

University of Duisburg-Essen

Module Handbook

Master course

**Environmental Toxicology
(EnviTox)**

Year 2024/2025

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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 latest 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 Programme EnviTox

Superior Aims of the Study Programme	Learning Outcomes	Target Oriented Module
Ability of systematic representation of complex relations in the topics pollutant fate, 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 on current reseach topics in specific disciplines and can critically interpret results based on 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 1,5,6,9,10,11</p> <p>Modules 4,7,10,11,12</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 	Module 10

	<ul style="list-style-type: none"> - Use this knowledge to assess and integrate new research and test results 	
Address, evaluate and present classical and new problems in the field of environmental toxicology and put them into the given research context	<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 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 2,5,6,8,9,11,12</p> <p>Modules 5,6,8,9,11,12</p> <p>Modules 5,6,8,9,11,12</p> <p>Modules 5,6,8,9,11,12</p> <p>Modules 5,6,8,9,11,12</p>
Ability to work in a leading position in the industry/governmental agency/NGO and/or to accomplish a PhD thesis	<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 	<p>All modules, but especially Module 12</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 12 modules, one of which represents a 16-week internship and the final module is 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 insight 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 organism groups. The module “Biological Interaction” covers the role of microbes in drinking water supply and waste water treatment, explains how pollutants are taken up by plants and animals and how

we can use population structures of different key groups 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 management 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	Crdts
Ecology and Evolution			4
Ecological and Evolutionary Concepts for Ecotoxicology	Schäfer	1	1
Ecological and Evolutionary Discourses in Ecotoxicology	Schäfer	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	Renner		5
Environmental Microbiology			5
Environmental Microbiology	Probst, Meckenstock	3	5
Ecotoxicology (continued in 2nd term)			13
Ecotoxicology I: Uptake and metabolisms	Sures, Zimmermann, Wittmann, Le, Diaz-Morales	3	4
Second term	Lecturer	hpw	Crdts
Environmental Analytics			10
Applied Analytical Chemistry	Schmitz	3	5
Environmental analytics	Telgheder	7	5
Theoretical Ecotoxicology			5
Theoretical Ecotoxicology: Concepts and applications	Schäfer	4	5
Ecotoxicology (continued from 1st term)			13
Ecotoxicology II: Effects	Sures, Zimmermann, Wittmann, Le	3	4
Applied methods in (eco-)toxicology	Zimmermann, Wittmann, Le, Grabner	6	6
Cellular toxicity			5
Cellular toxicity	Johannes, Ruchter	4	5
Third Term	Lecturer	hpw	Crdts
European Environmental Legislation			8
Introduction to EU-environmental legislation	Giersig, Smollich	2	3
Assessment of Chemicals under REACH	Giersig, Smollich	3	5
Internship			22
Fourth term			
Master Thesis			30

Module Descriptions

Module Name	Abbreviation Module
Ecology and Evolution	EnviTox-MA-1
Responsible for the Module	Faculty
Ralf B. Schäfer	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	Ecological and Evolutionary concepts for Ecotoxicology	VO	1	30 h
1.2	Ecological and Evolutionary Discourses in in Ecotoxicology	SE	2	90 h
Sum (Compulsory and Supplementary Courses)			3	120 h

Learning targets of the Module
<ul style="list-style-type: none"> – Students obtain insights into current research topics in the field of Ecology and Evolution and how their relevance for Ecotoxicology – Students are familiar with central ecological and evolutionary processes and theories – They understand how to read scientific papers in the field of Ecotoxicology, Ecology and Evolution and critically reflect their contents – They understand the basics of scientific writing
Associated Key Qualifications
-

Module examinations to gain grades	
Hausarbeit	
Contribution of the Module Grade for the Final Grade	4/119

Module Name	Abbreviation Module	
Ecology and Evolution	EnviTox-MA-1	
Course Name	Abbreviation Course	
Ecological and Evolutionary Concepts for Ecotoxicology	1.1	
Lecturer	Division	Module Type (C/S)
Ralf B. Schäfer	Biology	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
<ul style="list-style-type: none"> – Students obtain insights into current research topics in the field of Ecology and Evolution and how their relevance for Ecotoxicology – Students are familiar with central ecological and evolutionary processes and theories – They understand factors shaping communities and meta-communities and their interaction with pollutants
Contents
<ul style="list-style-type: none"> – Ecological processes of community assembly – Food webs and energy flow – Metacommunity concept – Population genetics and evolution – Ecosystem processes and nature's contribution to human well-being
Examination
Hausarbeit (mit 1.2)
Literature

<ul style="list-style-type: none">▪<ul style="list-style-type: none">▪ Clements, W.H. & Newman, M.C. (2002) Community ecotoxicology. Wiley, Chichester.▪ Landis, W.G., Sofield, R.M. & Yu, M.-H. (2011) Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes. CRC Press, Boca Raton, FL. 4th ed.▪ Newman, M.C. & Clements, W.H. (2008) Ecotoxicology : A Comprehensive Treatment. CRC Press, Boca Raton, FL.▪ Newman M.C. (2015) Fundamentals of Ecotoxicology: the science of pollution. CRC Press, Boca Raton F, USA.▪ Moes, S., van Gestel, K. & van Beek, G. (2024): Environmental Toxicology. Freely available at: https://chem.libretexts.org/Bookshelves/Environmental_Chemistry/Environmental_Toxicology_(van_Gestel_et_al.)▪ Scheiner S.M. & Willig M.R. (2011). <i>The theory of ecology</i>. The University of Chicago Press, Chicago; London.▪ Sparling D.W. (2017) Basics of ecotoxicology. Taylor & Francis, CRC Press, Boca Raton.▪ Turner, M. G. & Gardner, R. H. (2015) Landscape Ecology in Theory and Practice. Springer, New York, 2nd edition.▪ Vellend M. (2016). <i>The theory of ecological communities</i>. Princeton University Press, Princeton.▪
Further Information on the course (e.g. contact days,)
Compulsory attendance

Module Name	Abbreviation Module	
Ecology and Evolution	EnviTox-MA-1	
Course Name	Abbreviation Course	
Ecological and Evolutionary Discourses in Ecotoxicology	1.2	
Lecturer	Division	Module Type (C/S)
Ralf B. Schäfer	Biology	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
Seminar
Learning targets
<ul style="list-style-type: none"> Students understand how to read scientific papers in the field of Ecotoxicology, Ecology and Evolution and critically reflect their contents They understand the basics of scientific writing and can apply these in own writing
Contents
Critical reading and discussion of seminal and recent scientific papers related to Ecology and Evolution and effects of toxicants in communities and ecosystems
Examination
Hausarbeit (mit 2.2)
Literature
Will be announced at the beginning of the seminar, will be a selection of scientific papers
Further Information on the course (e.g. contact days,)
none

Module Name	Abbreviation Module
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
<p>To understand the movement of chemical elements in an ecosystem via physical and biological processes</p> <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 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, Fungicides) - 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 diverse and will be given in the moodle course.
Further Information on the course (e.g. contact days,)
Compulsory attendance
The presence of the student in the exercise part is obligatory.

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 takes 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</p> <p>Useful tools: Thermodynamic cycle, Mass balance equations, Single-parameter Linear Free Energy Relationships (LFERs), Poly-parameter LFERs</p> <p>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,</p> <p>Reaction kinetics: first-order, second-order and pseudo-first-order reactions, reaction rates and half life, kinetics and thermodynamics.</p> <p>Transformations: nucleophilic substitution including hydrolysis, elimination, redox reactions, introduction to photolysis.</p>
Examination
<p>Written exam and presentation of results of a case study</p> <p>(Duration of the exams will be announced at the beginning of the lecture. The written exam takes min. 45 and max. 180 min, the presentation between 15 and 45 min)</p>
Literature
<p>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</p>

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	
Written exam (120min)	
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

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	
Written exam	
Contribution of the Module Grade for the Final Grade	5/119

Module Name	Abbreviation Module	
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 SWS) and Seminar (1 SWS)
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 takes 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 metabolism	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 systems. - Students know modern methods of quantitative analysis of xenobiotics and of detection of effects in cells, plants and animals and are able to autonomously 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 organisms. - 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
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Module Name	Abbreviation Module	
Ecotoxicology	EnviTox-MA-6	
Course Name	Abbreviation Course	
Ecotoxicology I: Uptake and metabolisms	6.1	
Lecturers	Division	Module Type (C/S)
B. Sures, S. Zimmermann, C. Wittmann, T.T.Y. Le, D.M. Diaz-Morales	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
<p>The students</p> <ul style="list-style-type: none"> - 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 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
<p>Large number of journal articles and grey literature</p> <p>Klaassen C.D. (2008) Casarett and Doull's Toxicology -The Basic Science of Poisons, 7th edition, The McGraw-Hill Companies, Inc.</p>
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	
Ecotoxicology	EnviTox-MA-6	
Course Name	Abbreviation Course	
Ecotoxicology II: Effects	6.2	
Lecturers	Division	Module Type (C/S)
B. Sures, S. Zimmermann, C. Wittmann, T.T.Y. Le	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
<p>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.</p> <p>Students know modern methods of quantitative analysis 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 insight on current research topics with local and global importance. They are able to analyse results.</p>
Contents
<p>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.</p> <p>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,</p>
Examination
Oral exam together with 6.1 and 6.3
Literature
<p>Agrios GN (2004): Plant Pathology, 4 ed., Academic Press</p> <p>Connell D.W., Lam P., Richardson B., Wu R. (1999) Introduction to Ecotoxicology, Wiley-Blackwell</p> <p>Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B. (2006) Principles of Ecotoxicology, 3rd edition, CRC Press Taylor & Francis Group</p> <p>Wright D.A., Welbourn P. (2002) Environmental Toxicology, 1st edition, Cambridge University Press</p> <p>Fent K. (2007) Ökotoxikologie, 3. Auflage, Georg Thieme Verlag</p> <p>Landis W.G., Yu M.-H. (2003) Introduction to environmental toxicology: impacts of chemicals upon ecological systems, 3rd edition, CRC Press;</p> <p>Markert B.A., Breure A.M., Zechmeister H.G. (eds): Bioindicators and biomonitors. Elsevier Science B.V.</p> <p>Schüürmann G., Markert B.A.: Ecotoxicology, John Wiley & Sons</p> <p>large number of journal articles.</p>
Further information
Compulsory attendance

Module Name	Abbreviation Module	
Effects on biological functions	EnviTox-MA-6	
Course Name	Abbreviation Course	
Applied methods in (eco-)toxicology	6.3	
Lecturers	Division	Module Type (C/S)
S. Zimmermann, C. Wittmann, T.T.Y. Le, D. Grabner	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 analysis 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 insight on current research topics with local and global importance. They are able to analyse and interpret 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 biomonitoring. 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.

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 analysis 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 insight about current research topics in special branches. They are able to analyse results.</p>

Module examinations to gain grades	
Protocol	
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 analysis 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 insight about current 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
Protocol
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 are absent for more than one day of the course, they will not achieve all learning targets and will fail the laboratory course.

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	
<i>First part of the examination:</i> Written exam for 8.1. (Duration of the exam will be announced at the beginning of the lecture. It takes min. 45 and max. 180 min)	
<i>Second part of the examination (8.2):</i> Reports on experimental work and short colloquium for each experiment (Duration of the colloquium will be announced at the beginning of the practical. It takes 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

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 SWS) and Seminar (1 SWS)
Learning targets
<p>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.</p> <p>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.</p> <p>Target analytical level: Eurocurriculum</p>
Contents
<p>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:</p> <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
<p>Written exam</p> <p>(Duration of the exam will be announced at the beginning of the lecture. It takes min. 45 and max. 180 min)</p>
Literature
Holler, Skoog, Crouch: Principles of Instrumental Analysis, International Student Edition (2007)
Further Information on the course (e.g. contact days,)

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
<p>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.</p> <p>Students know modern analytical methods for quantitative determination of xenobiotics</p> <p>Students get an insight about current research topics in special branches.</p>
Contents
<p>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.</p>
Examination
<p>Reports on experimental work and short colloquium for each experiment.</p> <p>(Duration of the colloquium will be announced at the beginning of the practical. It takes min. 15 and max. 45 min)</p>
Literature
e.g., Holler, Skoog, Crouch: Principles of Instrumental Analysis, 6 th ed., Thomson, 2007
Further Information on the course (e.g. contact days,)
<p>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.</p>

Module Name	Abbreviation Module
Theoretical Ecotoxicology	EnviTox-MA-9
Responsible for the Module	Faculty
Prof. Dr. Ralf B. Schäfer, NN	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	Theoretical Ecotoxicology: Concepts and applications	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 modern concepts and theories in the area of ecotoxicology - understands central concepts and theories such as dose-response curve modelling, multiple stressor modelling, Ecotoxicological Big data, OMICS data, toxicity prediction and process-based ecotoxicological modelling approaches - Is familiar with software to practically implement theoretical approaches - can critically evaluate results obtained from these concepts and theories 	
Module examinations to gain grades	
Portfolio	
Contribution of the Module Grade for the Final Grade	5/119

Module Name	Abbreviation Module	
Theoretical Ecotoxicology	EnviTox-MA-9	
Course Name	Abbreviation Course	
Theoretical Ecotoxicology: Concepts and applications	9.1	
Lecturer	Division	Module Type (C/S)
Prof. Dr. Ralf B. Schäfer, NN	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
Combination of lecture and exercise: general lectures introduce to the topic and its application, the students work on related exercises.
Learning targets
<p>The student:</p> <ul style="list-style-type: none"> - gains knowledge of modern concepts and theories in the area of ecotoxicology - understands central concepts and theories such as toxicity prediction including dose-response curve modelling, multiple stressor modelling, Ecotoxicological Big data, biomolecular data and process-based ecotoxicological modelling approaches - Is familiar with software to practically implement theoretical approaches - can critically evaluate results obtained from these concepts and theories
Contents
<ul style="list-style-type: none"> - General overview of theoretical ecotoxicology - Approaches for complex experimental designs - Ecotoxicological data compilation and processing - Toxicity predictions with applications in machine learning - Multiple stressor modelling - Specifics of biomolecular data - Process-based ecotoxicological models
Examination
Portfolio
Literature
<p>Goodfellow I., Bengio Y. & Courville A. (2016). <i>Deep learning</i>. The MIT Press, Cambridge, Massachusetts.</p> <p>Haddock S.H.D. & Dunn C.W. (2011). <i>Practical computing for biologists</i>, 1st ed. Sinauer Associates, Sunderland, Mass.</p> <p>Newman M.C. (2012). <i>Quantitative Ecotoxicology</i>. (Ed. 2nd), CRC Press, Boca Raton, FL.</p> <p>Ritz C., Jensen S.M., Gerhard D. & Streibig J.C. (2021). <i>Dose-response analysis using R</i>, CRC Press, Boca Raton London New York.</p>
Further Information on the course (e.g. contact days,)
<p>Compulsory attendance</p> <p>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 year.</p>

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 10.1 and 10.2. (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
<p>E.g. (subject to changes because of possible adaptations and repeals of laws)</p> <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>tackling climate change</u>: directive 2009/31/EC on the geological storage of carbon dioxide - <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 10.2 (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, E. Smollich	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 insight about current 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 10.1 (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 10.1 between mid of September and end of October

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 Environmantel 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	11	
Course Name	Abbreviation Course	
Internship	11.1	
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 analysis 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 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
<ul style="list-style-type: none"> 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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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-12	
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 analysis 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 insights about current 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>– The projects will be provided by the lecturers. The students are free to choose the supervisor by themselves.</p>
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>The students are 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. They know the background of their work and are able to place 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 analysis 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 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 takes 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 master's thesis 			
Further Information on the course (e.g. contact days,)			

Impressum

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Faculty of Biology

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<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>