Programme syllabus for

Master's Programme in Toxicology, 120 credits

Masterprogrammet i toxikologi, 120 hp

Basic programme information

Programme code	4TX15
Name of the programme	Master's Programme in Toxicology
Number of credits	120.0 credits (120.0 ECTS credits)
Starting date	The syllabus applies to students who commence their studies in or after autumn 2015. Approved revisions of the syllabus are described under the heading Transitional Provisions.
Decision date	2014-12-18
Decided by	Board of Higher Education
Last revision	2018-01-18
Revised by	Board of Higher Education
Reference number	3-537/2018
Specific eligibility requirements	A Bachelor's degree or a professional degree equivalent to a Swedish Bachelor's degree of at least 180 credits in biomedicine, biology, cellular and molecular biology, pharmaceutics, chemistry, medicine, nutrition, biotechnology, or the equivalent. And proficiency in English equivalent to English B/English 6.
Main field of study	Toxicology
Qualification	Medicine masterexamen med huvudområdet toxikologi *Degree of Master of Medical Science (120 credits) with a Major in Toxicology* A student who fulfils the requirements for the award of a qualification shall, upon request, be provided with a certificate.

Outcomes

Outcomes of second cycle education according to the Higher Education Act

Second-cycle courses and study programmes shall be based fundamentally on the knowledge acquired by students during first-cycle courses and study programmes, or its equivalent.

Second-cycle courses and study programmes shall involve the acquisition of specialist knowledge, competence and skills in relation to first-cycle courses and study programmes, and in addition to the requirements for first-cycle courses and study programmes shall:

- further develop the ability of students to integrate and make autonomous use of their knowledge,
- develop the students' ability to deal with complex phenomena, issues and situations, and
- develop the students' potential for professional activities that demand considerable autonomy, or for research and development work.

Outcomes of the Degree of Master (120 credits) according to the Higher Education Ordinance

Knowledge and understanding
For a Degree of Master the student shall

- demonstrate knowledge and understanding in the main field of study, including both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current research and development work, and
- demonstrate specialised methodological knowledge in the main field of study.

Competence and skills
For a Degree of Master the student shall

- demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations even with limited information,
- demonstrate the ability to identify and formulate issues critically, autonomously and creatively as well as to plan and, using appropriate methods, undertake advanced tasks within predetermined time frames and so contribute to the formation of knowledge as well as the ability to evaluate this work,
- demonstrate the ability in speech and writing both nationally and internationally to report clearly and discuss his or her conclusions and the knowledge and arguments on which they are based in dialogue with different audiences, and
- demonstrate the skills required for participation in research and development work or autonomous employment in some other qualified capacity.

Judgement and approach
For a Degree of Master the student shall

- demonstrate the ability to make assessments in the main field of study informed by relevant disciplinary, social and ethical issues and also to demonstrate awareness of ethical aspects of research and development work,
- demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used, and
- demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.

Outcomes of the study programme at Karolinska Institutet

Knowledge and understanding

Students shall

- demonstrate in-depth knowledge of the interaction between exposure to exogenous chemicals and toxic effects in humans and relevant experimental models,
- demonstrate general and integrated understanding of the harmful effects of chemical substances on humans and underlying mechanisms,
- demonstrate in-depth knowledge of relevant experimental methods within the field of toxicology, including the theoretical background, implementation, applications and limitations of the methods, as well as considerably deeper knowledge of experimental methods within certain areas of the field of toxicology,
- demonstrate in-depth knowledge of basic principles and methods for assessing the health risks of chemical substances and products, and in-depth insight in needs for development,
- demonstrate knowledge of statistical methods that are used within toxicology.

Skills and abilities
Students shall

- demonstrate an insight into the toxicological research process and have a good ability to formulate, both individually and working with others, relevant hypotheses within the field of toxicology and, on the basis of this, to plan and carry out studies and experiments, document and analyse observations, and assess the relevance of these observations,
- demonstrate an ability to apply for the relevant permissions for carrying out studies within the field of toxicology,
- demonstrate a good ability to independently find, summarise and assess scientific information within the field of toxicology, and to be able to use this information in other problems and in assessing the health risks of chemical substances, and
- demonstrate a good ability, both orally and in writing, to present a toxicological problem, both for the public and for experts

Judgment and approach
Students shall

- demonstrate a good insight into research ethics, as well as respect for ethical aspects of experiments in which live animals are used and for the integrity of individuals, and
- be able to evaluate information and relate this to established knowledge and the needs of the society within the integrated field of Toxicology.

Content and structure

The *Master's Programme in Toxicology* is a research and vocational programme that is the basis for qualified work tasks in toxicology research, testing and risk assessment.

The *first term* begins with a broad introductory course on the principles and methods in toxicology. The term also includes courses about how chemical substances are absorbed, distributed, metabolised and excreted by the body, the toxicological mechanisms underlying organ and tissue damage, and how such effects can be studied.

In the *second term*, the students gain advanced knowledge about the methods used in toxicology research. Statistics and alternative methods to traditional animal testing are included as two components. Term 2 also includes a course in health risk assessment, where the applications of risk assessment theory are a key part. During the term, the students also attend a course in the practice and theory of laboratory animal science.

The *third term* includes a course on toxicity testing according to OECD guidelines and Good Laboratory Practice. One common theme is 3R - Refinement, Reduction and Replacement of animal experiments.

The course has all the components that are included in toxicity testing, including statistical analysis and the written reporting of results. In the same term, students address global chemical problems while focusing on possible solutions and the role of toxicology in a sustainable society. Term 3 also provides options for in-depth studies of toxicologically-relevant areas, through optional courses in experimental toxicology and health risk assessment.

The programme concludes with an individual degree project of 30 or 37.5 credits. The degree project can either be experimental or a risk assessment-related, literature-based project. A shorter degree project (30 credits) can be combined with optional courses and/or projects of toxicological relevance.

Scientific knowledge, competence and approach

The degree programme provides a broad theoretical knowledge within toxicology with focus on methods and findings in the research front. During the programme the students are trained to search and critically assess information as well as discuss both research ethics and sustainable development. Practical knowledge is an essential component of the entire programme, for example through laboratory work. The individual degree project focuses on scientific methodology and analysis as well as on oral and written presentation.

Practice Integrated Learning

Practice integrated learning is a generic term for the pedagogical models that are based on interaction and integration between higher education and working life. Practice integrated learning may take the form of placements, study visits, observing teaching activities, staff exchange training schemes or field studies within out-patient and in-patient healthcare, social care or other relevant activities.

The degree programme is mainly carried out in an academic environment with research-active teachers and practical training at research laboratories. A number of courses on the programme include study visits to potential future workplaces such as governmental agencies and research institutes. During the programme, representatives from various work places (often alumni) are invited to courses to teach toxicology from other (non-academic) perspectives, toxicological applications, as well as on how it is to work as a toxicologist within companies and agencies. The degree project is carried out within a research or work field of choice, of relevance for toxicology, and is performed within academia, governmental agency or company, in Sweden or abroad.

Internationalisation

Toxicology is an international subject and the students therefore have to be prepared for work in an international arena. The programme accepts both national and international students and the teachers on the programme have an international background and/or experience. The multicultural classroom is seen as a vital asset for the programme that facilitates discussions on the multinational/multicultural aspects of the subject areas included in the programme. Global health aspects in toxicology are included in relevant courses during the programme. The students are given the option to go on exchange studies at research-intensive universities in the world during their education.

Elective courses

During the third term the students can choose between two courses with different focus, which are partly given in collaboration with doctoral courses. The students have the possibility of choosing an elective course of 7.5 credits together with a degree project of 30 credits, instead of a longer degree project of 37.5 credits.

Transitional provisions

Students admitted to the Master's Programme in Toxicology follow the syllabus in accordance with the

year of their admittance.

Other guidelines

Grading scale

The grades used are Fail, Pass or Pass with Distinction. Alternative grading scales may apply to elective courses or cross-programme courses. The grading scale is detailed in the course syllabus.

Language of instruction

The teaching language is English.

Specific eligibility requirements within the programme

See respective course syllabus for course-specific entry requirements.

Study plan with constituent courses

For students starting the programme in 2018 or later:

Term	Name of the course	Credits	Main field of study	Cycle and depth of the course
1	Principles of toxicology	7.5	Toxicology	First (G2)
1	Target organ toxicology – toxicokinetics and toxicodynamics	17.5	Toxicology	Second (Advanced)
1	Histopathology and clinical pathology	5	Toxicology	Second (Advanced)
2	Laboratory animal science in theory and practice	4.5	Toxicology	Second (Advanced)
2	Applications of methods in toxicological research	16.5	Toxicology	Second (Advanced)
2	Health risk assessment	9	Toxicology	Second (Advanced)
3	Global toxicology in a sustainable society	2.5	Toxicology	Second (Advanced)
3	Regulatory toxicity testing	10	Toxicology	Second (Advanced)
3	Elective courses	10	Toxicology	Second (Advanced)

Alternative 1:

3 and 4	Degree project in toxicology	37.5	Toxicology	Second (Advanced)

Alternative 2:

3 and 4	Project work or elective courses	7.5	--	Second (Advanced)
3 and 4	Degree project in toxicology	30	Toxicology	Second (Advanced)

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For students starting the programme in 2017:

Term	Name of the course	Credits	Main field of study	Cycle and depth of the course
1	Principles of toxicology	7.5	Toxicology	First (G2)

1	Target organ toxicology – toxicokinetics and toxicodynamics	17.5	Toxicology	Second (Advanced)
1	Histopathology and clinical pathology	5	Toxicology	Second (Advanced)
2	Laboratory animal science in theory and practice	4.5	Toxicology	Second (Advanced)
2	Applications of methods in toxicological research	18	Toxicology	Second (Advanced)
2	Health risk assessment	7.5	Toxicology	Second (Advanced)
3	Global toxicology in a sustainable society	1.5	Toxicology	Second (Advanced)
3	Regulatory toxicity testing	12	Toxicology	Second (Advanced)
3	Elective courses	9	Toxicology	Second (Advanced)

Alternative 1:

3 and 4		37.5	Toxicology	Second (Advanced)

Alternative 2:

3 and 4		7.5	Toxicology	Second (Advanced)
3 and 4		30	Toxicology	Second (Advanced)

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For students starting the programme in 2016 or earlier:

Term	**Name of the course**	**Credits**	**Main field of study**	**Cycle and depth of the course**
1	Principles of toxicology	7.5	Toxicology	First (G2)
1	Toxicokinetics	3	Toxicology	Second (Advanced)
1	Target organ toxicology	14.5	Toxicology	Second (Advanced)
1	Histopathology and clinical pathology	5	Toxicology	Second (Advanced)
2	Laboratory animal science in theory and practice	4.5	Toxicology	Second (Advanced)
2	Applications of methods in toxicological research	18	Toxicology	Second (Advanced)
2	Health risk assessment	7.5	Toxicology	Second (Advanced)
3	Global toxicology in a sustainable society	1.5	Toxicology	Second (Advanced)
3	Regulatory toxicity testing	12	Toxicology	Second (Advanced)
3	Elective courses	9	Toxicology	Second (Advanced)

Alternative 1:

3 and 4	Degreeproject in toxicology	37.5	Toxicology	Second (Advanced)

Alternative 2:

3 and 4	Project work or elective courses	7.5	Toxicology	- - -
3 and 4	Degree project in toxicology	30	Toxicology	Second (Advanced)