

IEW-M1.1 Principles in Toxicology		Number of credit points (CP): 12		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Introduction to general toxicology • Foundations of toxicokinetics (ADME: absorption, distribution, metabolism, and excretion) • Foundations of toxicodynamics • Interactions between toxicokinetics and toxicodynamics • Foundations of statistics, biometry, and epidemiology • Toxicological effects: classification, limits, examples <p>Objectives:</p> <ul style="list-style-type: none"> • The module teaches a foundational understanding of the profiles of substances' toxic effects, incorporating toxicokinetics and toxicodynamics, including practical procedures for their determination. This requires working in small groups due to regulations on workplace safety/dangerous substances. • The students obtain foundational insights into statistics and biometry and their application. The students are also capable of employing basic concepts in epidemiology and can apply them to toxicological issues. • The students can scientifically process and present foundational questions in the fields of toxicokinetics, toxicodynamics, toxicological effects, and epidemiology, drawing on academic literature and working in teams (2–3 students). 				
Module (partial) exam(s) (number, form, scope):		Oral exam, 20 min		
Independent study time (in hours):		265 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module (partial) exam (Number, form, scope)
		For completing the module	For admission to the module exam	
“Foundations of Toxicology” lecture	2			-
Research internship (2 weeks)	Supervision: 20 hr		Log, approx. 30 pp.	-
“Statistics, Biometry, Epidemiology” lecture	2			-
Seminar	1		Presentation, 20 min	-
Offered:		Winter semester		
Prerequisite for taking the module:		-		
Teaching unit(s):		Nutritional Science		

IEW-M1.2 Pharmacology, Physiology and Pathophysiology		Number of credit points (CP): 6		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Foundations of drug action (dose-response relationship, drug elimination) • Introduction to major drug groups including mechanisms of action • Foundations of physiology and pathophysiology • Specific physiology and pathophysiology of nutrition, especially in connection with metabolism <p>Objectives:</p> <p>The students have foundational knowledge of the major drug groups, particularly their pharmacokinetics, mechanisms of action, and unintended effects.</p> <p>The students are familiar with the interactions between physiology and nutritional pathophysiology and their significance for nutrition-based illnesses.</p> <p>The students possess advanced knowledge of metabolism and the significance of its malfunction for the development of obesity.</p>				
Module (partial) exam(s) (number, form, scope):		Written exam (90 min)		
Independent study time (in hours):		120 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module partial exam (Number, form, scope)
		For completing the module	For admission to the module exam	
“Foundations of Pharmacology” lecture	2			-
“Physiology and Pathophysiology of Nutrition” lecture	2			-
Offered:		Winter semester		
Prerequisite for taking the module:				
Teaching unit(s):		Nutritional Science in collaboration with DfE		

IEW-M1.3 Tissue-Specific Toxicity and Histopathology		Number of credit points (CP): 6		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Characteristic organ-specific patterns of damage, examples of toxic effects, methods of investigation Organs: particularly the liver, lungs, kidneys and urinary system, blood and circulatory system, hematopoietic system, nervous system, gastrointestinal tract; brief introduction to the heart, eye, endocrine system, skin, ear • Foundations of immunotoxicology • Foundations of microscopy and histopathology <p>Objectives:</p> <ul style="list-style-type: none"> • The students are familiar with the clinical and morphological picture of major forms of organ damage and possess foundational knowledge of the underlying mechanisms of action. • The students have foundational knowledge of the immune system and the pathomechanisms of various immunomodulating substances. • The students can assess selected histological sections and can recognize and classify pathological changes in tissues. 				
Module (partial) exam(s) (number, form, scope):		Written exam (90 min)		
Independent study time (in hours):		120 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module partial exam (Number, form, scope)
		For completing the module	For admission to the module exam	
“Organ Toxicology, Pathological Anatomy, and Histopathology” lecture	2			-
“Microscopy and Histopathology” lab course (one week)	Supervision: 12 hr	Log, 20 pp.		-
Offered:		Winter semester		
Prerequisite for taking the module:				
Teaching unit(s):		Nutritional Science in collaboration with DIfE		

IEW-M1.4 Principles in Experimental Animal Toxicity Testing		Number of credit points (CP): 6		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Species-appropriate care, treatment and breeding of laboratory animals • Animal protection regulations and ethics • Anatomy, physiology, and pathology of the major laboratory animal species • Spontaneous illnesses, artificial illnesses • Transgenic animal models in toxicological research • Experiment planning and preparation, record-keeping, application forms, pain elimination and restriction of suffering, laboratory animal anesthesia, foundations of surgical work. <p>Objectives:</p> <ul style="list-style-type: none"> • The students are familiar with the legal foundations of animal protection and laboratory animal science and can implement it on a practical level. 				
Module (partial) exam(s) (number, form, scope):		Written exam (90 min)		
Independent study time (in hours):		120 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module partial exam (Number, form, scope)
		For completing the module	For admission to the module exam	
“Laboratory Animal Science” lecture	2			-
“Laboratory Animal Science, FELASA certificate” lab course (2 weeks)	Supervision: 30 hr			-
Offered:		Winter semester		
Prerequisite for taking the module:				
Teaching unit(s):		DIfE together with Nutritional Science		

IEW-M2.1 Advanced Toxicology		Number of credit points (CP): 9		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Molecular cell toxicology • Chemical mutagenesis and carcinogenesis • Foundations of the toxicology of reproduction • Food toxicology • Introduction to nanotoxicology and eco-toxicology • The seminar's purpose is to delve more deeply into the content covered in the lecture. To that end, the students give presentations on selected current questions in toxicology. <p>Objectives:</p> <ul style="list-style-type: none"> • The students are familiar with the basic mechanisms of toxic substances' cytotoxic effects, including how to provide evidence of them. • The students have profound knowledge of chemical mutagenesis and carcinogenesis as well as non-genotoxic mechanisms of carcinogenesis. • The students have learned the foundations of the male and female reproductive systems as well as methods for assessing changes based on relevant groups of substances. • The students are familiar with groups of substances relevant to nutritional toxicology, including their mechanisms of action and toxicological classifications. • The students possess basic knowledge of nano- and eco-toxicology. • The students can work autonomously and theoretically on a specific toxicological question, drawing on primary sources, and give a presentation on it. 				
Module (partial) exam(s) (number, form, scope):		Oral exam, 30 min		
Independent study time (in hours):		180 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module partial exam (Number, form, scope)
		For completing the module	For admission to the module exam	
“Special Topics in Toxicology” lecture	4			-
Seminar	1	Presentation, 30 min		-
Offered:		Summer semester		
Prerequisite for taking the module:		Successful completion of M1.1		
Teaching unit(s):		Nutritional Science		

IEW-M2.2 Experimental Toxicology		Number of credit points (CP): 15		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Introduction to the topics of testing strategies (including OECD testing procedures) • Standard testing procedures for pharmaceuticals, pesticides, food additives, and other chemical substances • Testing for acute and chronic toxicity, foundational aspects • Specialized testing, in particular testing for genotoxicity, mutagenicity, carcinogenicity, neurotoxicity, and reproductive toxicity • The need for targeted investigations into organ toxicity • The value and execution of <i>in vitro</i> tests • Alternatives to animal experiments, including <i>in vivo</i> model organisms (<i>Drosophila</i>, <i>C. elegans</i>, zebra fish), 3R principle • Modeling, <i>in silico</i> methods in toxicology • Introduction to instrumental analysis: chromatographic techniques, mass spectrometry, spectroscopy • Molecular biological techniques and “omics” technologies <p>Objectives:</p> <ul style="list-style-type: none"> • The students possess profound theoretical knowledge of toxicological testing strategies and the 3R principle. • The students have the skills to plan, conduct, and assess toxicological studies for substance approval. • The students are familiar with instrumental/analytical techniques and can assess data’s accuracy and meaningfulness. • The students possess profound practical knowledge of <i>in vitro</i> testing, including the end points of cytotoxicity, genotoxicity, mutagenicity, and toxicokinetics. • The students possess foundational practical knowledge for working with <i>in vivo</i> modeling systems. 				
Module (partial) exam(s) (number, form, scope):		Oral exam, 30 min		
Independent study time (in hours):		270 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module partial exam (Number, form, scope)
		For completing the module	For admission to the module exam	
“Testing Strategies” lecture	4			
“Bioanalytics; Analyzing Residue and Contaminants” lecture	2			-
Lab course	Supervision: 15 hr		3 logs, approx. 20 pp. each	-
Offered:		Summer semester		
Prerequisite for taking the module:		Successful completion of M1.1		
Teaching unit(s):		Nutritional Science		

IEW- M2.3 Human Toxicology		Number of credit points (CP): 6		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Foundations of clinical chemical diagnostics • Design and evaluation of human studies • Basic principles of therapy for poisoning • Foundations of diagnosis and treatment of acute intoxication • Acute poisoning by pharmaceuticals; acute and chronic poisoning by chemicals and other poisons (e.g. household chemicals, bacterial toxins, animal- and plant-based poisons), addictive substances <p>Objectives:</p> <ul style="list-style-type: none"> • The students have mastered the foundations of clinical chemical diagnostics and have basic knowledge of how to compile findings based on the results of analysis. • The students possess basic knowledge of clinical therapy for intoxication using prominent toxins as examples. • The students have basic knowledge of microbiology and are familiar with major microbiological risks to human beings. 				
Module (partial) exam(s) (number, form, scope):		Written exam (90 min)		
Independent study time (in hours):		120 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module partial exam (Number, form, scope)
		For completing the module	For admission to the module exam	
“Studies on Humans, Clinical Diagnostics, and Toxicology” lecture	2			
“Microbiology and Microbiological Risks” lecture	2			
Offered:		Summer semester		
Prerequisite for taking the module:		Successful completion of M1.1		
Teaching unit(s):		Nutritional Science in cooperation with the DIFE		

IEW-M3.1 Applied Toxicology, Regulatory Toxicology and Risk Assessment		Number of credit points (CP): 15		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Foundations of the legal system and institutions, national and international organization concerned with the risks of substances • Risk and danger, risk assessment, risk management, and risk communication • Toxicity endpoints and their significance for risk assessment • Regulation of carcinogenic substances • Toxicity thresholds and criteria for calculating them • Exposure assessment and estimation • Practical deepening of the content of completed modules through a specialization research internship at a scientific research institution working in toxicology <p>Objectives:</p> <ul style="list-style-type: none"> • The students are familiar with the principles of regulatory toxicology and understand the interaction between risk assessment, risk management, and risk communication. • The students possess profound knowledge on calculating toxicity thresholds. • The students can interpret and evaluate risk assessments. • The students can work practically on a toxicological question with guidance and present, discuss, and assess the results for a presentation. • The students can work on a practical question autonomously in pairs after an introductory lesson by the supervisor. 				
Module (partial) exam(s) (number, form, scope):		Written exam, 90 min (50%), thematically related to lecture; presentation, 30 min (50%), on specialization research internship		
Independent study time (in hours):		225 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module (partial) exam (Number, form, scope)
		For completing the module	For admission to the module exam	
“Regulatory Toxicology and Risk Assessment” lecture	2			
Specialization research internship (4 weeks)	Supervision: 20 hr			
Seminar accompanying research internship	1			
Offered:		Winter semester		
Prerequisite for taking the module:		Successful completion of M1.1, M1.2, M1.3, M1.4		
Teaching unit(s):		Nutritional Science in collaboration with BfR and DfE		

IEW-M3.2 Practical Toxicology – Industry		Number of credit points (CP): 15		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Practical toxicological work for industry • Composing a written internship report and presenting and discussing the work completed <p>Objectives:</p> <ul style="list-style-type: none"> • The students learn the processes and toxicological methods used in industry. • The students can document their work in writing and present it to an audience of toxicologists as an oral and poster presentation. 				
Module (partial) exam(s) (number, form, scope):		Report, approx. 40 pp. (50%), on advanced internship Presentation, 30 min, combined with a poster presentation (50%) on the seminar		
Independent study time (in hours):		245 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module partial exam (Number, form, scope)
		For completing the module	For admission to the module exam	
Advanced internship in industry (6 weeks)	Supervision: 15 hr			
Seminar	1			
Offered:		Winter semester		
Prerequisite for taking the module:		Successful completion of M1.1, M1.2, M1.3, M1.4		
Teaching unit(s):		Nutritional Science		

IEW-M3.3 Practical Toxicology - Authorities		Number of credit points (CP): 15		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Practical toxicological work in a regulatory agency • Composing a written internship report and presenting and discussing the work completed <p>Objectives:</p> <ul style="list-style-type: none"> • The students learn the processes and toxicological methods used in a regulatory agency. • The students can express their work in writing and present it to an audience of toxicologists. 				
Module (partial) exam(s) (number, form, scope):		Report, approx. 40 pp. (50%), on advanced internship Presentation, 30 min, combined with a poster presentation (50%) on the seminar		
Independent study time (in hours):		245 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module partial exam (Number, form, scope)
		For completing the module	For admission to the module exam	
Advanced internship at a regulatory agency (6 weeks)	Supervision: 15 hr			
Seminar	1			
Offered:		Winter semester		
Prerequisite for taking the module:		Successful completion of M1.1, M1.2, M1.3, M1.4		
Teaching unit(s):		Nutritional Science		

IEW-M3.4 Practical Toxicology - Applied Research		Number of credit points (CP): 15		
Module type (mandatory or elective):		Listed in the respective discipline-specific Regulations for Study and Examinations.		
Content and objective of module:				
<p>Contents:</p> <ul style="list-style-type: none"> • Practical toxicological work at a scientific institution • Composing a written internship report and presenting and discussing the work completed <p>Objectives:</p> <ul style="list-style-type: none"> • The students learn the processes and toxicological/analytical methods used in a scientific institution. • The students can express their work in writing and present it to an audience of toxicologists. 				
Module (partial) exam(s) (number, form, scope):		Report, max. 40 pp., on advanced internship Presentation, 30 min, combined with a poster presentation on the seminar		
Independent study time (in hours):		245 hr		
Courses (type of teaching)	Contact time (in semester hours)	Supplementary exam work (Number, form, scope)		Module partial exam (Number, form, scope)
		For completing the module	For admission to the module exam	
Advanced internship at DIfE, FhI, or IEW, for example (6 weeks)	Supervision: 15 hr			
Seminar	1			
Offered:		Winter semester		
Prerequisite for taking the module:		Successful completion of M1.1, M1.2, M1.3, M1.4		
Teaching unit(s):		Nutritional Science, DIfE, Fraunhofer		