

MAS

Master of Advanced Studies
Maîtrise universitaire d'études avancées

Toxicology

September 2018 – June 2020



The only part-time curriculum in Toxicology in Switzerland compatible with the needs of scientists already in employment



The Master of Advanced Studies in Toxicology provides a comprehensive educational programme recognized by national and international professional bodies as a postgraduate academic qualification in toxicology. It is designed to fulfill the needs of recently graduated students who are already in employment and potential employers in industry, academia and regulatory bodies.

The assessment of the potential risk of chemicals and pharmaceuticals to which humans and the environment are exposed provides the necessary basis for protection measures. This increasingly complex process has created a demand for qualified scientists in industry, academia and regulatory bodies with the appropriate knowledge, experience and professional qualification. The MAS in Toxicology was initiated in 2010 by the Swiss Centre for Applied Human Toxicology (SCAHT) as part of its mandate to promote education and continued professional development in this important discipline. The curriculum has been developed by the School of Pharmaceutical Sciences of the Universities of Geneva and Lausanne (Ecole de Pharmacie Genève-Lausanne). The master is part of an educational platform of collaboration with the Universities of Zürich and Basel, the Swiss Society of Toxicology, the Swiss Register of Toxicologists, the Centre of Competence in Analytic Chemistry and Toxicology (CCCTA), the Centre for Ecotoxicology (eawag/EPFL), regulatory authorities, and the pharmaceutical and chemical industry.

The curriculum is designed to comply with the regulations for toxicological training set by the Swiss Register of Toxicologists¹ and EUROTOX². Successful completion of the course may be used towards fulfillment of the requirements for professional registration as a toxicologist.

1 www.swisstox.ch/swisstox-en/register/reglement.php

2 www.eurotox.com/sub/eurotox.com/images/docs/guidelines_for_registration_2012.pdf



MAS Programme Management

The programme is run by the Universities of Geneva and Lausanne

Director

Prof. **Jules Desmeules**, Department of Anesthesiology, Pharmacology and Intensive Care, Faculty of Medicine / School of Pharmaceutical Sciences, Faculty of Sciences, University of Geneva

Coordinators

Dr **Marc Fathi** and Dr **Caroline Samer**, Department of Anesthesiology, Pharmacology and Intensive Care, Faculty of Medicine / School of Pharmaceutical Sciences, Faculty of Sciences, University of Geneva

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- Prof. **Jean-Luc Veuthey**, School of Pharmaceutical Sciences, Faculty of Sciences, University of Geneva
- Prof. **Martin Wilks**, Director, Swiss Centre for Applied Human Toxicology, SCAHT



Scientific Committee

- Dr **Marc Fathi**, School of Pharmaceutical Sciences, Faculty of Sciences, University of Geneva
- Dr **Hugo Kupferschmidt**, Director, Tox Info Suisse, Affiliated Institute of the University of Zürich
- Prof. **Alex Odermatt**, Institute of Molecular and System Toxicology, University of Basel
- PD Dr **Michel Rossier**, Head of Clinical Chemistry and Chief of Laboratories, Central Institute of Hospitals, Hospital of Valais
- Prof. **Serge Rudaz**, School of Pharmaceutical Sciences, Faculty of Sciences, University of Geneva
- PD Dr **Caroline Samer**, Department of Anesthesiology, Pharmacology and Intensive Care, Faculty of Medicine, University of Geneva
- PD Dr **Thomas Singer**, DABT, Global Head of Pharmaceutical Sciences, Roche Innovation Center, Basel

Teaching Methods

- Module leaders and teachers are specialists in their various toxicological disciplines from academia, industry and regulatory authorities
- Access to dedicated e-teaching tool throughout the course
- Teaching in English
- Possibility for accreditation of prior postgraduate education on a case-by-case basis
- Each module is assessed by examination



Objectives

- To provide specialist education and training in toxicological sciences and risk assessment with a focus on human toxicology, leading to a recognized academic qualification.
- To fulfill the educational requirements of national and international professional bodies towards registration as a toxicologist.

Competencies

- Scientific understanding of the mechanisms and consequences of adverse effects in living organisms caused by chemical exposure.
- Ability to ethically apply the science of toxicology in research, product development and safety assessment.

Who should apply?

- Graduates employed in a toxicological discipline who wish to obtain a recognized academic qualification in toxicology. Those who have already received formal postgraduate training in toxicology may be eligible for recognition of equivalence for some courses.
- Graduates wishing to embark on a career in toxicology who have completed a master's degree in medicine, veterinary medicine, pharmacy, biochemistry, chemistry, biology or a qualification which is judged equivalent.



Programme Structure

- MAS programme of 90 ECTS credits including 14 modules (60 ECTS credits) and a Master Thesis (30 ECTS credits)
- Complete course corresponding to 16-week teaching over 4 semesters on a modular schedule plus e-learning and self-teaching (14 modules)
- Minimum of 80 % attendance by each student in each module
- Possibility to attend individual modules with free-student status if places are available. However, Part A of Module 1 must be completed and passed before attending any other module.
- Master thesis in an academic, regulatory or industrial environment corresponding to ca. 14 weeks (full time basis)
- Option to take the full course over two cycles (4 years)

Diploma Awarded

Students who successfully complete the programme (90 ECTS credits) will be awarded the Master of Advanced Studies in Toxicology (Maîtrise universitaire d'études avancées en Toxicologie) by the Faculty of Medicine and the Faculty of Sciences.

Module 1 | Basic Principles in Toxicology

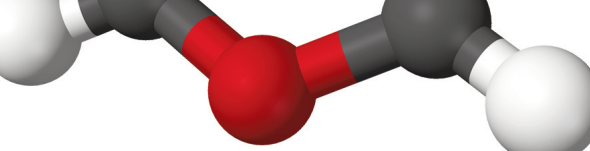
7 ECTS Credits

Prof. Bernard Rossier, Dr Michelle Rossier

This module in e-learning format, is a mandatory prerequisite for all following modules. It gives the basic concepts of general toxicology: pharmaco- and toxicokinetics (absorption, distribution, metabolism, excretion, bioavailability, absorption rate constant, half-life, volume of distribution, clearance, area under the curve), toxicodynamics or mechanistic toxicology (non receptor and receptor mediated mechanisms, binding, dose-response relationship, potency versus efficacy, agonism, antagonism, synergy, potentiating, tolerance, sensitization), basic principles of toxicology (administration or exposure routes, role of metabolites, accumulation, characteristics of toxic effects, toxicity targets).

Descriptive toxicology presents an overview of the effects of the main toxic agents which will be further developed in different modules.

The module is divided into two parts. Part A must be passed (multiple choice questions) in order to attend any other module. The evaluation of Part B is based on presentations (article or case) by the students.



Module 2 | **Xenobiotic Metabolism, Toxicogenetics**

5 ECTS Credits

Prof. Chin Eap, Dr Caroline Samer

This module describes the metabolic pathways involved in the biotransformation of xenobiotics leading to poisonous compounds, detoxification or producing toxic intermediates, as well as their circadian control.

The students will learn to interpret methods to quantify or predict cytochrome P450 activities.

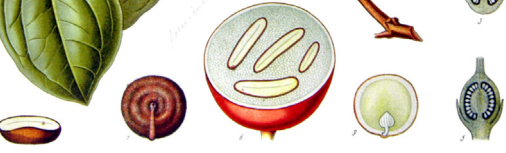
Toxicokinetic and toxicodynamic principles and physiologically based toxicokinetic modelling will be presented.

The student will be able to understand, describe and interpret the impact of gene polymorphisms on the safety of medications, drugs and environmental agents (toxicogenetics), as well as the technologies involved in their assessment.

The present and the future use of genetic tests in pharmacogenetics / toxicogenetics will also be discussed.

Finally, the role of toxicology in drug development will be described.

The evaluation of the module is based on a written exam (short open answer questions).



Module 3 | Organ Toxicology

8 ECTS Credits

Dr Olivier Sorg, Dr Marie-Gabrielle Zurich Fontanellaz

This transversal module is the largest module of the programme. Its content is linked to several other modules as it describes the basic physiology of liver, kidney, heart, lungs, brain and skin (this background knowledge will be delivered partly as e-learning), as well as their specific susceptibilities to toxicants. General mechanisms of toxicity, such as oxidative stress, inflammation, induction of apoptosis and necrosis, as well as mechanisms of toxicity specific to the different organs will be taught by internationally recognized researchers based on their expertise in these fields. As illustration of the adverse effects in the different organs, the toxic “signature” of some environmental toxicants or drugs will be analyzed.

The evaluation of this module is a combination of oral presentation, paper presentation and written exam (short open answer questions).

Module 4 | Animal Experimentation

3 ECTS Credits

Dr Fabienne Chabaud, Ms Danielle Gerster

This course is organized by the Network ResAL. It follows Swiss national regulation and requires work in animal experimentation.

The module includes a theoretical part presenting the main



aspects of the laboratory animal (anatomy, physiology, breeding, housing, enrichment and transport), as well as the knowledge and manipulations necessary for animal experimentation (anesthesia, pain assessment, diseases, allergies, identification of rodents, genetically modified animals and euthanasia). In addition, a reflection is proposed on ethics. The rules to obtain a permit for animal experimentation according to Swiss legislation are given.

The practical part can only be followed by students performing or planning to perform animal experimentation. It allows handling of mice, rats and guinea pigs and teaches several manipulations described during the theoretical part, as well as perfusion and organ dissection.

The module is evaluated by a written exam (multiple choice questions).

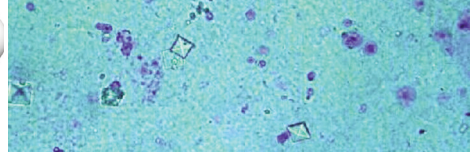
Module 5 | Alternatives to Animal Experimentation

3 ECTS Credits

Prof. Luc Stoppini, Dr Olivier Sorg

This module introduces a promising alternative to animal experimentation: the 3D cultures. The students will acquire the basic knowledge on the different techniques and methods used to perform in vitro screening of toxic molecules and to replace classical animal experimentation. The models described are the 3D cultures as well as the stem cells (rodent/human origin), cell lines, primary cultures, slices and the Zebra fish. Such alternative methods allow a mechanistic understanding of the toxicity pathways, which will be useful for risk evaluation.

The evaluation of this module is based on a practical work as well as a written exam (short open answer questions).



Module 6 | **Carcinogenesis, Mutagenesis and Teratogenesis**

3 ECTS Credits

Prof. Muriel Cuendet, Prof. Shana Sturla

In this module, the students will be able to understand the cellular and molecular basis underlying carcinogenesis and the multi-stage process of carcinogenesis.

Moreover, they should be able to describe various factors, such as chemicals, radiation, viruses or the diet, which can cause/prevent carcinogenesis, as well as their mechanisms. The students will learn to describe how carcinogens / mutagens can be tested, and also how to organize data and information, and to critically discuss publications on these topics, as well as teratogenesis.

Finally, in vitro and in vivo assays will be described.

The module is evaluated through individual paper presentations.

Module 7 | **Molecular Endocrinology**

5 ECTS Credits

Dr Michel Rossier, Dr Ariane De Agostini

Endocrine disruptors and reproductive disorders caused by disrupting endocrine functions are current critical concerns.

This course focuses on the biochemistry of hormones, their biosynthesis, their metabolism, their regulation, their measurement and their molecular mode of action at the level of receptors. Various endocrine systems are described in animals and humans, and physiological and



pathophysiological contexts are presented, such as the consequences of given genetic mutations or of exposure to toxicants.

The following topics are discussed by experts in the field, giving the students the opportunity to interact with them: endocrinology, receptors and cellular signaling, steroid hormones, reproductive function (including pregnancy, sexual differentiation and puberty, testis and ovary functions), thyroid function, bone metabolism, lipotoxicity and diabetes, neuroregulation of energy metabolism, chronobiology of endocrine systems, endocrine disruptors.

The evaluation of this module is based on a written exam (short open answer questions).

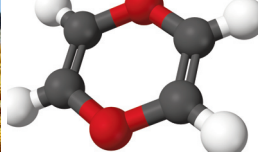
Module 8 | **Clinical Toxicology, Immunotoxicology**

4 ECTS Credits

Dr Caroline Samer, Dr Hugo Kupferschmidt

Clinical toxicology is concerned with the adverse effects of drugs and other chemicals in humans and how to treat poisoning by such agents. The students will be able to understand, describe and interpret qualitative and quantitative aspects of intoxications and adverse drug reactions, with specific references to the harmful effects on individuals and specific vulnerable populations, as well as on the immune system (immunotoxicology) and be able to interpret laboratory tests. Based upon the principles of toxicokinetics and toxicodynamics, the students will be able to analyze intoxications and harmful drug effects such as major clinical toxicology syndromes and to establish general preventive and therapeutic measures.

The evaluation of this module is based on a written exam (short open answer questions).



Module 9 | **Epidemiology, Food and Industrial Toxicology**

5 ECTS Credits

Dr Nancy Hopf, Dr David Vernez, Dr Didier Ortelli

Food safety and occupational health are major concerns. The goal of the module is to identify the problems related to these issues and to assess the toxicological risk of toxicants present in food and in the workplace for consumers and workers, respectively. This module introduces basic concepts in occupational epidemiology, occupational exposure and risk assessment, and occupational risk management, in addition to describing typical occupational toxicants such as particles, nanoparticles, bioaerosols, gases, and vapors. Food toxicology encompasses nutritional toxicology, regulation and risk assessment, microbiology, natural toxins, contaminants, and toxicants resulting from technological processes. At the end of this module, students will have acquired the competencies related to the understanding of where, which, how and why toxicants are found in the workplace and in food.

The evaluation is based on individual student reports on a significant substance, relevant in industrial toxicology and epidemiology or food toxicology.



Module 10 | Risk Assessment and Regulatory Toxicology

4 ECTS Credits

Prof. Martin Wilks, Dr Rex FitzGerald

In the first part of this module, students will learn methods of toxicological hazard and exposure assessment and how to apply them to risk characterization. Risk management, risk-benefit analysis, risk perception and communication will also be discussed. In the second part, experts from federal authorities and industry will provide insights into the role of safety assessment in the regulation of human and veterinary pharmaceuticals, pesticides, cosmetics, food and food additives and industrial chemicals.

The module is evaluated by a written exam (multiple-choice questions).

Module 11 | Ecotoxicology

3 ECTS Credits

Dr Nathalie Chèvre, Dr Benoît Ferrari

This module will enable participants to understand and to be able to apply ecotoxicological concepts to evaluate the risk and the impact of pollutants in the environment. In the theoretical part, they will learn about general principles of ecotoxicological testing for water, sediment and soil compartments. Statistical aspects (dose-response curves), risk assessment of single substances and mixture as well as risk management will also be addressed. During the practical part, participants will be trained in substance toxicity testing with daphnids and earthworms. They will learn how to estimate EC₅₀ and NOEC and how to conduct risk assessment.

The module is evaluated through a presentation based on laboratory testing done by the students during the course.



Module 12 | Analytical Toxicology

2 ECTS Credits

Prof. Serge Rudaz, Prof. Jean-Luc Veuthey

This technical module presents some important aspects in toxicological analysis including the matrices of interest and sample preparation methods prior to qualitative and/or quantitative determination. The most important analytical techniques (spectral or separation approaches) used for determining potential toxic substances in different matrices are presented, including hyphenation with mass spectrometry. Students will be able to choose and evaluate appropriate analytical tools related to toxicological situations.

The evaluation of this module is based on a critical analysis of scientific articles.

Module 13 | Forensic Toxicology

4 ECTS Credits

Prof. Aurélien Thomas, Dr Christian Giroud

This module profits from the world-renowned expertise of the University Center of Legal Medicine (CURML).

Forensic toxicology (FT) deals with the study of behavioral and toxic effects of psychoactive, doping substances, harmful drugs or chemicals on humans and living systems in a medico-legal context. FT relies heavily on analytical toxicology for the screening of unknown molecules, their unequivocal identification and quantitative determination in biofluids, tissues and seized illegal narcotic substances.

This course will provide a basic knowledge of doping and forensic toxicology. The content will be divided in different



sections aiming to give a broad cover of the field. Students will have an overview of the main classes of drugs that are relevant in forensic toxicology, they will learn how to perform toxicological analyses of biological samples, and how to interpret their findings.

Students are assessed by written exam (theoretical and practical questions). They also have to discuss and interpret sample case data from routine practice in forensic toxicology.

Module 14 | **Biostatistics**

4 ECTS Credits

Dr Julien Boccard, Prof. Serge Rudaz

This course introduces the fundamentals of epidemiology and the principles of the statistical methods most frequently encountered in human toxicology. While it includes short formal presentations of concepts and techniques, emphasis is placed on their application to real data in toxicology. Seminars are held in a computer room, where hands-on sessions focus on conducting analyses and interpreting results.

After completing this course, students should be able to understand the principles of statistical methods, to interpret main results and to critically discuss the conclusions of many scientific publications in clinical toxicology. They should also be able to carry out simple data analyses using statistical software.

The module exam consists of presentation and discussion of a scientific article, focussing on statistical aspects. Completion of homework assignments proposed during the course is a prerequisite for participation in the exam.



Master Thesis

30 ECTS Credits

Prof. Martin Wilks

The master thesis involves 14 weeks of research work in one of the areas of toxicology covered by the MAS programme.

This comprises carrying out the research itself (bibliographical research and practical work, which may or may not include an experimental part), writing up a report (thesis) and attending a viva voce (thesis oral defence) at the University of Geneva.

The thesis requires an original piece of work by the student which consists primarily of defining the topic, organizing the research, contributing new information or insights adding to the sum of knowledge in the chosen field, expressing a viewpoint and presenting a clearly written text.

The master thesis is carried out under the supervision of a director from a Swiss University appointed by the Board of Directors.

Admission to a master thesis project is open to students who have obtained sufficient credits to pass Module 1 (Basic principles in toxicology).

Attending the viva requires the successful completion of all course modules.

General Information

Admission Criteria

- Master in Medicine, Veterinary Medicine, Pharmacy, Biochemistry, Chemistry, Biology or equivalent, or
- Bachelor in Medicine, Veterinary Medicine, Pharmacy, Biochemistry, Chemistry, Biology or equivalent + at least 3 years of professional experience in a field related to toxicology
- Letter of application including motivation to take the course
- Strong command of both written and spoken English

Application

- Registration online *or* Registration form (pdf) to be downloaded (if the online process is not used) from www.unige.ch/formcont/toxico
- Registration deadline for the whole programme: **June 15, 2018**
For individual module: **one month** prior to the beginning of the module

Information

Dr Marc Fathi and **Dr Caroline Samer**

Department of Anesthesiology, Pharmacology and Intensive Care
Faculty of Medicine / Geneva University
mas-toxicology@unige.ch

Tuition Fee

- CHF 10,900.- for the programme
- CHF 1,100.- for those attending the practical part of Module 4 (animal experimentation)
- Special fees for individual modules (for persons who do not seek the MAS degree)

Course Location

Courses are held in both Geneva and Lausanne

For more details see: www.unige.ch/formcont/toxico

Contact

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www.scaht.org

Partnership

- University of Basel
- University of Lausanne
- University of Zurich



Swiss Centre for Applied Human Toxicology



Centre de compétence en chimie et toxicologie analytiques



Swiss Society of Toxicology
Swiss Register of Toxicologists



Centre suisse d'écotoxicologie appliquée
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