gain all learning targets and will fail the laboratory course.

Master-EnviTox-30

Module Name	Abbreviation Module
Environmental analytics	EnviTox-MA-8
Responsible for the Module	Faculty
Dr. U. Telgheder	Chemistry

Relevance for following study programmes:	Module Level
Master Environmental Toxicology, Master Water Science	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Second term	One term	C	10

Prerequisites according to examination Regulations	Recommended Prerequisites
None	Basic knowledge in analytical chemistry

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
8.1	Applied Analytical Chemistry	VO/SE	3	150 h
8.2	Environmental analytics	VO/PR	7	150 h
Sum (Compulsory and Supplementary Courses)			10	300 h

Learning targets of the Module
<ul style="list-style-type: none"> – Students know modern analytical-chemical methods of quantitative determination of xenobiotics and are able to autonomously handle those methods in the laboratory and field work. – Students understand the opportunities and limitations of instrumental analytical techniques to obtain information on environmental systems. – Students can critically interpret the results of the above mentioned methods in context of the given research hypothesis and the ecotoxicological context. – They are able to use their knowledge to assess and integrate new research and test results – They present results in oral and written form to different stakeholders.

Module examinations to gain grades

First part of the examination:

Written exam for 8.1.

(Duration of the exam will be announced at the beginning of the lecture. It durates min. 45 and max. 180 min)

Second part of the examination (8.2):

Reports on experimental work and short colloquium for each experiment

(Duration of the colloquium will be announced at the beginning of the practical. It durates min. 15 and max. 45 min)

For the module Grade:

Grades of the examination parts are weighted accordingly to the credits of the respective lecture

Contribution of the Module Grade for the Final Grade	10/119
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Module Name		Abbreviation Module	
Environmental analytics		EnviTox-MA-8	
Course Name		Abbreviation Course	
Applied Analytical Chemistry		8.1	
Lecturer		Division	Module Type (C/S)
Prof. Dr. O. Schmitz		Analytical Chemistry	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	English	100

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	42 h	108 h	150 h

Education Methodology
Lecture (2 HPW) and Seminar (1 HPW)
Learning targets
Acquisition of basic theoretical and practical knowledge in applied analytical chemistry. The handling and preparation of samples and the reduction of matrix effects through application of appropriate analytical methods will be addressed. Students understand the opportunities and limitations of instrumental analytical methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. Target analytical niveau: Eurocurriculum
Contents
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 chromatography and mass spectrometry. Exemplary topics are: <ul style="list-style-type: none"> • Sampling and sample preparation. • Use of CE, GC, GCxGC, HPLC and LCxLC with various detectors such as mass analyzers or fluorescence detector for the development of analytical applications • Qualitative and quantitative determination of main, trace and ultratrace components
Examination
Written exam (Duration of the exam will be announced at the beginning of the lecture. It lasts min. 45 and max. 180 min)
Literature
Holler, Skoog, Crouch: Principles of Instrumental Analysis, International Student Edition (2007)
Further Information on the course (e.g. contact days, ...)
Students have to participate at all practical course days. Otherwise, they are not able to achieve the learning targets. In case of an attested illness, students are allowed to catch up a course day within the same term.

Module Name		Abbreviation Module	
Environmental analytics		EnviTox-MA-8	
Course Name		Abbreviation Course	
Environmental analytics		8.2	
Lecturer		Division	Module Type (C/S)
Dr. U. Telgheder		Analytical Chemistry	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	English	15

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
7	105 h	45 h	150 h

Education Methodology
Lab Course, inclusive a seminar for the theoretical background
Learning targets
Acquisition of practical knowledge in analytical chemistry and an understanding of how to select and use appropriate analytical techniques to address environmentally relevant problems. Interpretation of analytical results by knowing characteristic analytical parameters e.g. calibration, confidence, prediction band, confidence interval, limit of detection, limit of quantification. Students know modern analytical methods for quantitative determination of xenobiotics Students get an inside about current relevant research topics in special branches.
Contents
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, water sum parameters and hyphenated methods applied to environmentally relevant problems.
Examination
Reports on experimental work and short colloquium for each experiment. (Duration of the colloquium will be announced at the beginning of the practical. It durates min. 15 and max. 45 min)
Literature
e.g., Holler, Skoog, Crouch: Principles of Instrumental Analysis, 6 th ed., Thomson, 2007
Further Information on the course (e.g. contact days,)
Attendance of the labcourse is obligatory to pass the module. If you miss a labday you will be given the chance to repeat it on another day, as far as you only miss two labday at maximum. If you miss more than two laboratory days, you will have to repeat the laboratory course.

Module Name	Abbreviation Module
Ecology and Protection of Freshwater Ecosystems	EnviTox-MA-9
Responsible for the Module	Faculty
Prof. Dr. D. Hering, Dr. S. Birk, PD Dr. C. Feld, Dr. J. Kail, Dr. A. Lorenz	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology, Master Water Science	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Second Term	One term	C	5

Prerequisites according to examination regulations	Recommended Prerequisites
none	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
9.1	Ecology and Protection of Freshwater Ecosystems; Ecosystems and Aquatic Organisms	VO/ÜB	4	150 h
Sum (Compulsory and Supplementary Courses)			4	150 h

Learning targets of the Module	
<p>The student:</p> <ul style="list-style-type: none"> - Gains knowledge of different freshwater ecosystem and classifications - Gains knowledge of related environmental impacts and stressors - Gains knowledge of and practice with freshwater ecological assessment and monitoring - Gains a basic understanding of applied water management - Gains knowledge of basic multivariate tools to analyse ecological data - Is able to transfer freshwater ecology into actual policies (e.g. the Water Framework Directive) - Is able to gain and filter information to understand and explain water-related problems - Is able to derive measures to protect freshwater ecosystems <p>They are able to participate in scientific discussions about current topics and to assess them critically.</p>	
Module examinations to gain grades	
Written examination (45-180 min., jointly with Aquatic Organisms, both parts each cover 50% of the exam) homework	
Contribution of the Module Grade for the Final Grade	5/119

Module Name	Abbreviation Module	
Ecology and Protection of Freshwater Ecosystems	EnvTox-MA-9	
Course Name	Abbreviation Course	
Ecology and Protection of Freshwater Ecosystems and Aquatic Organisms	9.1	
Lecturer	Division	Module Type (C/S)
Prof. Dr. D. Hering, Dr. S. Birk, PD Dr. C. Feld, Dr. J. Kail, Dr. A. Lorenz	Aquatic Ecology	C

Designated Semester	Frequency	Language	no. Students/Course
Second term	SS	English	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
4	56 h	94 h	150 h

Education Methodology (Ecology and Protection of Freshwater Ecosystems)
Combination of lecture and exercise: general lectures introduce to the topic, the student partly prepares a topic based on background materials; presentations of students and discussions.
Learning targets
The student: <ul style="list-style-type: none"> - Gains knowledge of different freshwater ecosystem and classifications - Gains knowledge of related environmental impacts and stressors - Gains knowledge of and practice with freshwater ecological assessment and monitoring - Gains a basic understanding of applied water management - Gains knowledge of basic multivariate tools to analyse ecological data - Is able to transfer freshwater ecology into actual policies (e.g. the Water Framework Directive) - Is able to gain and filter information to understand and explain water-related problems - Is able to derive measures to protect freshwater ecosystems They are able to participate in scientific discussions about current topics and to assess them critically.
Contents
A-priori and <i>a-posteriori</i> typology of freshwater ecosystems, impacts of different perturbations (pollution, eutrophication, acidification, pesticides, hydromorphological alteration, waterpower) on aquatic ecosystems, river and lake assessment according to national and international regulations, the organism groups addressed by the Water Framework Directive and how to use them in biomonitoring, transferring monitoring results into restoration measures, lake and river restoration, impact of global climate change
Examination
Written examination (45-180 min., jointly with Aquatic Organisms, both parts each cover 50% of the exam) homework
Literature
Rosenberg, D.M. & V.H. Resh (ed.) (1992): Freshwater Biomonitoring and Benthic Macroinvertebrates. Springer, Chapman & Hall, New-York, 504pp. Davis, W.S. & T.P. Simon (1995): Biological Assessment and Criteria. Boca Raton, Lewis Publishers. Cooke, D., E.B. Welch, S.A. Peterson & S.A. Nichols (2005): Restoration and Management of Lakes and Reservoirs. 3rd edition. CRC Press, Boca Raton. Naiman, R.J., R.E. Bilby (ed.) (2001): River Ecology and Management. New-York, Springer. Firth, P. & S.G. Fisher (1992): Global Climate Change and Freshwater Ecosystems. New-York, Springer.

Further Information on the course (e.g. contact days,)
Willing students can do an optional presentation Numerous literature (pdf files) will be available on the internet; also course materials will be made available prior to the courses on ILIAS
Education Methodology (Aquatic Organisms)
Introductory overview of the specific organism groups, systematic information on the groups, practical exercises in identification and application of determination keys, ecological background information, application of bioindicators, practical exercise in river assessment using different organism groups.
Learning targets
The students - get an overview on organism groups inhabiting fresh and marine waters - are capable to use determination keys - know about morphological and autecological characteristics of organism groups - understand the pros and cons with regard to the usage of bioindicators for aquatic monitoring.
Contents
Algae, Protozoa, Bivalvia, Gastropoda, Annelida, Entomostraca, Malacostraca, insect larvae, insect adults, insect special groups, fish, amphibians, birds; extension to macrophytes possible
Examinations
Written examination (45-180 min., jointly with Ecology and Protection of Freshwater Ecosystems, both parts each cover 50% of the exam)
Literature
Will be newly compiled for the purpose of the course and introduced during the classes. Overview of useful determination keys is subject to frequent updates and will be provided during the course.
Further Information on the course (e.g. contact days,)
Presence of the students is obligatory in the practical part of the course, in order to achieve the practical Learning goals. If students miss more than two course days, they have to repeat the complete practical part in the next year.

Master-EnviTox-37

Module Name	Abbreviation Module
European environmental legislation	EnviTox-MA-10
Responsible for the Module	Faculty
Dr. Nadine Ruchter	Biology

Relevance for following study programmes:	Module Level
Master Environmental Toxicology	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Third term	One Term	C	8

Prerequisites according to examination Regulations	Recommended Prerequisites
None	none

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
10.1	Introduction to EU-environmental legislation	VO	2	90 h
10.2	Assessment of Chemicals under REACH	VO/SE	3	150 h
Sum (Compulsory and Supplementary Courses)			5	240 h

Learning targets of the Module
<ul style="list-style-type: none"> - Students possess basic knowledge of the environmental legislation of the European Union relevant to environmental toxicology. - They use their skills to assess and interpretation of new research results. - They can address and evaluate ethical questions relevant to society and give new impulses, especially to topics related to „diversity“, „sustainability“ and “resource protection”.

Module examinations to gain grades	
Written exam together for 7.1 and 7.2. (Duration of the exam will be announced at the beginning of the lecture (minimum 45 and max. 180 min))	
Contribution of the Module Grade for the Final Grade	8/119

Module Name		Abbreviation Module	
European environmental legislation		EnviTox-MA-10	
Course Name		Abbreviation Course	
Introduction to EU Environmental Legislation		10.1	
Lecturer	Division	Module Type (C/S)	
M. Giersig	External lecturer	C	

Designated Semester	Frequency	Language	no. Students/Course
Third term	WS	English	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
2	30 h	60 h	90 h

Education Methodology
Lectures, lecture notes; papers, prepared and presented by students
Learning targets
The students possess basic knowledge of the environmental legislation of the European Union relevant to environmental toxicology. The students are able to use their skills to analyse and to deal with the scientific aspects of the discussed legislation. The students understand the basic principles of law making on EU level, and they know where to find relevant information (e.g. laws and court cases).
Contents
E.g. (subject to changes because of possible adaptations and repeals of laws) <ul style="list-style-type: none"> - <u>- water protection</u>: directive 2000/60/EC establishing a framework for Community action in the field of water policy; - <u>- quality of ambient air</u>: directive 96/62/EC on ambient air quality assessment and management; directive 2008/1/EC concerning integrated pollution prevention and control; related legislative acts - <u>- waste management</u>: directive 2008/98/EC on waste; directive 1999/31/EC on the landfill of waste; directive 2000/76/EC on the incineration of waste - <u>- The European Green Deal</u>: COM(2019) 640 final - <u>- chemical products</u>: regulation 1907/2006/EC concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) - <u>- environmental liability</u>: directive 2004/35/EC on environmental liability with regard to the prevention and the remedying of environmental damaging
Examination
-/Written exam together with 7.2 (45 - 210 minutes)
Literature
<ul style="list-style-type: none"> ▪ Actual versions of the discussed legislation to be downloaded from http://eur-lex.europa.eu/homepage.html?locale=en ▪ Further details will be announced during the course. Additional information will be made available in Moodle, if necessary.
Further Information on the course (e.g. contact days,)
Course will be taught in a block with 7.2, mid of September and end of October

Module Name		Abbreviation Module	
European environmental legislation		EnviTox-MA-10	
Course Name		Abbreviation Course	
Assessment of Chemicals under REACH and CLP		10.2	
Lecturer		Division	Module Type (C/S)
M. Giersig, C. Koch		External lecturer	C

Designated Semester	Frequency	Language	no. Students/Course
Third term	WS	English	25

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
3	45 h	105 h	150 h

Education Methodology
Lectures, lecture notes and official REACH and CLP material; papers, prepared and presented by students
Learning targets
<p>The students understand the basic principles and processes of REACH and CLP. The students know the approaches taken under these regulations to assess and classify chemicals; focal point: Assessment of chemicals in environmental compartments. The students know the differences between risk and hazard-based decision making processes and their implications under REACH.</p> <p>Students get an inside about current relevant research topics in special branches. They are able to analyse results. They are able to participate in scientific discussions about current topics and to assess them critically in the context of REACH and CLP.</p>
Contents
<ul style="list-style-type: none"> - The need for a joint European assessment strategy of industrial chemicals - The derivation and assessment of phys-chem, toxicological and eco-toxicological data of chemicals <ul style="list-style-type: none"> - The assessment of the exposure of humans and ecosystems to industrial chemicals - The environmental behaviour of chemicals based on their physical chemical properties - Ecotoxicological endpoints in chemical assessments within REACH - The use of QSAR techniques for grouping and filling gaps in phys-chem, environmental and human health hazard data and other tools (e.g. QSAR Toolbox, EUSES) to carry out safety assessments in a structured, harmonised, transparent and efficient way. <ul style="list-style-type: none"> - The comparison of modelled and measured exposure data
Examination
-/Written exam together with 7.1 (45 - 180 minutes)
Literature
<ul style="list-style-type: none"> ▪ Current versions of REACH and CLP and ECHA guidelines, to be downloaded from http://eur-lex.europa.eu/homepage.html?locale=en and https://echa.europa.eu/ ▪ Additional information will be made available in Moodle, if necessary.
Further Information on the course (e.g. contact days,)
Course will be taught in a block with 7.1 between mid of September and end of October

Master-EnviTox-40

Module Name	Abbreviation Module
Internship	EnviTox-MA-11
Responsible for the Module	Faculty
The supervisor of the Internship (Lecturer of the EnviTox program)	Biology and Chemistry

Relevance for following study programmes:	Module Level
Master Environmentel Toxicology	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Third term	16 weeks	C	22

Prerequisites according to examination Regulations	Recommended Prerequisites
None	Module 1-8

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
11.1	Internship	PR		660 h
Sum (Compulsory and Supplementary Courses)				660 h

Learning targets of the Module
<ul style="list-style-type: none"> - Students have the ability to effectively apply theoretical/practical knowledge and competencies to real-world problems in environmental toxicology. - They develop autonomous research questions and hypotheses. - They plan (research) projects under time and resources restrictions. - Students apply (research) projects with suitable methods. - They work in a multidisciplinary (and bi-/multinational) setting. - Students evaluate results, interpret them critically and bring them into an ecotoxicological context. - They communicate and cooperate with industrial managers, stakeholders, NGOs, and the general public and present results in a written and oral form to different stakeholders.

Module examinations to gain grades	
protocol	
Contribution of the Module Grade for the Final Grade	22/119

Module Name		Abbreviation Module	
Internship		EnviTox-MA-8	
Course Name		Abbreviation Course	
Internship		8.1	
Lecturer	Division	Module Type (C/S)	
The supervisor of the Internship (Lecturer of the EnviTox program)			C

Designated Semester	Frequency	Language	no. Students/Course
Third term	WS	English (exceptions possible depending on the country)	

Duration	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
16 weeks			660 h

Education Methodology
Practical work in an institution/organisation in the field of Environmental Toxicology.
Learning targets
<ul style="list-style-type: none"> • The students have work and practical experience in environmental toxicology; Have knowledge about current problems and apply theoretical/practical knowledge and competencies in practice; • Get insight into projects and activities; • Know how to act in multidisciplinary (and bi-/multinational) groups (communication skills). <p>Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. The students have an inside about current relevant research topics in special branches. They are able to analyse results. They are able to participate in scientific discussions about current topics and to assess them critically.</p>
Contents
– a) Elaboration of a small self-contained <i>project</i> , or b) carrying out <i>research</i> related to a project/activity in the field of Environmental Toxicology. The student's project/research might be embedded in a larger project/activity carried out by the host institution/organisation.
Examination
-/Protocoll examined by a lecturer of the EnviTox curriculum
Further information

Students have to take care of finding their internship position. Advice and support is available from the study counselling. There are e.g. a collection of field reports. External Internships are possible if the students find a second supervisor from the Faculty of Biology.

The internship must be registered!

Information on the internship will be given in an annual information meeting (usually in the beginning of the second term).

Further information on the rules, the registration form, as well as placement ideas can be found at:

<https://moodle.uni-due.de/course/view.php?id=4581#section-3>

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Master-EnviTox-43

Module Name	Abbreviation Module
Master project	EnviTox-MA-12
Responsible for the Module	Faculty
The supervisor of the Master project (Lecturer of the EnviTox program)	Biology or Chemistry

Relevance for following study programmes:	Module Level
Master Environmental Toxicology	Master

Designated Semester	Duration of Module	Module Type (C/S)	Credits
Fourth term	One term	C	30

Prerequisites according to examination regulations	Recommended Prerequisites
90 Credits	

Associated Courses:

No.	Course Name	Module Type	hours per week (SWS)	Workload (h)
12.1	Master Thesis			840
12.2	Master Colloquium			60
Sum (Compulsory and Supplementary Courses)				900 h

Learning targets of the Module
<ul style="list-style-type: none"> - Students have the ability to effectively apply theoretical/practical knowledge and competencies to real-world problems in environmental toxicology. - They develop autonomous research questions and hypotheses. - They plan (research) projects under time and resources restrictions. - Students apply (research) projects with suitable methods. - They work in a multidisciplinary (and bi-/multinational) setting. - Students evaluate results, interpret them critically and bring them into an ecotoxicological context. - They communicate and cooperate with industrial managers, stakeholders, NGOs, and the general public and present results in a written and oral form to different stakeholders.

Module examinations to gain grades	
Master Thesis (2/3), Colloquium (1/3)	
Contribution of the Module Grade for the Final Grade	30/119

Module Name	Abbreviation Module	
Master Project	EnviTox-MA-9	
Course Name	Abbreviation Course	
Master Thesis	12.1	
Lecturer	Division	Module Type (C/S)
The supervisor of the Master project (Lecturer of the EnviTox program)		C

Designated Semester	Frequency	Language	no. Students/Course
Fourth term	WS	Depending on thesis	

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
			840 h

Education Methodology
Experimental and theoretical work and evaluation and written documentation
Learning targets
<p>– The Master Thesis is an experimental or theoretical work presented in written form showing that the students can perform and evaluate a scientific topic within 6 months time. The students will gain experiences with modern scientific methods.</p> <p>The students have the ability to effectively apply theoretical/practical knowledge and competencies to real-world problems in environmental toxicology. They are able to work in a multidisciplinary (and bi-/multinational) setting and to analyse and present complex matters. They have the ability to communicate and cooperate with industrial managers, stakeholders, NGOs, and the general public.</p> <p>The Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. The students have an inside about current relevant research topics in special branches. They are able to analyse results. They are able to participate in scientific discussions about current topics and to assess them critically.</p>
Contents
– The projects will be provided by the lecturers. The students are free to choose the supervisor by themselves.
Examination
-/- Master thesis
Further Information on the course (e.g. contact days,)

The Master's thesis must be registered at the examination office.

The registration form, along with a comprehensive guide to the master project is stored in Moodle:

<https://moodle.uni-due.de/course/view.php?id=4581#section-8>

There is detailed information on applying for external master works, extensions, periods, title pages etc.

Module Name		Abbreviation Module	
Master Project		EnviTox-MA-12	
Course Name		Abbreviation Course	
Master colloquium		12.2	
Lecturer		Division	Module Type (C/S)
The supervisor of the Internship (Lecturer of the EnviTox program)			C

Designated Semester	Frequency	Language	no. Students/Course
Fourth term	WS	english	

hours per week (SWS)	Presence (h)	preparation, self tutoring, preparation for exam (h)	Workload (h)
2			60 h

Education Methodology
Presentation of the most important results of the thesis and discussion
Learning targets
<p>Student is able to reflect the results of the master thesis and to present it to a broad public with experts and non experts in his topic. He knows the background of his work and is able to set it into a wider context.</p> <p>The students have the ability to effectively apply theoretical/practical knowledge and competencies to real-world problems in environmental toxicology. They are able to work in a multidisciplinary (and bi-/multinational) setting and to analyse and present complex matters. They have the ability to communicate and cooperate with industrial managers, stakeholders, NGOs, and the general public.</p> <p>The Students know modern methods of quantitative captures of xenobiotics and of detection of effects. They will understand the opportunities and limitations of these methods to obtain information on environmental systems. They are able to use these methods and to assess and interpret their results. They are able to present their results in an oral and written way. The students have an inside about current relevant research topics in special branches. They are able to analyse results. They are able to participate in scientific discussions about current topics and to assess them critically.</p>
Contents
<p>In the colloquium, students present the content of the master thesis to two supervisors. The presentation is open to the public. It durates 20 min. The presentation is followed by discussion (approx.. 20 min). The questions and the result of the colloquium are noted on a protocol sheet, which can be downloaded at: https://moodle.uni-due.de/course/view.php?id=4581#section-8.</p> <p>The colloquium has not to be registered at the examination office. Date and room are organized by the supervisors of the student.</p>
Examination
<p>-/- Presentation and discussion</p> <p>Duration of the complete exam: max 45 min</p>
Literature
<ul style="list-style-type: none"> ▪ Depending on the masters thesis

Further Information on the course (e.g. contact days,)

Impressum

University of Duisburg-Essen

Faculty of Biology

Nadine Ruchter

Phone: 0201/183-3103

E-mail: envitox@uni-due.de

<http://www.uni-due.de/envitox>

Please also consult the examination regulations. A german and an english version can be found at :

https://www.uni-due.de/verwaltung/satzungen_ordnungen/pruefungsordnungen.php#m

Helpful information on the course can be downloaded at :

<https://moodle.uni-due.de/course/view.php?id=4581>