

Course directory 2023.2024

school of biology (FBM-BIO)  
master

> Master of Science (MSc) in Medical Biology

## SUMMARY

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Notice	3
Legend	4
List of courses	5

## NOTICE

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This course catalogue was produced using data from the *SylviaAcad* information system of the University of Lausanne. Its database contains all information about courses proposed by the different faculties and their times. This data can also be consulted online at the address :

**<https://applicationspub.unil.ch/interpub/noauth/php/Ud/index.php>.**

Web site of the faculty : **<http://www.unil.ch/ecoledibiologie/>**

Generated on : 11.11.2024

## LEGEND

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### NAME OF THE COURSE

Teacher

Type of course	Status	Hours per week	Teaching language	Hours per year
Semester	Credits			

N: Levels

P: Programme requirements

O: Objective

C: Content

B: Bibliography

I: Additional information

DISCIPLINE

## ABBREVIATIONS

### TYPE OF COURSE

Attest.	Attestation
C	Course
C/S	Course - seminar
Cp	Camp
E	Exercises
Exc	Excursion
Lg	Guided lecture
S	Seminar
T	Fieldwork
TP	Practical work

### STATUS

Fac	Facultative
Obl	Compulsory
Opt	Optional
Fac/Comp/Opt	Facultative, compulsory or optional (according to the study programme)

### SEMESTER

Sp	Spring
A	Autumn

The Master program has a normal duration of 3 semesters and comprises 90 ECTS :

Module 1 : 15 ECTS : Compulsory Courses

Module 2 : 15 ECTS : Practical Project

Module 3 : 15 ECTS : Compulsory and Optional Courses

Module 4 : 45 ECTS : Personal Research Project

Training objectives are available in its programme regulations.

Specific training objectives are described at the top of each track in the module 3.

## Autumn Semester (semester 1)

	Courses / Enseignements	Hours per semester				Teaching Staff	ECTS Credits
		C	E	S	PW		
MODULE 1	<b>Common courses 1 / Cours communes 1</b>						
	Cellular Biology <i>Biologie cellulaire</i>	10	-	2	-	Staub O.	
	Immunology <i>Immunologie</i>	10	-	2	-	Luther S.	
	Intracellular Signalling <i>Signalisation intracellulaire</i>	8	-	2	-	Diviani D.	
	Medical Microbiology <i>Microbiologie médicale</i>	10	-	2	-	Opota O.	
	Mouse Models Genetics <i>Modèles génétiques murins</i>	4	-	2	-	Hummler E.	
	MB Poster Day					Luther S.	
	<b>Common courses 2 / Cours communes 2</b>						
	Cancer <i>Cancer</i>	10	-	3	-	Rufer N.	
	Cardiovascular Diseases <i>Maladies cardiovasculaires</i>	10	-	3	-	Diviani D.	
	Metabolic Diseases <i>Maladies métaboliques</i>	10	-	3	-	Knobloch M.	
	Neuroscience and Brain Diseases <i>Neurosciences et maladies du cerveau</i>	10	-	3	-	Murray M.	
	Pharmacology <i>Pharmacologie</i>	10	-	3	-	Broillet M.-C.	
	<b>Common courses 1 and 2 / Cours communes 1 et 2</b>						
	Scientific Method and Communication <i>Méthode et communication scientifiques</i>	6	-	-	-	Broillet M.-C.	
	Biostatistics <i>Biostatistiques</i>	4	-	-	-	Schütz F.	
	<b>Total</b>		<b>102</b>	<b>0</b>	<b>25</b>	<b>0</b>	
MODULE 2	<b>Practical Project / Travail pratique</b>						
	First Step Research Project <i>Travail d'initiation à la recherche</i>	-	-	-	280	Luther S., Broillet M.-C.	15

### Abbreviations

C = Course

E/S = Exercise/Seminar

PW = Practical Work

The pandemic has shown us that circumstances beyond our control may require us to make the following adjustments / adaptations to study plans during the semester:

- possibility to switch from one mode of teaching to another (face-to-face <-> distance, synchronous <-> asynchronous, switch to co-modal teaching where it was not initially planned).
- change / modification of evaluation modalities, without inducing derogations from the Study Regulations (oral <-> written, exam <-> validation, individual work <-> group work, practical work <-> theoretical work, face-to-face evaluation <-> online evaluation, etc.)
- alternative or time-shifted modalities for teachings, internships, practical work, fieldworks and camps that could not take place or teachings that could no longer take place in the form initially planned.

**Students are invited to consult this document regularly (Study Plan & Evaluation Procedure)**

## LIST OF COURSES

### BIOLOGICAL SECURITY

Marie Bedra

C	Obl	English	2
A			

N: Master

P: A basic knowledge of microbiology and vegetal science

O: To familiarise future researchers with legislation concerning genetic engineering. In addition, possible biological risks associated to different applications of this technology will be discussed with the help of examples. This teaching is a mandatory prerequisite for First-Step.

- C: \* Legislation: article 24 of the Federal Constitution; law concerning environmental protection; law concerning epidemics; ordinance on protection against major accidents; Swiss commissions on biological security: notification and registration of projects.  
\* Biological security in the laboratory: containment; security equipment; technical measures: laboratory construction; standard laboratory (microbiological) practice; classification of biological material: plasmids, microorganisms, cell lines, primary cells; security levels 1-4.  
\* Release of genetically modified bacteria in the environment: monitoring, survival and dissemination, ecological impact, transfer of genes, containment systems.  
\* Potential biological risks associated with the use of transgenic plants: dissemination, cross-pollination, gene transfer.  
\* The problem of recombinant vaccines: vectors, DNA vaccines.  
\* Somatic genetic therapy I: Illnesses accessible to treatment by somatic genetic therapy, gene transfer methods.  
\* Somatic genetic therapy II: Evaluation of the biological risk for the patient and his environment.

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**CELLULAR BIOLOGY**

Olivier Staub

C	Obl	English	10
A			
S	Obl	English	2
A			

N: Master

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**IMMUNOLOGY**

Sanjiv Luther

C	Obl	English	10
A			
S	Obl	English	2
A			

N: Master



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**INTRACELLULAR SIGNALLING**

Dario Diviani

C	Obl	English	8
A			
S	Obl	English	2
A			

N: Master

P: Bachelor in Biology

O: Introduction to the hormonal system. Physiological, pathophysiological and pharmacological aspects

C: 1) Signal transduction by peptide hormones (G protein-coupled receptors, second messengers, protein kinases, genetic pathologies, pharmacological targets).  
 2) Receptor-mediated endocytosis (transferrin, LDL, toxins, virus, ligand-targeted therapeutics)  
 3) Signal transduction by steroid hormones (mechanism of action, pathologies, pharmacological targets)

B: - Endocrinology: An Integrated Approach.

Nussey, S.S.; Whitehead, S.A. London: Taylor &amp; Francis; c2001

- Molecular Biology of the Cell 4th ed.

Alberts, Bruce; Johnson, Alexander; Lewis, Julian; Raff, Martin; Roberts, Keith; Walter, Peter, New York and London: Garland Science; c2002

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**MEDICAL MICROBIOLOGY**

Onya Opota

C	Obl	English	10
A			
S	Obl	English	2
A			

N: Master

P: Course Virology B.Sc. 5th semester or equivalent

O: This course will provide an overview over medical microbiology at an advanced level. Introductory parts will cover the basic concepts of bacterial, viral, and fungal infections in humans. Selected pathogens will be used to highlight the principles underlying human infectious diseases from the standpoint of the pathogen and the host defense.

- 
- C: Outline course Medical Microbiology  
 Part I Medical Bacteriology (Gilbert Greub, 6 hours total)  
 This part of the course will first present the concepts of bacterial colonization, of infection and of barriers against invading micro-organisms. The importance of clinical bacteriology for the etiological diagnosis of infectious diseases will be presented, as well as the main diagnosis approaches used. Then, the most important virulence factors implicated in bacterial pathogenesis and in the transmission of pathogenic agents will be presented. These fundamental principles will be illustrated using relevant human pathogens as examples. First, we will present the pathogenesis of some pyogenic bacteria (*Escherichia coli*, *Staphylococcus* spp., *Streptococcus* spp.), highlighting the importance of bacterial toxins and of bacteriophages. Then, we will present some specific aspects of the mode of transmission and pathogenesis of infections due to intracellular bacteria, using as examples the atypical pneumonia and the zoonotic infections. Finally, we will illustrate using mycobacteria some key principles in bacterial pathogenesis including the importance of pathogens evolution and of immune defense.
- Colonisation, infection and barriers against invading pathogens (1hour)  
 Colonisation, physiological flora  
 Infection and inflammation  
 Chemical, mechanical, physical and biological barriers  
 Diagnostic bacteriology (1 hour)  
 Gram and direct examination  
 Cultures approaches  
 Bacterial identification  
 Molecular diagnosis/serology  
 Pyogenic bacterial infections and toxins (1hour)  
*Escherichia coli*: commensal and pathogen: (ETEC/EPEC/EIEC)  
*Staphylococcus aureus*: virulence factors  
*Streptococcus*, superantigens and bacteriophages  
 Pneumonia (1hour)  
 Etiological diagnosis of pneumonia  
 Pneumocoques and other encapsulated pyogenic bacteria  
*Legionella pneumophila*, water and amoebae  
 Other agents of atypical pneumonia (*Chlamydia* spp., *Coxiella burnetii*)  
 Zoonotic infections (1hour)  
 Ticks/fleas/lice: role in the transmission  
*Rickettsia*: pathogenesis and reductive evolution  
*Bartonella*: red blood cells and endothelial cells  
 Mycobacteria (1hour)  
 Importance of immune defense mechanisms  
 Pathogenomic with an evolutionary perspective
- Part II Medical Virology  
 This part of the course will cover fundamental aspects of medical virology and viral diseases in humans. A short introduction will provide a survey of the landscape and outline basic principles of human viral infection and viral pathogenesis. These fundamental principles will then be illustrated using relevant human pathogens as examples. The most important families of human pathogenic viruses will be presented in a general way. From each family, we will select specific viruses that will serve as examples to illustrate fundamental aspects of virus-host interaction and viral pathogenesis in a more detailed manner. A final block will cover virus infections in the central nervous system (CNS) and re-visit the basic principles outlined before to give a synthesis of the highly complex virus-host interaction underlying viral CNS disorders.
- Introduction to medical virology (1 hour)  
 Basic principles of human viral infection  
 Basic principles of innate and adaptive anti-viral defense  
 Virus infection of the central nervous system (1 hour)  
 Mechanisms of CNS invasion by viruses  
 Anti-viral immune defense in the CNS  
 Acute viral infection of the CNS: meningitis and encephalitis  
 Persistent viral infection in the CNS  
 Infection of the developing CNS: virus infection in pediatric medicine  
 Human pathogenic DNA viruses (2 hours)  
 Overview human pathogenic DNA viruses  
 Poxviruses  
 Overview poxviruses  
 Pathogenesis of smallpox  
 Subversion of innate host cell immunity by poxviruses  
 Adenoviruses  
 Adenoviruses as human pathogens  
 Herpesviruses  
 Overview human pathogenic herpesviruses  
 Herpes simplex virus and viral latency  
 Epstein-Barr Virus: viral latency and cancer  
 Human pathogenic RNA viruses I (1 hour)  
 Overview human pathogenic DNA viruses  
 Enteroviruses  
 Overview human pathogenic enteroviruses  
 Rhinoviruses and cosackievirus: viral tropism and pathogenesis  
 Herpesviruses

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B: Will be provided for each block.

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**MOUSE MODELS GENETICS**

Edith Hummler Beermann

C	Obl	English	4
A			
S	Obl	English	2
A			

N: Master

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**CANCER**

Nathalie Rufer

C	Obl	English	10
A			
S	Obl	English	3
A			

N: Master

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**CARDIOVASCULAR DISEASES**

Dario Diviani

S	Obl	English	3
A			
C	Obl	English	10
A			

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 N: Master

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 O: Integrated overview of the respiratory and cardio-vascular systems  
 Introduction to cardiac and respiratory pathophysiology, pathology, and pharmacology  
 Cellular mechanisms of selected cardiovascular and respiratory diseases

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 C: respiratory and cardiovascular physiology  
 respiratory and cardiovascular pathophysiology and pharmacology  
 cellular basis of arterial hypertension  
 cellular basis of heart failure  
 heart conduction defectc (problem-based learning)

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 B: Medical Physiology. W F Boron & E L Boulpaep; Saunders 2003

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**METABOLIC DISEASES**

Marlen Knobloch

C	Obl	English	10
A			
S	Obl	English	3
A			

N: Master

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P: The following metabolic pathway should be known beforehand:

- Glycolysis
- Neoglucogenesis
- Glycogen synthesis
- Fatty acids and triglyceride synthesis
- Krebs cycle

The basic regulation of receptor tyrosine kinases, G protein-coupled receptors, small GTP-binding proteins should also be known.

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O: The objectives of this course is to understand the complex aetiology of diabetes by studying the environmental, genetic, and molecular factors underlying the development of the disease

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- C:
1. Physiopathology, genetic and environmental factors in diabetes.
  2. Epidemiology of and complications in diabetes.
  3. Diabetes: a pancreatic beta cell disease.
  4. Diabetes: an insulin-resistance disease.
  5. Genetics of diabetes



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## NEUROSCIENCE AND BRAIN DISEASES

Micah Murray

C	Obl	English	10
A			
S	Obl	English	3
A			

N: Master

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**PHARMACOLOGY**

Marie-Christine Broillet

C	Obl	English	10
A			
S	Obl	English	3
A			

N: Master

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**SCIENTIFIC METHOD AND COMMUNICATION**

Marie-Christine Broillet

C	Obl	English	6
A			

N: Master

**BIostatISTICS**

Frédéric Schütz

C	Obl	English	4
A			
TP	Obl	English	13
S			
C	Obl	English	2
S			

N: Master

P: Basics of biostatistics and bioinformatics

O: Methodology in biostatistics and bioinformatics

C: At the end of this module, the students will have used and developed the needed biostatistics or bioinformatics tools to analyze the data obtained during their Master thesis work.

B: /

I: /

**FIRST STEP PROJECT**

Richard Benton, Marie-Christine Broillet, Antoine Guisan, Tadeusz Kawecki, Laurent Lehmann,  
Sanjiv Luther

TP	Obl	English	224
A	15		
TP	Obl	English	280
A	15		
TP	Obl	English	250
S	14/25		
TP	Obl	English	224
A	15		
TP	Obl	English	224
A	15		
TP	Obl	English	224
A	15		

N: Master

P: Practicals performed during the bachelor (molecular biology, genetics, biochemistry, bioinformatics)

O: - An initiation to the work of a scientist  
 - Conduct experimental work in research lab (wet bench or in silico)  
 - Interpretation of research results  
 - Implement basic principles in experimental design (e.g. include the appropriate controls, statistical significance of the results etc...)  
 - Present your experimental work in a written report which will be organized like a typical research article (introduction, results, discussion, materials and methods)  
 - present your work orally (seminar style)

C: Perform laboratory work for about 12 weeks during the time when the student does not follow theoretical classes. This research project will typically be performed under the guidance of a PhD student or a post-doc from the host laboratory.

## Spring Semester (semester 2)

One track among the below proposals / Une filière au choix parmi les propositions ci-dessous :

MODULE 3	Immunology and Cancer					Responsible: Esser-von Bieren J.	
	<i>Immunologie et Cancer</i>						
	At the end of the course the students will be able to:						
	<ul style="list-style-type: none"> <li>• Mobilise theoretical and practical knowledge in immunology and cancer biology.</li> <li>• Systematically analyse fundamental and clinical problems in immunology and cancer biology, starting with diseases related to the immune system or cell transformation, drug development and treatments.</li> <li>• Apply basic research techniques in immunology and cancer biology to solve research questions (proteomics, peptide-based assays, flow cytometry, histology and biostatistics).</li> </ul>						
	Courses / Enseignements	Hours per semester				Teaching Staff	ECTS Credits
		C	E/S	S	PW		
	Introduction to Clinical Medicine <i>Introduction à la médecine clinique</i>	20	-	-	-	Wuerzner G., Gonzalez Rodriguez E.	15
	Immunology II. Advanced Concepts in Immunology : from Antigen Recognition and Signalling to Leukocyte Responses <i>Immunologie II. Concepts avancés en immunologie : de la présentation et reconnaissance d'antigène à la signalisation et aux réponses des leucocytes</i>	24	-	5	-	Esser-von Bieren J., Luther S., Held W., Rebsman M., Thome M., Ho P.-C., Monticelli S.	
	Immunology III. Immunity and Disease : Microbiome, Infections and Autoimmunity <i>Immunologie III. Immunité et maladie : Microbiome, Infections et Autoimmunité</i>	21	-	4	-	Esser-von Bieren J., Broz P., Velin D., Perreau M., Roger T., Pot C., Verdeil G., Ubags N.	
	Cancer II. Advanced Concepts in Cancer Biology : from Genetics and Epigenetics to Metabolism <i>Cancer II. Concepts avancés en biologie du cancer : De la génétique et épigénétique au métabolisme</i>	8	-	1	-	Petrova T., Missiaglia E., Hanahan D., Ciriello G.	
	Cancer III. Advanced Concepts in Cancer Biology : from Angiogenesis to Tumor Invasion and Metastasis <i>Cancer III. Concepts avancés en biologie du cancer : de l'angiogenèse à l'invasion tumorale et au métastases</i>	12	-	2	-	Petrova T., Joyce J., Gfeller D.	
	Treatments. Treatments and Prevention of Disease : Drug Development, Vaccines, Anti-Tumor Immunity, Immunotherapy, Leukemia, Transplantation, Allergy <i>Traitements. Traitements et prévention de maladies : Développement de médicaments, vaccins, immunité contre tumeurs, immunothérapie, leucémie, transplantation, allergie</i>	17	-	5	-	Petrova T., Harari A. Kandalaf L., Vozenin M.-C., Arber C., Perez L., Golshayan D., Comte D.	
	Molecular and Cellular Techniques. Applications to the Study of Lymphocytes and Tumor Cells. Techniques moléculaires et cellulaires. Applications à l'étude des lymphocytes et cellules tumorales. - Lectures on protein analysis (proteomics) - Cours ex-cathédra sur l'analyse des protéines (protéomique) - PW Molecular and cellular techniques : proteomics, antigen discovery, 3D-modeling, immunological assays based on peptides - TP Techniques moléculaires et cellulaires: protéomique, découverte d'antigènes, modélisation en 3D, tests immunologiques basés sur peptides	14	-	-	35	Quadroni M., Bassani M., Zoete V., Baumgartner P., Verdeil G., Derré L.	
	PW Ex Vivo and In Situ Techniques TP techniques ex vivo et in situ - Histological Analysis of Lymph Nodes or Cancer Tissues - Analyse histologique des ganglions et tissus cancéreux - Multicolor Flow Cytometric Analysis of Lymphoid Organs - Cytométrie de flux en multiples couleurs pour analyser des tissus lymphoïdes - Discussion and Feedback Session - Discussion et session 'feedback'	8	-	4	28	Bénéchet A., Mayol J.-F., Nobile A., Arber C., Bernier-Latmani J.	
	E-Learning Exercises. Article- and Case-based Learning in Proteomics / Immunology / Cancer <i>Exercices de type 'e-learning'. Apprentissage par article ou problème en protéomiques / immunologie / cancer</i>	1	-	2	-	Luther S., Esser-von Bieren J., Naveiras O., Perreau M., Perez L.	
	Write and Defend Grant Proposal, prepare Journal Club <i>Rédaction et défense d'une demande de subsides, préparation d'un journal Club</i>	-	2	-	-	Petrova T.	
	Bioinformatics: lecture and PW <i>Bioinformatique: cours et TP</i>	2	-	-	4	Gfeller D.	
	Biostatistics <i>Biostatistiques</i>	2	-	-	13	Schütz F.	
	<b>Optional / Optionnel</b>						
	Training in Animal Experimentation (RESAL Module 1) * <i>Expérimentation animale (RESAL module 1)</i>	20	-	-	20	Broillet M.-C., Cadilhac C.	
	Clinical Research Module <i>Module de recherche clinique</i>					Wuerzner G.	
		149		25	103		277

\* Only students who choose a master project with animal experimentation are allowed to select this course

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## INTRODUCTION TO CLINICAL MEDICINE

Grégoire Emmanuel Würzner

C	Obl	English	20
S			

N: Master

P: Bachelor of Science

O: The main goals of this course is to have the students able to:  
1) describe the basic principles underlying human clinical medicine;  
2) explain the concepts and language used in clinical medicine and research

C: -

B: /

I: -

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**IMMUNOLOGY II**

Julia Esser-von Bieren

C	Obl	English	24
S			
S	Obl	English	5
S			

N: Master

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P: The key concepts of immunology which are summarized in chapter 1 of 'Janeways Immunobiology' by Kenneth Murphy (Garland Science) 2016 Version francaise de 2018

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O: Know dendritic cells and lymphocytes  
Know lymphoid organ structure and function  
Know the cellular migration and interaction  
Know the molecular basis of cellular interactions  
Know how antigen is recognized, sampled, processed and presented to lymphocytes  
Know how lymphocytes get activated, proliferate and differentiate into effector cells  
Know the effector function  
Know what memory cells are and do  
Know the phases of adaptive immunity  
Know the pros and cons of adaptive immune responses

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C: See under goals



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**IMMUNOLOGY III**

Julia Esser-von Bieren

C	Obl	English	21
S			
S	Obl	English	4
S			

N: Master

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**CANCER II**

Tatiana Petrova

C	Obl	English	8
S			
S	Obl	English	1
S			

N: Master

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**CANCER III**

Tatiana Petrova

C	Obl	English	12
S			
S	Obl	English	2
S			

N: Master

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**TREATMENTS**

Tatiana Petrova

C	Obl	English	17
S			
S	Obl	English	5
S			

N: Master

P: Have a basic knowledge of the principles of humoral and cellular immunology. Innate and adaptive immune responses. Basic mechanisms of cell transformation and cancer development.

O: Provide an overview of the principles of tumor immunology and the applications to cancer immunotherapy

C: Immunosurveillance of tumors  
 Tumor antigens  
 Approches to cancer immunotherapy  
 Immunosuppression in the tumor microenvironment  
 Immune checkpoint blockade with monoclonal antibodies

B: - Mellman I, Coukos G, Dranoff G. Cancer immunotherapy comes of age. Nature. 2011 480(7378):480-9. doi:10.1038/nature10673.  
 - Schreiber RD, Old LJ, Smyth MJ. Cancer immunoediting: integrating immunity's roles in cancer suppression and promotion. Science. 2011 331(6024):1565-70. doi:10.1126/science.1203486.

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**MOLECULAR AND CELLULAR TECHNIQUES**

Manfredo Quadroni

C	Obl	English	14
S			
TP	Obl	English	35
S			

N: Master

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## PW EX VIVO AND IN SITU TECHNIQUES

Alexandre Bénéchet

C	Obl	English	8
S			
TP	Obl	English	28
S			
S	Obl	English	4
S			

N: Master

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**E-LEARNING EXERCISES: ABL AND CBL**

Julia Esser-von Bieren, Sanjiv Luther

C	Obl	English	1
S			
E	Obl	English	2
S			

N: Master

P: Knowledge from the lectures in immunology and cancer (first and second semester)

O: Article-based learning (ABL):

- 1) Read and understand this immunology publication on T follicular helper cell development
- 2) Understand the hypothesis raised by the authors and learn to develop an experimental protocol with group members to address the open question
- 3) Present your proposal in front of the class and discuss the various proposals in a critical way

Case-based learning (CBL):

- 1) Explore a clinical case called 'weight loss and lymphadenopathy'(field of immunology and oncology) and learn about a disease from a clinical point of view
- 2) Learn the way a medical doctor approaches a patient in a step-wise manner to make a diagnosis and come up with a therapeutic approach
- 3) Complete group assignments
- 4) Present your results orally in front of the class

C: The ABL exercise is divided into four phases:

- 1) Individual work: Reading of the paper
- 2) Group work: Discussion with group members on hypothesis raised by the authors and the best experimental approaches
- 3) Group work: Preparation of a presentation explaining the open question and the experimental approach proposed
- 4) In class: Oral presentation of the proposal in English and critical discussion on the strengths and weaknesses of the approaches proposed by each group (in presence of two tutors)

The CBL exercise is divided into four phases:

- 1) Individual work: Reading of the paper
- 2) Group work: Discussion with group members on the clinical case and the questions assigned to the group
- 3) Group work: Preparation of a presentation presenting the answers to the assigned questions/tasks
- 4) In class: Oral presentation of the assignments in English and discussion of the case with the medical doctor present in class.

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**WRITE AND DEFEND GRANT PROPOSAL, PREPARE JOURNAL CLUB**

Marie-Christine Broillet, Micah Murray, Onya Opota, Tatiana Petrova

E	Obl	English	2
S			
E	Obl	English	2
S			
E	Obl	English	2
S			
E	Obl	English	18
S			

N: Master



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**BIOINFORMATICS: LECTURE AND PW**

David Gfeller

C	Obl	English	2
S			
TP	Obl	English	4
S			

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N: Master

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O: Present fundamental concepts for the analysis of gene expression data (RNA-Seq). Introduce some tools to perform these types of analyses

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C: - Introduction to RNA-Seq technologies  
- Data processing and normalisation  
- High-dimensional data analysis  
- Clustering  
- Differential expression  
- Single-cell RNA-Seq

**BIostatISTICS**

Frédéric Schütz

C	Obl	English	4
A			
TP	Obl	English	13
S			
C	Obl	English	2
S			

N: Master

P: Basics of biostatistics and bioinformatics

O: Methodology in biostatistics and bioinformatics

C: At the end of this module, the students will have used and developed the needed biostatistics or bioinformatics tools to analyze the data obtained during their Master thesis work.

B: /

I: /

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**TRAINING IN ANIMAL EXPERIMENTATION (RESAL MODULE 1)**

Marie-Christine Broillet

C	Opt	English	20
A S	2		
TP	Opt	English	20
A S			

N: Master

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- O: Learning outcomes To acquire the practical and theoretical skills with laboratory animals as requested by legislation (Swiss ordinance N° 455.171.2, October 1998) to get the accreditation to perform animal experimentation delivered by the Federal Veterinary Office. This course (20h theory + 20h practical) will be recognized by the Swiss federal veterinary office to undertake animal experiments.
- 
- C: What is animal experimentation? Any interventions in which live animals are used to : - Test a scientific hypothesis in various fields (behavior, neurology, metabolism, immunology, cardiovascular...) - Verify the effects of a particular procedure on an animal - Test a substance (pharmacology, toxicology...) - Collect or examine cells, organs or body fluids - Education, training and continuing education Choosing an appropriate animal model - Before an animal model is chosen, investigators must consider alternatives to the use of live animals (3Rs) - Investigators must consider all factors when selecting the best model for research Who is concerned by this module? This training module is relevant to all students working with animals during their master project. Conditions for registration to this module: - The host laboratory must have permission to work with animals - Students must be announced to the cantonal veterinary office

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**CLINICAL RESEARCH MODULE**

Grégoire Emmanuel Würzner

C	Opt	English	20
S			
TP	Opt	English	20
S			

N: Master

- 
- O: To get acquainted with basic methods in clinical research
- o study design
  - o statistical analysis
  - o ethical considerations
  - o legal aspects
- To know the basic skills for the realization of research protocols on human beings
- o Techniques of asepsis, iv drips
  - o how to react in case of acute adverse effects
  - o basic life support
- To understand the relationships between clinical practice and research
- o cancer
  - o metabolic disorders
  - o neuro-psychiatric disorders

## Metabolism and Human Health

Responsible: Opota O. and Mansuy-Aubert V.

### Métabolisme et santé humaine

At the end of the course the students will be able to:

- Mobilise knowledge from a physiological point of view on metabolism, endocrinology, nutrition and health.
- Acquire a current vision of the issues of medical microbiology, host-microbe interactions in health and metabolic diseases, microbiota and health.
- Critically analyse and present case studies on metabolic diseases and the influence of the microbiome on human health.
- Interact with scientists and professionals from different backgrounds to learn and practice the various steps involved in the research, diagnostics and treatments of metabolic diseases.

Courses / Enseignements	Hours per semester				Teaching Staff	ECTS Credits	
	C	E	S	PW			
Introduction to Clinical Medicine <i>Introduction à la médecine clinique</i>	20	-	-	-	Wuerzner G., Gonzalez Rodriguez E.	15	
Human Nutrition and Metabolism <i>Nutrition humaine et métabolisme</i>	10	-	-	-	Mansuy-Aubert V., Puder J., Vonaesch P.		
Metabolic Syndrome and its Consequences (Diabetes, Obesity, Cancer, Cardiac Diseases) <i>Syndrôme métabolique et ses conséquences (diabète, obésité, cancer, maladies cardiaques)</i>	8	-	2	-	Rosenblatt N., Puder J.		
Interaction Gut-Nervous System <i>Interaction intestin-système nerveux</i>	4	-	-	-	Langlet F., Mansuy-Aubert V.		
Developmental Origin of Health and Diseases (Maternal-Fetal-Child Interactions) <i>Origine développementale de la santé et des maladies (interactions mère-fœtus-enfant)</i>	8	-	2	-	Crozier S., Fischer-Fumeaux C., Vonaesch P., Zydorczyk C.		
Genetics of Metabolic Diseases <i>Génétiq ue des maladies métaboliques</i>	2	-	-	-	Messina A.		
Cellular Metabolism, Stem Cells <i>Métabolisme cellulaire, cellules souches</i>	8	-	-	-	Paolicelli R., Knobloch M., Jourdain A.		
Case Study on Metabolic Diseases <i>Etude de cas sur les maladies métaboliques</i>	-	10	-	-	Mansuy-Aubert V., Langlet F., Messina A.		
Exercise and Metabolism <i>Exercice et métabolisme</i>	6	-	2	-	Amati F.		
Sport, Metabolism, Health and Performance <i>Sport, métabolisme, santé et performance</i>	6	-	-	-	Place N., Zanou N.		
Energy Metabolism and Rheumatic Diseases <i>Métabolisme énergétique et maladies rhumatismales</i>	6	-	-	-	Geurts J.		
Human-Microbes Interactions <i>Interactions entre l'homme et les microbes</i>	10	-	2	-	Opota O., Bertelli-Lombardo C., Jacot D., Niculita Hirzel H., Mazza-Stalder J.		
Human Microbiota in Metabolic Health and Diseases <i>Microbiote humain dans la santé métabolique et les maladies</i>	12	-	2	-	Bertelli-Lombardo C., Ubags N., Guery B., Stojanov M., Vonaesch P.		
Diet, Lifestyle, Microbiota and Brain Diseases <i>Alimentation, mode de vie, microbiote et maladies neurobiologiques</i>	6	-	2	-	Mansuy-Aubert V., Boutrel B., Pot C.		
Preventive and Therapeutic Interventions on Microbiota <i>Interventions préventives et thérapeutiques sur le microbiote</i>	4	-	-	-	Galperine T., Vonaesch P.		
Human Microbiome and Interactions with Chemotherapies <i>Microbiome humain et interactions avec les chimiothérapies</i>	2	-	-	-	Homicsko K.		
Case Study on the Microbiome and Human Health <i>Etude de cas sur le microbiome et la santé humaine</i>	-	10	-	-	Opota O.		
Laboratory Approaches in Clinical Chemistry (Metabolomics, Proteomics) <i>Approches en chimie clinique (métabolomique, protéomique)</i>	8	-	-	4	Braissant O., Binz P.-A., Choong E., Gallart-Ayala H., Ivanisevic J.		
Laboratory Approaches in Medical Microbiology <i>Approches en microbiologie médicale</i>	8	-	-	4	Opota O., Bertelli-Lombardo C., Jacot D., Niculita Hirzel H.		
Monitoring Physiological Functions <i>Méthodes analytiques des fonctions physiologiques</i>	-	-	-	8	Puder J., Amati F., Mansuy-Aubert V.		
Therapies of Gut-Brain Communication (from By-Pass Surgery to Endopharmacology) <i>Axe intestin cerveau, approches thérapeutiques (de la chirurgie de dérivation à l'endopharmacologie)</i>	2	-	-	-	Favre L.		
Fundamental Principles : Pharmacokinetics / Pharmacogenomics <i>Principes fondamentaux de pharmacocinétique et pharmacogénomique</i>	10	-	2	-	Firsov D.		
Principles of Chemotherapy : Infectious Diseases <i>Principes de la chimiothérapie : les maladies infectieuses</i>	6	-	2	-	Staub O.		
Visit of Nestlé SA, Vers-chez-les-Blanc <i>Visite de Nestlé SA, Vers-chez-les-Blanc</i>	-	-	-	4	Opota O.		
Visit FIND Geneva or WHO Geneva <i>Visite de FIND Genève ou WHO Genève</i>	-	-	-	4	Opota O.		
Recent Advances in Metabolic Health/Career Development <i>Avances récentes en santé métabolique / Evolution de carrières</i>	-	-	12	-	Opota O., Mansuy-Aubert V.		
Write and Defend Grant Proposal, prepare Journal Club <i>Rédaction et défense d'une demande de subside, préparation d'un journal Club</i>	-	2	-	-	Opota O.		
Biostatistics <i>Biostatistiques</i>	2	-	-	13	Schütz F.		
<b>Optional / Optionnel</b>							
Training in Animal Experimentation (RESAL Module 1) * <i>Expérimentation animale (RESAL module 1)</i>	20	-	-	20	Broillet M.-C., Cadilhac C.		275
Clinical Research Module <i>Module de recherche clinique</i>					Wuerzner G.		
	168	22	28	57			

\* Only students who choose a master project with animal experimentation are allowed to select this course

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## INTRODUCTION TO CLINICAL MEDICINE

Grégoire Emmanuel Würzner

C	Obl	English	20
S			

N: Master

P: Bachelor of Science

O: The main goals of this course is to have the students able to:  
1) describe the basic principles underlying human clinical medicine;  
2) explain the concepts and language used in clinical medicine and research

C: -

B: /

I: -

---

**HUMAN NUTRITION AND METABOLISM**

Virginie Mansuy-Aubert

C	Obl	English	10
S			

N: Master

---

**METABOLIC SYNDROME AND ITS CONSEQUENCES (DIABETES, OBESITY, CANCER, CARDIAC DISEASES)**

Nathalie Rosenblatt-Velin

C	Obl	English	8
S			
S	Obl	English	2
S			

N: Master



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**INTERACTION GUT-NERVOUS SYSTEM**

Fanny Langlet

C	Obl	English	4
S			

---

N: Master

- 
- O:
- 1) To apprehend the different access and response pathways in the control of energy balance
  - 2) To highlight the organization and functioning of periphery-brain interfaces in the context of energy balance
  - 3) To estimate the impact of energy status on hypothalamic activity

---

C: 3 axes:

- Periphery-brain interface: organization, functions, and plasticity
- Access of metabolic signals to the brain: focus on the hypothalamus
- Hypothalamic responses for the control of energy balance

---

## DEVELOPMENTAL ORIGIN OF HEALTH AND DISEASES (MATERNAL-FETAL-CHILD INTERACTIONS)

Sophie Croizier

C	Obl	English	10
S			
S	Obl	English	2
S			

N: Master

P: Students will need to have some knowledge of anatomy and DNA structure to understand the types of pathologies addressed (metabolic, cardiovascular, etc.) and what epigenetic modifications are.

O: At the end of the Master's degree, students will be able to :

- Define the concept of DOHAD (Developmental Origin of Health and Diseases)
- Recognize the major stages of fetal development (intrauterine) to be aware of windows of vulnerability
- Describe the environmental factors that can lead to developmental diseases
- Define what epigenetics is, and be able to give concrete examples of epigenetic modifications leading to pathologies with developmental origin
- List the different interventions that can be done during development to limit the onset of developmental pathologies
- Integrate this information and comment on it publicly
- Analyze a scientific review demonstrating the developmental origin of a pathology

---

C: **Hour 1: Introduction to Developmental Origins of Health and Diseases (DOHaD)**

1.1. Overview of DOHaD

Definition and significance of DOHaD

The concept of early-life programming

1.2. Historical Perspective

Key milestones and discoveries in DOHaD research

Evolution of the field

**Hour 2: Fetal Development and Intrauterine Environment**

2.1. Embryonic and Fetal Development

Stages of fetal development and organogenesis

Vulnerable periods during development

2.2. Intrauterine Environment

Maternal nutrition and its impact on the fetus

Maternal stress, toxins, and other environmental factors

Role of placenta

**Hour 3: Epigenetics and DOHaD**

3.1. Epigenetics Basics

Overview of epigenetic mechanisms (DNA methylation, histone modifications)

How epigenetics influences gene expression

3.2. Epigenetic Programming

Discuss how early-life experiences can lead to epigenetic changes

Epigenetic marks and their role in DOHaD

---

B: Les étudiants peuvent lire des revues sur 'the early origin of diseases' ou 'maternal and paternal programming'.  
Ils peuvent également lire sur les modifications épigénétiques.

---

**GENETICS OF METABOLIC DISEASES**

Andrea Messina

C	Obl	English	2
S			

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N: Master

O: Students will be able to:

- Provide written and oral descriptions of the genetic bases of obesity and demonstrate its contribution to the alteration of energy balance.
- Categorize the genetic components of obesity and explain their interaction with the environment.
- Explain the approaches used to identify the genetic causes of obesity and illustrate their scientific rationale.

---

C: Introduction and learning objectives. Obesity and mechanisms controlling energy balance. Genetic bases of obesity and alteration of energy homeostasis. Study of genetic causes and role of the environment.

---

**CELLULAR METABOLISM, STEM CELLS**

Rosa Chiara Paolicelli

C	Obl	French	8
S			

N: Master

---

**CASE STUDY ON METABOLIC DISEASES**

Virginie Mansuy-Aubert

E	Obl	French	10
S			

N: Master

---

## EXERCISE AND METABOLISM

Francesca Amati

C	Obl	English	6
S			
S	Obl	English	2
S			

N: Master



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**SPORT, METABOLISM, HEALTH AND PERFORMANCE**

Julien Favre

C	Obl	English	6
S			

N: Master

---

## ENERGY METABOLISM AND RHEUMATIC DISEASES

Jeroen Geurts

C	Obl	English	6
S			

N: Master

---

**HUMAN-MICROBES INTERACTIONS**

Onya Opota

C	Obl	English	10
S			
S	Obl	English	2
S			

N: Master

---

## HUMAN MICROBIOTA IN METABOLIC HEALTH AND DISEASES

Claire Bertelli Lombardo

C	Obl	English	12
S			
S	Obl	English	2
S			

N: Master

---

**DIET, LIFESTYLE, MICROBIOTA AND BRAIN DISEASE**

Virginie Mansuy-Aubert

C	Obl	English	6
S			
S	Obl	English	2
S			

N: Master

---

## PREVENTIVE AND THERAPEUTIC INTERVENTIONS ON MICROBIOTA

Katerina Tatiana Galperine

C	Obl	English	4
S			

N: Master

---

**HUMAN MICROBIOME AND INTERACTIONS WITH CHEMOTHERAPIES**

Krisztian Homicsko

C	Obl	English	2
S			

N: Master

---

## CASE STUDY ON THE MICROBIOME AND HUMAN HEALTH

Onya Opota

E	Obl	English	10
S			

N: Master



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**LABORATORY APPROACHES IN CLINICAL CHEMISTRY (METABOLOMICS,  
PROTEOMICS)**

Olivier Braissant

C	Obl	English	8
S			
TP	Obl	English	4
S			

N: Master

---

## LABORATORY APPROACHES IN MEDICAL MICROBIOLOGY

Onya Opota

C	Obl	English	8
S			
TP	Obl	English	4
S			

N: Master

---

**MONITORING PHYSIOLOGICAL FUNCTIONS**

Jardena Puder

TP	Obl	English	8
S			

N: Master

---

**THERAPIES OF GUT-BRAIN COMMUNICATION (FROM BY-PASS SURGERY TO  
ENDOPHARMACOLOGY)**

Lucie Favre

C	Obl	English	2
S			

N: Master

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**FUNDAMENTAL PRINCIPLES: PHARMACOKINETICS / PHARMACOGENOMICS**

Dmitri Firsov

C	Obl	English	10
S			
S	Obl	English	2
S			

---

N: Master

---

P: good knowledge of physiology, human anatomy and genetics

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O: to provide a description of factors that influence drug action in human population

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C: Pharmacokinetics: principal models and parameters  
Drug Absorption, Distribution, Metabolism and Excretion (ADME)  
Chronopharmacology: effect of circadian time on drug action  
Pharmacogenetics: candidate genes for variable drug response

---

## PRINCIPLES OF CHEMOTHERAPY: INFECTIOUS DISEASES

Olivier Staub

C	Obl	English	6
S			
S	Obl	English	2
S			

N: Master

---

**VISIT OF NESTLÉ SA, VERS-CHEZ-LES-BLANC**

Onya Opota

EXC	Obl	English	4
S			

N: Master

---

**VISIT FIND GENEVA OR WHO GENEVA**

Onya Opota

EXC	Obl	English	4
S			

N: Master



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**RECENT ADVANCES IN METABOLIC HEALTH/CAREER DEVELOPMENT**

Virginie Mansuy-Aubert, Onya Opota

S	Obl	English	12
S			

N: Master

---

**WRITE AND DEFEND GRANT PROPOSAL, PREPARE JOURNAL CLUB**

Marie-Christine Broillet, Micah Murray, Onya Opota, Tatiana Petrova

E	Obl	English	2
S			
E	Obl	English	2
S			
E	Obl	English	2
S			
E	Obl	English	18
S			

N: Master

**BIostatISTICS**

Frédéric Schütz

C	Obl	English	4
A			
TP	Obl	English	13
S			
C	Obl	English	2
S			

N: Master

P: Basics of biostatistics and bioinformatics

O: Methodology in biostatistics and bioinformatics

C: At the end of this module, the students will have used and developed the needed biostatistics or bioinformatics tools to analyze the data obtained during their Master thesis work.

B: /

I: /

---

**TRAINING IN ANIMAL EXPERIMENTATION (RESAL MODULE 1)**

Marie-Christine Broillet

C	Opt	English	20
A S	2		
TP	Opt	English	20
A S			

N: Master

- 
- O: Learning outcomes To acquire the practical and theoretical skills with laboratory animals as requested by legislation (Swiss ordinance N° 455.171.2, October 1998) to get the accreditation to perform animal experimentation delivered by the Federal Veterinary Office. This course (20h theory + 20h practical) will be recognized by the Swiss federal veterinary office to undertake animal experiments.
- 
- C: What is animal experimentation? Any interventions in which live animals are used to : - Test a scientific hypothesis in various fields (behavior, neurology, metabolism, immunology, cardiovascular...) - Verify the effects of a particular procedure on an animal - Test a substance (pharmacology, toxicology...) - Collect or examine cells, organs or body fluids - Education, training and continuing education Choosing an appropriate animal model - Before an animal model is chosen, investigators must consider alternatives to the use of live animals (3Rs) - Investigators must consider all factors when selecting the best model for research Who is concerned by this module? This training module is relevant to all students working with animals during their master project. Conditions for registration to this module: - The host laboratory must have permission to work with animals - Students must be announced to the cantonal veterinary office

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**CLINICAL RESEARCH MODULE**

Grégoire Emmanuel Würzner

C	Opt	English	20
S			
TP	Opt	English	20
S			

N: Master

- 
- O: To get acquainted with basic methods in clinical research
- o study design
  - o statistical analysis
  - o ethical considerations
  - o legal aspects
- To know the basic skills for the realization of research protocols on human beings
- o Techniques of asepsis, iv drips
  - o how to react in case of acute adverse effects
  - o basic life support
- To understand the relationships between clinical practice and research
- o cancer
  - o metabolic disorders
  - o neuro-psychiatric disorders

**Neuroscience**  
**Neurosciences**

**Responsibles: Murray M. and Knobloch M.**

At the end of the course the students will be able to:

- Mobilise theoretical knowledge about the physiological, pathological and medical aspects of selected domains of neuroscience such as nervous system development, sensory functions, neuron-gland interactions, synaptic functions, neuronal death and tissue repair, psychiatric neuroscience.
- Use advanced research techniques to study the physiological function of the nervous system or neuropsychiatric diseases in animal models or in humans.
- Systematically analyse fundamental and clinical problems and experimental approaches in neuroscience.

MODULE 3

Courses / Enseignements	Hours per semester				Teaching Staff	ECTS Credits
	C	E	S	PW		
Introduction to Clinical Medicine <i>Introduction à la médecine clinique</i>	20	-	-	-	Wuerzner G., Gonzalez Rodriguez E.	15
Brain Development <i>Développement du cerveau</i>	16	-	2	2	Bagni C., Cardinaux J.-R., Achsel T., Puyal J., Restivo L.	
Introduction to Psychiatric Neuroscience <i>Introduction aux neurosciences psychiatriques</i>	20	-	2	-	Cardinaux J.-R., Dwir D., Klauser P., Kolly S., Magara F., Preissmann D., Steullet P., Marquet P.	
Modulation of Synaptic Transmission <i>Modulation de la transmission synaptique</i>	14	-	2	-	Nikoletopoulou V., Fasshauer D., Lüthi A., Stoop R., Croizier S.	
Neuron-glia Biology <i>Biologie neurones-glie</i>	18	-	2	-	Bezzi P., Nikoletopoulou V., Finsterwald C., Lengacher S., Paolicelli R., Tenenbaum L., Richetin K., Volterra A.	
Neuronal Death and Repair in the Central Nervous System <i>Mort neuronale et réparation dans le système nerveux central</i>	16	-	2	-	Toni N., Brunet J.-F., Courtine G., Déglon N., Hirt L., Puyal J., Truttmann A.	
Sensory Functions <i>Fonctions sensorielles</i>	24	-	2	-	Murray M., Broillet M.-C., Chung P.C.S., Mameli M., Neukomm L., Collignon O., Pascucci D., Crottaz-Herbette S.	
Write and Defend Grant Proposal, prepare Journal Club <i>Rédaction et défense d'une demande de subside, préparation d'un journal Club</i>	-	18	-	-	Murray M.	
Biostatistics <i>Biostatistiques</i>	2	-	-	13	Schütz F.	
<b>Optional / Optionnel</b>						
Training in Animal Experimentation (RESAL Module 1)* <i>Expérimentation animale (RESAL module 1)</i>	20	-	-	20	Broillet M.-C., Cadilhac C.	
Clinical Research Module <i>Module de recherche clinique</i>					Wuerzner G.	
	150	18	12	35		215

\* Only students who choose a master project with animal experimentation are allowed to select this course

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## INTRODUCTION TO CLINICAL MEDICINE

Grégoire Emmanuel Würzner

C	Obl	English	20
S			

N: Master

P: Bachelor of Science

O: The main goals of this course is to have the students able to:  
1) describe the basic principles underlying human clinical medicine;  
2) explain the concepts and language used in clinical medicine and research

C: -

B: /

I: -

---

**BRAIN DEVELOPMENT**

Claudia Bagni

C	Obl	English	16
S			
S	Obl	English	2
S			
TP	Obl	English	2
S			

N: Master



---

**INTRODUCTION TO PSYCHIATRIC NEUROSCIENCE**

Jean-René Cardinaux

C	Obl	English	20
S			
S	Obl	English	2
S			

N: Master

B: Quelques références :

- Kandel, EJ et al (last edition) Principles of Neural Science. Elsevier
  - Charney DS & Nestler EJ (last edition) Neurobiology of Mental Illness, Oxford University Press
  - Jeannerod M, Le Cerveau volontaire, Odile Jacob, 2009
  - Purves, D (last edition) Neurosciences. De Boeck
- une bibliographie spécifique sera distribuée pour chaque volet du cours.

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## MODULATION OF SYNAPTIC TRANSMISSION

Vassiliki Nikolettou

C	Obl	English	14
S			
S	Obl	English	2
S			

N: Master

---

**NEURON-GLIA BIOLOGY**

Paola Bezzi, Vassiliki Nikolettou

C	Obl	English	18
S			
S	Obl	English	2
S			

N: Master

---

**NEURONAL DEATH AND REPAIR IN THE CENTRAL NERVOUS SYSTEM**

Nicolas Toni

C	Obl	English	16
S			
S	Obl	English	2
S			

N: Master

P: Basic knowledge of neurobiology and of cell biology.

O: Understand the roles of neuronal death occurring in normal development and the factors which determine it.  
Understand the various cellular mechanisms of neuronal death, active in both normal and pathological situations.  
Understand the roles of neuronal death in various pathological situations including cerebral ischemia, Parkinson's disease and motoneuron diseases.

C: Cell death: introduction, history and typology  
Pathways of apoptosis  
Trophic influences and neuronal death  
Neuronal death in development and its regulation  
Excitotoxicity, its signalling pathways and neuroprotection against it  
Cerebral ischemia and its treatment  
Alzheimer's disease  
Parkinson's disease

B: Les six enseignants impliqués dans ce module proposeront des matières de lecture.

**SENSORY FUNCTIONS**

Micah Murray

C	Obl	English	24
S			
S	Obl	English	2
S			

N: Master

---

**WRITE AND DEFEND GRANT PROPOSAL, PREPARE JOURNAL CLUB**

Marie-Christine Broillet, Micah Murray, Onya Opota, Tatiana Petrova

E	Obl	English	2
S			
E	Obl	English	2
S			
E	Obl	English	2
S			
E	Obl	English	18
S			

N: Master

**BIostatISTICS**

Frédéric Schütz

C	Obl	English	4
A			
TP	Obl	English	13
S			
C	Obl	English	2
S			

N: Master

P: Basics of biostatistics and bioinformatics

O: Methodology in biostatistics and bioinformatics

C: At the end of this module, the students will have used and developed the needed biostatistics or bioinformatics tools to analyze the data obtained during their Master thesis work.

B: /

I: /

---

**TRAINING IN ANIMAL EXPERIMENTATION (RESAL MODULE 1)**

Marie-Christine Broillet

C	Opt	English	20
A S	2		
TP	Opt	English	20
A S			

N: Master

- 
- O: Learning outcomes To acquire the practical and theoretical skills with laboratory animals as requested by legislation (Swiss ordinance N° 455.171.2, October 1998) to get the accreditation to perform animal experimentation delivered by the Federal Veterinary Office. This course (20h theory + 20h practical) will be recognized by the Swiss federal veterinary office to undertake animal experiments.
- 
- C: What is animal experimentation? Any interventions in which live animals are used to : - Test a scientific hypothesis in various fields (behavior, neurology, metabolism, immunology, cardiovascular...) - Verify the effects of a particular procedure on an animal - Test a substance (pharmacology, toxicology...) - Collect or examine cells, organs or body fluids - Education, training and continuing education Choosing an appropriate animal model - Before an animal model is chosen, investigators must consider alternatives to the use of live animals (3Rs) - Investigators must consider all factors when selecting the best model for research Who is concerned by this module? This training module is relevant to all students working with animals during their master project. Conditions for registration to this module: - The host laboratory must have permission to work with animals - Students must be announced to the cantonal veterinary office



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**CLINICAL RESEARCH MODULE**

Grégoire Emmanuel Würzner

C	Opt	English	20
S			
TP	Opt	English	20
S			

N: Master

- 
- O: To get acquainted with basic methods in clinical research
- o study design
  - o statistical analysis
  - o ethical considerations
  - o legal aspects
- To know the basic skills for the realization of research protocols on human beings
- o Techniques of asepsis, iv drips
  - o how to react in case of acute adverse effects
  - o basic life support
- To understand the relationships between clinical practice and research
- o cancer
  - o metabolic disorders
  - o neuro-psychiatric disorders

**Pharmacology and Toxicology**
**Responsible: Broillet M.-C.**
**Pharmacologie et toxicologie**

At the end of the course the students will be able to:

- Mobilise knowledge from a physiological point of view on the functioning of five major classes of drugs (anti-infection, anti-cancer, neurological, cardiovascular and hormonal)
- Acquire a current vision of the issues of pharmacogenetics, personalised medicine and pharmacovigilance.
- Critically analyse and present the practical steps of drug development, pharmaceutical industry and the drug-market policy.
- Interact with scientists and professionals from different backgrounds to learn and practice the various steps involved in the identification of a toxic substance, from the discovery of its mechanism of action to the press release and risk management.

MODULE 3

Courses / Enseignements	Hours per semester				Teaching Staff	ECTS Credits	
	C	E	S	PW			
Introduction to Clinical Medicine <i>Introduction à la médecine clinique</i>	20	-	-	-	Wuerzner G., Gonzalez Rodriguez E.	15	
Case Study in Toxicology <i>Etude de cas en toxicologie</i>	-	12	-	-	Broillet M.-C.		
Development of Drugs : Practical Aspects <i>Développement de médicaments : aspects pratiques</i>	4	-	-	-	Dumont J.-M.		
Development of Therapeutics <i>Développement d'agents thérapeutiques</i>	10	-	-	-	Broillet M.-C.		
Drug Design <i>Conception de médicaments</i>	4	-	-	-	Scapozza L.		
Fundamental Principles : Pharmacokinetics / Pharmacogenomics <i>Principes fondamentaux de pharmacocinétique et pharmacogénomique</i>	10	-	2	-	Firsov D.		
Optimization of Drug Treatment <i>Optimisation des traitements médicamenteux</i>	6	-	-	-	Choong E.		
Pharmaceuticals as Doping Drugs <i>Les médicaments comme produits dopants</i>	4	-	-	-	Leuenberger N.		
Principles of Chemotherapy : Infectious Diseases <i>Principes de la chimiothérapie : les maladies infectieuses</i>	6	-	2	-	Staub O.		
Principles of Chemotherapy : Cancer <i>Principes de la chimiothérapie : le cancer</i>	6	-	2	-	Ocampo Méndes A.		
Radiation Protection and Radiological Risk: Quantitative and Public Health Aspects <i>Protection contre les radiations, risque radiologique : aspects quantitatifs et de santé publique</i>	2	-	-	-	Staedler D.		
Regulation and Regulatory Agencies <i>Réglementations et les agences de réglementations</i>	2	-	-	-	Girardin F.		
Seminars on Drug Discovery & Development <i>Séminaires sur la découverte et le développement de médicaments</i>	-	-	12	-	Kellenberger S., Staub O.		
System Pharmacology : Cardiovascular Pharmacology <i>Pharmacologie des systèmes : pharmacologie cardiovasculaire</i>	8	-	2	-	Kellenberger S., Diviani D.		
System Pharmacology : Neuropharmacology <i>Pharmacologie des systèmes : neuropharmacologie</i>	18	-	4	-	Kellenberger S., Eap C., Hummler E., Steullet P.		
System Pharmacology : Endocrine Pharmacology <i>Pharmacologie des systèmes : pharmacologie endocrinienne</i>	8	-	2	-	Hummler E.		
Toxicology <i>Toxicologie</i>	16	-	4	-	Broillet M.-C., Hopf N., Chèvre N.		
Toxicology : e-Learning <i>Toxicologie : formation en ligne</i>	-	8	-	-	Broillet M.-C.		
Visit of an Industrial Pharmaceutical Research Center <i>Visite d'un centre de recherche d'une industrie pharmaceutique</i>	-	-	-	8	Staub O., Broillet M.-C.		
Visit of a Waste or Water Recycling Plant <i>Visite d'une station d'épuration des eaux ou d'une usine de recyclage</i>	-	-	-	5	Broillet M.-C.		
Analytical Techniques in Toxicology and Ecotoxicology (optional) <i>Techniques d'analyses en toxicologie et écotoxicologie (cours à option)</i>	10	-	-	-	Staedler D.		
Synthetic Drugs : an Emerging Toxicology and Social Health Problem (optional) <i>Drogues de synthèse : un problème d'actualité en matière de toxicologie et de santé publique (cours à option)</i>	10	-	-	-	Gilardi F.		
Pharmaceutical Drugs : Pregnancy and Breastfeeding (optional) <i>Médicaments : grossesse et allaitement (cours à option)</i>	10	-	-	-	Winterfeld U.		
Write and Defend Grant Proposal, prepare Journal Club <i>Rédaction et défense d'une demande de subside, préparation d'un journal Club</i>	-	2	-	-	Broillet M.-C.		
Biostatistics <i>Biostatistiques</i>	2	-	-	13	Schütz F.		
<b>Optional / Optionnel</b>							
Training in Animal Experimentation (RESAL Module 1) * <i>Expérimentation animale (RESAL module 1)</i>	20	-	-	20	Broillet M.-C., Cadilhac C.		
Clinical Research Module <i>Module de recherche clinique</i>					Wuerzner G.		
	162	22	30	46		260	

**Total per study path / Total par filière**
**15**

\* Only students who choose a master project with animal experimentation are allowed to select this course

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## INTRODUCTION TO CLINICAL MEDICINE

Grégoire Emmanuel Würzner

C	Obl	English	20
S			

N: Master

P: Bachelor of Science

O: The main goals of this course is to have the students able to:  
1) describe the basic principles underlying human clinical medicine;  
2) explain the concepts and language used in clinical medicine and research

C: -

B: /

I: -

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## CASE STUDY IN TOXICOLOGY

Marie-Christine Broillet

E	Obl	English	12
S			

N: Master

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**DEVELOPMENT OF DRUGS: PRACTICAL ASPECTS**

Jean-Maurice Dumont

C	Obl	English	4
S			

N: Master

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**DEVELOPMENT OF THERAPEUTICS**

Marie-Christine Broillet

C	Obl	English	10
S			

N: Master

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**DRUG DESIGN**

Leonardo Scapozza

C	Obl	English	4
S			

N: Master

P: - Basics of Biochemistry and Chemistry

O: - To give an introduction and a general overview on Drug Design.

C: - Definitions and basic principles of Drug Design (what is a drug?; Which are the protein-ligand interactions; What is drug design?  
 - Which are the fundamental questions in drug design?  
 - Ligand-based drug design: principles and examples  
 - Target-based drug design: principles and examples  
 - The whole process will be exemplified by means of case study namely the development of Glivec, a molecularly targeted anti-cancer drug.

B: - Höltje, Hans-Dieter; Sippl, Wolfgang; Rognan, Didier; Folkers, Gerd "Molecular Modeling: Basic Principles and Applications" 3., revised and expanded Edition - January 2008, Wiley-VCH, Weinheim  
 - Capdeville R., Buchdunger E., Zimmermann J. and Matter A. GLIVEC (STI571,IMATINIB), A RATIONALLY DEVELOPED, TARGETED ANTICANCER DRUG Nature Review Drug Discovery (2002) 1:| 493

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**FUNDAMENTAL PRINCIPLES: PHARMACOKINETICS / PHARMACOGENOMICS**

Dmitri Firsov

C	Obl	English	10
S			
S	Obl	English	2
S			

N: Master

P: good knowledge of physiology, human anatomy and genetics

O: to provide a description of factors that influence drug action in human population

C: Pharmacokinetics: principal models and parameters  
 Drug Absorbtion, Distribution, Metabolism and Excretion (ADME)  
 Chronopharmacology: effect of circadian time on drug action  
 Pharmacogenetics: candidate genes for variable drug response



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**OPTIMIZATION OF DRUG TREATMENT**

Eva Choong

C	Obl	English	6
S			

N: Master

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**PHARMACEUTICALS AS DOPING DRUGS**

Nicolas Leuenberger

C	Obl	English	4
S			

N: Master

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## PRINCIPLES OF CHEMOTHERAPY: INFECTIOUS DISEASES

Olivier Staub

C	Obl	English	6
S			
S	Obl	English	2
S			

N: Master

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**PRINCIPLES OF CHEMOTHERAPY: CANCER**

Alejandro Ocampo Méndez

C	Obl	English	6
S			
S	Obl	English	2
S			

N: Master

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## RADIATION PROTECTION AND RADIOLOGICAL RISK: QUANTITATIVE AND PUBLIC HEALTH ASPECTS

Davide Städler

C	Obl	English	2
S			

N: Master

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**REGULATION AND REGULATORY AGENCIES**

François Girardin

C	Obl	English	2
S			

N: Master

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## SEMINARS ON DRUG DISCOVERY & DEVELOPMENT

Stephan Kellenberger

S	Obl	English	12
S			

N: Master

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**SYSTEM PHARMACOLOGY: CARDIOVASCULAR PHARMACOLOGY**

Stephan Kellenberger

C	Obl	English	8
S			
S	Obl	English	2
S			

N: Master

P: B. Sc.

O: Introduction to pharmacology of the cardiovascular system

C: - Pharmacology of blood hemostasis and thrombosis  
 - Hyperlipidemia and lipid-lowering agents  
 - Pharmacology of heart failure

B: - Principles of Pharmacology, by D.E. Golan et al., 4th edition, Lippincott-Williams & Wilkins, 2016  
 - Pharmacology, by Rang, Dale et al., 8th edition, Elsevier Churchill Livingstone, 2016

I: -



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**SYSTEM PHARMACOLOGY: NEUROPHARMACOLOGY**

Stephan Kellenberger

C	Obl	English	18
S			
S	Obl	English	4
S			

N: Master

P: Bachelor in Biology

O: Introduction to Neuropharmacology

C: - Pharmacology of the central and peripheral nervous system  
 - Pharmacology of ion channels: Introduction, principles; pain pharmacology; targeting GABAA receptors; antiepileptic drugs; local anesthetic drugs.  
 - Pharmacogenetics in Psychiatry

B: - Principles of Pharmacology, by D.E. Golan et al., 4th edition, Lippincott-Williams & Wilkins, 2016  
 - Rang & Dale's Pharmacology, by Ritter, Flower et al., 9th edition, Elsevier Churchill Livingstone, 2020

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**SYSTEM PHARMACOLOGY: ENDOCRINE PHARMACOLOGY**

Edith Hummler Beermann

C	Obl	English	8
S			
S	Obl	English	2
S			

N: Master

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**TOXICOLOGY**

Marie-Christine Broillet

C	Obl	English	16
S			
S	Obl	English	4
S			

N: Master

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**TOXICOLOGY: E-LEARNING**

Marie-Christine Broillet

E	Obl	English	8
S			

N: Master

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**VISIT OF AN INDUSTRIAL PHARMACEUTICAL RESEARCH CENTER**

Marie-Christine Broillet, Olivier Staub

EXC	Obl	English	8
S			

N: Master

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## VISIT OF A WASTE OR WATER RECYCLING PLANT

Marie-Christine Broillet

EXC	Obl	English	5
S			

N: Master

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**ANALYTICAL TECHNIQUES IN TOXICOLOGY AND ECOTOXICOLOGY**

Davide Städler

C	Opt	English	10
S			

N: Master

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**SYNTHETIC DRUGS : AN EMERGING TOXICOLOGY AND SOCIAL HEALTH PROBLEM**

Federica Gilardi

C	Opt	English	10
S			

N: Master

- 
- C: In this optional course, we propose to the students an in-depth reflection about the emerging issue in toxicology of synthetic drugs, whose consumption increases and alerts in the European countries. The course will offer an integrated vision of key concepts ranging from forensic toxicology (the place of toxicology in the forensic field, the problems in relation to the detection of these new substances, the presentation and interpretation of real cases,...) to social and medical issues (circulation of these substances in Switzerland and in Europe, DarkMarket, seizure by the police, problem of addiction, how to set up an effective warning systems,...). In view of their continuous and rapid evolution, and their increasing diffusion in our country, synthetic drugs represent a very topical "model" and are ideal to introduce students in these reflections. In order to give this global vision, toxicologists and experts in the other fields involved (e.g. a doctor, an addiction expert, an expert in criminal sciences, etc.) will be involved in the teaching.



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**PHARMACEUTICAL DRUGS : PREGNANCY AND BREASTFEEDING**

Ursula Winterfeld

C	Opt	English	10
S			

N: Master

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**WRITE AND DEFEND GRANT PROPOSAL, PREPARE JOURNAL CLUB**

Marie-Christine Broillet, Micah Murray, Onya Opota, Tatiana Petrova

E	Obl	English	2
S			
E	Obl	English	2
S			
E	Obl	English	2
S			
E	Obl	English	18
S			

N: Master

**BIostatISTICS**

Frédéric Schütz

C	Obl	English	4
A			
TP	Obl	English	13
S			
C	Obl	English	2
S			

N: Master

P: Basics of biostatistics and bioinformatics

O: Methodology in biostatistics and bioinformatics

C: At the end of this module, the students will have used and developed the needed biostatistics or bioinformatics tools to analyze the data obtained during their Master thesis work.

B: /

I: /

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**TRAINING IN ANIMAL EXPERIMENTATION (RESAL MODULE 1)**

Marie-Christine Broillet

C	Opt	English	20
A S	2		
TP	Opt	English	20
A S			

N: Master

- 
- O: Learning outcomes To acquire the practical and theoretical skills with laboratory animals as requested by legislation (Swiss ordinance N° 455.171.2, October 1998) to get the accreditation to perform animal experimentation delivered by the Federal Veterinary Office. This course (20h theory + 20h practical) will be recognized by the Swiss federal veterinary office to undertake animal experiments.
- 
- C: What is animal experimentation? Any interventions in which live animals are used to : - Test a scientific hypothesis in various fields (behavior, neurology, metabolism, immunology, cardiovascular...) - Verify the effects of a particular procedure on an animal - Test a substance (pharmacology, toxicology...) - Collect or examine cells, organs or body fluids - Education, training and continuing education Choosing an appropriate animal model - Before an animal model is chosen, investigators must consider alternatives to the use of live animals (3Rs) - Investigators must consider all factors when selecting the best model for research Who is concerned by this module? This training module is relevant to all students working with animals during their master project. Conditions for registration to this module: - The host laboratory must have permission to work with animals - Students must be announced to the cantonal veterinary office

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**CLINICAL RESEARCH MODULE**

Grégoire Emmanuel Würzner

C	Opt	English	20
S			
TP	Opt	English	20
S			

N: Master

- 
- O: To get acquainted with basic methods in clinical research
- o study design
  - o statistical analysis
  - o ethical considerations
  - o legal aspects
- To know the basic skills for the realization of research protocols on human beings
- o Techniques of asepsis, iv drips
  - o how to react in case of acute adverse effects
  - o basic life support
- To understand the relationships between clinical practice and research
- o cancer
  - o metabolic disorders
  - o neuro-psychiatric disorders

## Spring semester (semester 2) and Autumn Semester (semester 3)

MODULE 4	<b>Personal Research Project / Projet de recherche personnel</b>		<b>ECTS Credits</b>
	Master Research Project / <i>Travail de Master</i>	<b>Thesis Director</b>	<b>45</b>

The pandemic has shown us that circumstances beyond our control may require us to make the following adjustments / adaptations to study plans during the semester:

- possibility to switch from one mode of teaching to another (face-to-face <-> distance, synchronous <-> asynchronous, switch to co-modal teaching where it was not initially planned).
- change / modification of evaluation modalities, without inducing derogations from the Study Regulations (oral <-> written, exam <-> validation, individual work <-> group work, practical work <-> theoretical work, face-to-face evaluation <-> online evaluation, etc.)
- alternative or time-shifted modalities for teachings, internships, practical work, fieldworks and camps that could not take place or teachings that could no longer take place in the form initially planned.

**Students are invited to consult this document regularly (Study Plan & Evaluation Procedure)**

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**PERSONAL RESEARCH WORK**

TP	Obl	French	520
S			

N: Master

