

Course directory 2018.2019

school of biology (FBM-BIO)
master

* your selection

> Biology > Master of Science (MSc) in Molecular Life Sciences

SUMMARY

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NOTICE

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/>**

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LEGEND

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 :

- 16 ECTS : Module 1 (Compulsory courses (7 ECTS) + Optional courses (9 ECTS))
- 14 ECTS : Module 2 (First Step Project)
- 15 ECTS : Module 3 (Compulsory courses (6 ECTS) + Optional courses (9 ECTS))
- 45 ECTS : Personal research project (Master Thesis)

Abbreviations

C = Course
E/S =
Exercise/Seminar
PW = Practical Work

Training objectives are available in its programme regulations.

Specific training objectives: At the end of the course the students will be able to:

Specialisation in Integrative Biology

- Mobilise multidisciplinary knowledge to design experiments that can involve the various levels of structural and functional organisation of the living.
- Interpret data resulting from multiple phenomena: from the cell to the organism as a whole, in its normal and pathological states.

Specialisation in Bioinformatics

- Design experiments to analyse and understand genetic and genomic data.
- Mobilise in-depth knowledge of statistics and bioinformatics applied to biology.
- Use computer programming techniques.

Specialisation in Microbiology

- Mobilise in-depth knowledge in microbiology, genetics and genomics covering aspects of environmental microbiology, microbial ecology, biotechnology, cell microbiology, virology, microbial pathogenesis, bacteriology, fungal biology, yeast models, epidemiology or synthetic biology.

Condition to obtain the specialisation / Condition pour obtenir une spécialisation

Specialisation Integrative Biology :

Obtain at least 18 ECTS credits in any field of study in Modules 1 and 3.
Free choice for the First Step Project (Module 2) and the Master Thesis (Module 4).

Specialisation Bioinformatics :

Obtain 9 ECTS credits in the field of Bioinformatics (marked in dark blue) in Module 1 and 9 ECTS credits in any field of study in Module 3
Carry out the First Step Project (Module 2) and the Master Thesis (Module 4) in the field of Bioinformatics.
Produce a significant computer program, in the context of any Module.

Specialisation Microbiology :

Obtain 12 ECTS credits in the field of Microbiology (marked in yellow) and 6 ECTS credits in any field of study in Modules 1 and 3.
Free choice for the First Step Project (Module 2).
Carry out the Master Thesis (Module 4) in the field of Microbiology.

Autumn Semester (semester 1)

	Courses / Enseignements	Hours per semester			Teaching Staff	ECTS Credits	Limited nb of students
		C	E/S	PW			
General and common activities - Compulsory / Activités générales et communes - Obligatoires							
	Retreat and BIG Seminars <i>Retraite et séminaires BIG</i>	-	-	-	Benton R., ...		
	Sequence a Genome I <i>Séquençage d'un génome I</i>	14	30	-	van der Meer J., Engel P., Rivolta C., tutors	3	
	Write a Review <i>Rédaction d'une revue</i>	15	-	42	Benton R., Sohmman M., tutors	4	
	Critical Readings of Scientific Literature <i>Lectures critiques de la littérature scientifique</i>	-	-	56			
	Subtotal	29	30	98		7	
Optional (at least 9 credits) Optionnel (minimum 9 crédits)							
MODULE 1	Biotechnology <i>Biotechnologie</i>	14	-	-	Poirier Y., Memrod N.	1,5	
	Development of the Nervous System <i>Développement du système nerveux</i>	14	-	-	Braissant O.	1,5	
	Human Molecular Genetics <i>Génétique moléculaire humaine</i>	14	-	-	Rivolta C.	1,5	
	Molecular Mechanisms of Evolution <i>Mécanismes moléculaires de l'évolution</i>	14	-	-	Benton R., Geldner N.	1,5	
	Plant Functional Genetics <i>Génétique fonctionnelle des plantes</i>	14	-	-	Poirier Y.	1,5	
	Scientific Research in all its Forms (for Biology) (Sciences2 - in French only) <i>La recherche dans tous ses états (pour biologie) (Sciences2)</i>	14	-	-	Preissmann D.	1,5	
	LTK1 Module : Training in Animal Experimentation * <i>Module LTK1 : expérimentation animale</i>	20	-	20	Broillet M.-C.	1,5	
	Introduction to R (optional support) <i>Introduction à R (mise à niveau optionnelle)</i>	-	-	-	Schütz F.	-	
	Advanced Data Analysis in Biology I-II (compulsory for Bioinformatics specialisation) <i>Analyse de données en biologie I-II : niveau avancé</i>	12	-	12	Robinson M. Malaspina A.S.	4,5	
	Case Studies in Bioinformatics (compulsory for Bioinformatics specialisation) <i>Etudes de cas en bioinformatique</i>	4	32	-	Bergmann S., others	2,5	
	Programming for Bioinformatics (compulsory for Bioinformatics specialisation) <i>Programmation pour bioinformatique</i>	7	14	-	Salamin N.	2	
	Advanced Microbial Genetics <i>Génétique avancée des microbes</i>	14	-	-	Collier J., Pelet S.	1,5	
	Bacterial Genomes and Genome Evolution <i>Génomés bactériens et évolution du génome</i>	14	-	-	van der Meer J.	1,5	
	Fungal Virulence and Pathogenicity <i>Pathogénicité et virulence fongique</i>	14	-	-	Sanglard D., Lamoth F., Hauser P.	1,5	
	Immunology and Infectious Diseases <i>Immunologie et maladies infectieuses</i>	14	-	-	Roger T., Perreau M., Di Domizio J.	1,5	
	Plant Interactions with Microbes and Insects <i>Interactions des plantes avec les microbes et les insectes</i>	14	-	-	Keel C., Reymond P.	1,5	
	Virus-Host Interactions <i>Interactions virus-hôtes</i>	14	-	-	Kunz S., Gouttenoire J.	1,5	
Total						16	
MODULE 2	Practical Project / Travail pratique						
	First Step Project <i>Travail d'initiation à la recherche</i>	-	-	250	Benton R.	14	

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

BIOLOGICAL SECURITY

Patrick Michaux

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.

RETREAT AND BIG SEMINARS

Richard Benton, Sophie Martin

CP	Obl	English	18
A			
S	Obl	English	3
A			
S		English	3
S			

N: Master

-
- O: Research seminars are a very important mode of communication/information sharing in the scientific community. The goal is to get students exposed to this important part of life of a scientist. The goal of the MLS master retreat is to inform students about courses, labs in which they can perform their experiments and other practical aspects related to the program. Each year we also invite a speaker from the non-academic world (e.g. in the past we had speakers from Nestlé, Novartis,...). We also start the course "write a review" during the retreat.
-
- C: BIG seminars: seminar series given by world-class scientists.
MLS retreat: 1 and a half days in the mountains for conferences, courses and discussions.

SEQUENCE A GENOME (PART I)

Jan Roelof van der Meer

C	Obl	English	14
A	3.00		
E	Obl	English	30
A			

N: Master

O: The goals of this class are to understand and practice the road map of sequencing, assembly and annotating a (bacterial) genome.

C: The class is a combination of both practical aspects, theory, bioinformatics and presentation of genome analysis. We will work in small student groups.
 The class starts with a short introduction on the biology of the microorganisms to be sequenced, introductions to high-throughput sequence technology and assembly.
 After that a number of sessions in bioinformatics follow, first to learn to communicate in Unix, then to run assemblies on the sequence data sets produced by LGF.
 We will teach and practice annotation and subsystems analysis.
 In the second (8th) semester, the class is followed with another practical part, annotation of the major important functions in the genome and presentation of results.

I: <http://www.unil.ch/sequenceagenome/>

WRITE A REVIEW

Richard Benton

C	Obl	English	15
A	4.00		
TP	Obl	English	42
A			

N: Master

O: Establish the current state of the art in a chosen research field.
Formulate the current knowledge in the form of a review article.
Learn basic aspects of scientific writing.
Learn how to work as a team.

C: Students form groups of 2-3 and work under the guidance of an expert of the field (the tutor) to write a review article. Students have to follow precise guidelines regarding the review format.

BIOTECHNOLOGY

Yves Poirier

C	Opt	English	14
A	1.50		

N: Master

P: None

O: Get exposure to some themes in animal, plant and microbial biotechnologies as well as to aspects relating to patenting and the biotechnology business.

C: Some of the general topics discussed will be:
 What is biotechnology, and what is it good for?
 Do I wish to pursue a career in biotechnology?
 What is a patent and is it useful to submit one as a biologist?
 How do universities and scientists valorize their research findings?
 Some examples of themes in biotechnology will be:
 Biopolymers
 Pollutant remediation
 Biofactories
 Biosensors
 Cells as factories for medicine and industry
 Gene engineering
 Cell engineering
 Red biotechnology (e.g. for medical use)
 Agriculture and transgenesis

B: Introduction to Biotechnology, 2nd edition
 W.J. Thieman and M. A. Palladino
 Pearson International Edition

DEVELOPMENT OF THE NERVOUS SYSTEM

Olivier Braissant

C	Opt	English	14
A	1.50		

N: Master

HUMAN MOLECULAR GENETICS

Carlo Rivolta

C	Opt	English	14
A	1.50		

N: Master

P: - Knowledge of concepts of genetics and molecular biology

O: - Provide advanced knowledge on human molecular genetics
 - Learn how to exploit the massive amounts of data stored in in silico repositories for specific experimental purposes
 - Understand the bases of functional analyses of genes involved in inherited disease via the use of cellular and animal models

C: - The course will take monogenic hereditary conditions in humans as an example to describe the link between DNA variants and phenotypes
 - Classes will follow the threads "from observation to the DNA", "from the DNA to the gene" and "from gene to function" to illustrate classical scenarios of genetic investigations in humans
 - Several experimental strategies leading to the identification and the validation of DNA variants determining simple human phenotypes will be described
 - The program will rely heavily on "hands-on" approaches, allowing the student to perform practical exercises by using the information present in on-line databases. All classes will be held in a room equipped with individual computers connected to the internet

B: In principle, no textbook is needed. However, additional information related to the course can be found in:
 - Strachan & Read, Human Molecular Genetics, 3rd issue. Garland Science Ed. ISBN 0-8153-4184-9

MOLECULAR MECHANISMS OF EVOLUTION

Richard Benton

C	Opt	English	14
A	1.50		

N: Master

P: Students should have a solid background in molecular genetics and developmental/cell biology.

O: To explore our current understanding of the molecular mechanisms underlying phenotypic differences between species, using examples from animals and plants.

What are the specific genetic loci underlying divergence of traits?

- how do you identify these loci and prove they are responsible?

What are the functional changes in these loci?

- what kinds of changes are possible?

What is the origin of the functional variation in natural populations?

- how do the properties of populations influence evolution?

Are there common principles in how evolution works across species and across traits?

- if so, why? If not, why not?

C: Four primary research articles (available on MyUNIL) will be read in advance by the students and discussed in the detailed during the course.

PLANT FUNCTIONAL GENETICS

Yves Poirier

C	Opt	English	14
A	1.50		

N: Master

P: Good understanding of molecular biology

O: Get an overview of the spectrum of genetic and genomic tools used to isolate and decipher the role of genes involved in various aspects of plant biology

C: A Gene expression and transgenesis
Agrobacterium and biolistic
Transient vs. stable transformation
Inducible promoters
Viral vectors
Transformation of plastids
B Tools used in forward and reverse genetics
Mutagenesis and gene mapping
T-DNA and transposon tagging
Tilling
RNAi
Homologous recombination

SCIENTIFIC RESEARCH IN ALL ITS FORMS

Delphine Preissmann

C	Opt	2	French	14
A	1.50			

N: Master

P: * Bachelor degree
* Passive knowledge of French

O: - Integrate technics & scientific methods from different academic fields
- Synthesize information from different disciplines
- Transpose knowledge & results from one academic field to another

C: This course offers a multidisciplinary perspective on decision making. While addressing this topic, speakers from different faculties will shed light on their own way of practicing research.

I: <http://www.unil.ch/sciencesaucarre/page86487.html>

LTK1 MODULE : TRAINING IN ANIMAL EXPERIMENTATION

Marie-Christine Broillet

C	Opt	English	20
A	1.50		
TP	Opt	English	20
A			

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

ADVANCED DATA ANALYSIS IN BIOLOGY I

Anna Sapfo Malaspinas, Matthew Robinson

C	Obl/Opt	English	6
A	2.00		
TP	Obl/Opt	English	6
A			

N: Master

ADVANCED DATA ANALYSIS IN BIOLOGY II

Anna Sapfo Malaspinas, Matthew Robinson

C	Obl/Opt	English	6
A	2.50		
TP	Obl/Opt	English	6
A			

N: Master

CASE STUDIES IN BIOINFORMATICS

Sven Bergmann

C	Opt	English	4
A	2.50		
E	Opt	English	32
A			

N: Master

PROGRAMMING FOR BIOINFORMATICS

Nicolas Salamin

C	Obl/Opt	English	7
A	2.00		
E	Obl/Opt	English	14
A			

N: Master

P: There are not prerequisites for this course. The students are however expected to be familiar with computers. They should have a good understanding of the functioning of a computer (hardware components, operating system/file system). A basic knowledge of UNIX/LINUX would be good, although it is not essential. It will be necessary to install the following software on your own laptop: - python3 with the modules numpy and biopython - a text editor with syntax highlighting (simple one or IDE) - for windows user: a terminal environment (e.g. cygwin or MinGW)

C: We will cover the following aspects of programming in Python:

- 1) basic syntax
- 2) data types in Python

ADVANCED MICROBIAL GENETICS

Justine Collier Close, Serge Pelet

C	Opt	English	14
A	1.50		

N: Master

P: - Bachelor course "Génétique Moléculaire des Bactéries" - Bachelor course "Génétique des modèles eukaryotes"

O: - Appreciate the history and founding principles of microbial genetics.
- Think logically about experimental approaches.
- Illustrate how cleverly designed genetic experiments can provide answers to fundamental problems.
- Learn about new technology developments in genome-wide screens.
- Read the scientific literature critically.

C: - Lecture on the design of genetic screens using bacteria (JC)
- Lecture on eukaryotic genetics (SP)
- Assisted and critical reading of historical (example: discovery of the genetic code) and modern publications (examples: identification of all the essential genes of a bacteria, global analysis of protein localization in yeast, or synthesis of a complete eukaryotic chromosome)

BACTERIA GENOMES AND GENOME EVOLUTION

Jan Roelof van der Meer

C	Opt	English	14
A	1.50		

N: Master

O: Discover bacterial genome evolution at the example of life in the ocean, in particular that of the 'Prochlorococcus federation' of phototrophic bacteria.
Learn how to interpret genomic data and bacterial metabolism with the help of online databases.

C: The class is a mix of subjects that are introduced by the teacher, classical reading and self-working in class, notably by interrogating metabolic databases
1) Overview of utilities for interpretation of bacterial genomes (databases, online programs) - Self-learning and practise using specific examples
2) History of discoveries in bacterial genome evolution at the example of the Prochlorococcus federation of species in the oceans
3) Understanding bacterial genome evolution (literature reading)

B: Ad hoc research articles.

FUNGAL VIRULENCE AND PATHOGENICITY

Dominique Sanglard

C	Opt	English	14
A	1.50		

N: Master

O: The lecture will illustrate the importance of different human fungal pathogens and give their principal characteristics. General principles of fungal pathogenesis will be given with illustrative examples

C: A first part of the lecture will be given by D. Sanglard (8h)

- 1) Characteristics of principal fungal pathogens
Candida, Cryptococcus, Aspergillus, Pneumocystis, Dermatophytes
- 2) Fungal cell walls: interface with the environment
- 3) Host/pathogen interactions, virulence and dimorphism
- 4) Strategies of fungi used for host survival
- 5) Papers discussions

A second part will be given by P. Hauser:
Pneumocystis and dimorphic fungal pathogens

- 1) Presentation of the medical aspects, epidemiology, virulence factors, and pathogenicity of *Pneumocystis jirovecii* and dimorphic fungal pathogens (2 h).
- 2) Analysis of a research related article (1 h)
- 3) Demonstration in the laboratory of the methods used for identification and drug sensitivity measurement of clinically important fungi (1 h).

A third part will be given by M. Monod:

- 1) Aspergilli
- 2) Relevance of aspartic proteases in virulence (2h)
- 3) Demonstration in the laboratory of the methods used for identification of clinically important fungi (1 h)
- 4) Analysis of a research related article (1 h).

IMMUNOLOGY AND INFECTIOUS DISEASES

Thierry Roger

C	Opt	English	14
A	1.50		

N: Master

PLANT INTERACTIONS WITH MICROBES AND INSECTS

Christoph Keel

C	Opt	English	14
A	1.50		

N: Master

O: to provide students with knowledge on how intricate interactions between plants and beneficial or detrimental organisms are operating at the molecular level

C: Part C. Keel

"Molecular basis of host specificity in phytopathogenic bacteria"

The course illustrates the sophisticated molecular mechanisms by which plant pathogenic bacteria subvert plant defense mechanisms, focusing on bacterial injection devices (type III secretion systems) and virulence and avirulence proteins delivered directly into the plant host cell. The effector injection machinery of the plant pathogens is compared to that of human pathogenic bacteria to highlight the conservation of the virulence strategy.

Part P. Reymond

"Molecular study of plant-insects interactions"

The course describes the molecular mechanisms by which a plant detects the presence of an herbivore attack and responds to it by inducing hundreds of genes. It presents recent findings on the suppression of plant defense responses by insects. Finally, examples of insects that are useful for defending plants against other enemies are provided.

Exercise: Students designing research

In a final part of the course, students will design research approaches based on the topics presented during the three lecture parts and on questions provided by the lecturers. Student inputs will be discussed collectively, with the aim to highlight common and contrasting aspects occurring during interaction of microbes and insects with plants.

VIRUS-HOST INTERACTIONS

Stefan Kunz

C	Opt	English	14
A	1.50		

N: Master

P: Cours virologie générale 5th semester (20 hours) Kunz

O: To understand fundamental principles of virus-host interaction at an advanced level.
To understand basic principles of virus cell pathology.
To understand the molecular and cellular mechanisms of innate anti-viral immunity, including pathogen recognition, signaling, and the cellular interferon response.
To understand the basic principles of viral pathogenesis at the systemic level.

C: Teaching: Pascal Meylan, Jérôme Gouttenoire, Stefan Kunz
Innate defense against viruses (S. Kunz)
Receptors and signaling of innate anti-viral defense
The interferon response
Virus infection and anti-viral defense in the nervous system (S. Kunz)
Virus invasion of the central nervous system
Anti-viral defense in the nervous system
Basic principles of cellular and molecular viral pathogenesis (J. Gouttenoire)
Viral pathogenesis at the level of the organism (P. Meylan)
Lectures combined with discussion of key papers in the course

B: Sera donnée lors du cours

FIRST STEP PROJECT

Richard Benton, Marie-Christine Broillet, Jérôme Goudet, Antoine Guisan, Laurent Lehmann,
Marc Robinson-Rechavi

TP	Obl	English	224
A	15.00		
TP	Obl	English	282
A	15.00		
TP	Obl	English	250
A	14.00		
TP	Obl	English	224
A	15.00		
TP	Obl	English	224
A	15.00		
TP	Obl	English	224
A	15.00		

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)

	Courses / Enseignements	Hours per semester			Teaching Staff	ECTS Credits	Limited nb of students
		C	E/S	PW			
General and common activities - Compulsory / Activités générales et communes - Obligatoire							
	Sequence a Genome II <i>Séquençage d'un génome II</i>	14	28	-	van der Meer J., Engel P., Rivolta C., tutors	3	
	Write a Fellowship <i>Rédaction d'une demande de bourse</i>	7	-	-	Benton R., tutors	3	
	Subtotal	21	28	-		6	
Optional (choice -> 9 credits) * / Optionnel (choix -> 9 crédits)*							
	Genomics, Proteomics and Quantitative Genetics <i>Génomique, protéomique et génétique quantitative</i>	24	-	-	Franken P., Tafti M., Quadroni M., Harshman K., Gambetta M.C.	3	
	Herbivory : Why is the Earth Green ? <i>Herbivorie : pourquoi la terre est verte ?</i>	24	-	-	Farmer E.	3	6
	Plant and Animal Domestication : from History to Molecular Mechanisms <i>Domestication des animaux et des plantes : de l'histoire aux mécanismes moléculaires</i>	12	12	-	Hardtke C., Fankhauser C.	3	
	Scientific Mediation and Communication - Scientific Hands-on Workshop Module (in French only, MSc BEC) <i>Communication et médiation scientifique - module atelier scientifique (MSc BEC)</i>	8	-	20	Kaufmann A., Reymond P., Ducoulombier D., Trouilloud S.	3	8
	Seminars Biology and Integrative Genetics (BIG) <i>Séminaires Biologie et Génétique Intégratives (BIG)</i>	-	-	-	Martin S.	-	
	Supplement : Sequence a Genome <i>Enseignement complémentaire : Séquençage d'un génome.</i>	-	14	10	van der Meer J., Engel P., Rivolta C.	1,5	
	Advanced Quantitative Genetics (MSc BEC-CEE) <i>Génétique quantitative avancée (MSc BEC-CEE)</i>	10	7	-	Robinson M.	1,5	
	Advanced Population Genetics <i>Génétique des populations avancée</i>	14	6	-	Malaspinas A.-S.	3	20
	Bioinformatic Algorithms <i>Algorithmes de bioinformatique</i>	15	15	-	Dessimoz C., Gfeller D.	3	
	Computational Thinking in Cancer Genomics <i>Approche computationnelle pour la génomique du cancer</i>	7	-	7	Ciriello G.	1,5	
	Evolution of Genome Architecture (MSc BEC) <i>Evolution de l'architecture du génome (MSc BEC)</i>	7	7	-	Arguello R.	1,5	
	Industrial Bioinformatics <i>Bioinformatique industrielle</i>	14	-	-	Xenarios I.	1,5	15
	Phylogeny and Comparative Methods (MSc BEC) <i>Phylogénie et méthodes comparatives (MSc BEC)</i>	7	14	-	Salamin N.	1,5	
	Anti-Infective Agents <i>Agents anti-infectieux</i>	14	-	-	Sanglard D., Hauser P., Croxatto A., Ciuffi A.	1,5	
	Bacterial Virulence and Pathogenesis <i>Virulence bactérienne et pathogénèse</i>	14	-	-	Greub G., Hauser P., Jacquier N.	1,5	
	Chromosome Organization and Dynamics <i>Organisation et dynamique des chromosomes</i>	4	10	-	Gruber S.	1,5	
	Environmental Microbiology <i>Microbiologie environnementale</i>	14	-	-	van der Meer J.	1,5	
	Epidemiology of Human Pathogens <i>Epidémiologie de pathogènes humains</i>	14	-	-	Blanc D., Hauser P., Meylan P., Sanglard D., Senn L.	1,5	
	Microbes as Tools in Experimental Biology <i>Les microbes comme outils de biologie expérimentale</i>	10	4	-	Sanglard D., Ciuffi A.	1,5	
	Microbial Cytoskeleton - A Scientific Writing Class <i>Cytosquelette microbien - écriture scientifique</i>	4	10	-	Martin S., Collier J.	1,5	
	Viral Pathogenesis and Emerging Viruses <i>Pathogénèse virale et virus émergents</i>	14	-	-	Kunz S., Gouttenoire J., Ciuffi A.	1,5	
	Total					15	

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

	Course / Enseignement	ECTS Credits
	Master Thesis Travail de Master	45
	Thesis Director	

* Students can choose some courses of the Master of Science (MSc) in Behaviour, Evolution and Conservation (max 3 ECTS credits)

SEQUENCE A GENOME (PART II)

Jan Roelof van der Meer

C	Obl	English	14
S	3.00		
E	Obl	English	28
S			

N: Master

P: Sequence a genome I (compulsory)

O: The goals of the second part of this class are to learn how to carry out a comparative genome analysis. Groups of three students will work on different analysis project. At the end of the course the students will present their results to the other groups, try to integrate the different results and relate it to the biology of the organisms in question.

C: Following up on the first semester, students will carry out a comparative genome analysis covering various aspects such as:

- Comparison of genome structures
- Inferring genome-wide phylogenetic trees
- Identifying clade-specific gene families
- Assessing gene family evolution
- Identifying mobile genetic elements
- Inferring gene functions by homology and literature search
- Working in a team and integrating results with other groups
- Writing and presenting the results

I: <http://www.unil.ch/sequenceagenome/>

WRITE A FELLOWSHIP

Richard Benton

C	Obl	English	7
S	3.00		

N: Master

-
- O: - Construct meaningful hypotheses in the context of a particular open question in the field (typically related to the master project of the student)
- Develop an experimental strategy that tests these hypotheses
 - Formulate this experimental strategy in the form of a grant application
 - Present your work in a concise oral presentation
 - Appreciate the granting system used to fund biological research

-
- C: The student writes a research proposal that is typically addressing questions in the research area related to his/her master project. The research proposal has to follow precise guidelines. The student is closely supervised by his/her master supervisor who serves as the tutor for this course. The written proposal and a short oral presentation are both evaluated.

GENOMICS, PROTEOMICS AND QUANTITATIVE GENETICS

Paul Franken

C	Opt	English, French	24
S	3.00		

N: Master

O: Get acquainted with the various experimental approaches and technologies to address fundamental principles of gene and genome function

C: This course consists of four components. Together these components introduce and give an overview of functional genomics from gene transcription to the protein, and, finally, the phenotype. Besides providing a background, the techniques applied in the various approaches will be emphasized.

Genomic technologies and applications

- Advanced techniques in microarray analysis: Tiling arrays, SNP detection, ChIP on chip experiments.
- Biology of non-coding RNAs and their detection
- qPCR, theory and applications.

Epigenetics and Chromatin structure

- What is epigenetics?
- Dynamics of chromatin structure
- Pros and cons of the techniques utilized to quantify/identify chromatin modifications

Proteomics

- Introduction to expression proteomics (analysis of protein expression levels and their changes) and functional proteomics (functional relationships between proteins).
- Introduction to separation techniques (liquid chromatography, 2D electrophoresis, mass spectrometry), typical workflows in which these techniques can be applied, and bioinformatics analysis.
- Discussion of the potential and limitations of the proteomics approach to study complex biological systems.

Analysis of Quantitative Traits

- Introduction into quantitative genetics.
- How to map quantitative traits in model organisms (mice, fruitfly)?
- Mapping strategies in humans and in non-model organisms.
- Introduction to the use of Quantitative-Trait-Loci mapping tools using WebQTL and statistical issues in QTL mapping.

HERBIVORY : WHY IS THE EARTH GREEN ?

Edward Elliston Farmer

C	Opt	English	24
S	3.00		

N: Master

P: Admission into the Masters programme and Bachelors in biology or a related subject

O: Understand why leaves are so abundant on earth

C: Leaf energetics and herbivore diets, physical defenses, coevolution of leaves and stomachs, molecular targets of leaf defense chemicals, the growth/defence dilemma

Note: this is an interactive, question-based course requiring active participation

B: Fourni sur MyUNIL avant et durant le cours

PLANT AND ANIMAL DOMESTICATION : FROM HISTORY TO MOLECULAR MECHANISMS

Christian Fankhauser, Christian Hardtke

E	Opt	English	12
S			
C	Opt	English	12
S	3.00		

N: Master

P: BSc level understanding of genetics.

O: Provide an overview of the genetic diversity present in species and how this was used by mankind in the process of domestication.
Learn how to orally present a scientific paper about this topic to your fellow master & bachelor students.

C: - A brief history of agriculture
- Genetic basis underlying the diversity in species
- Methods used by humans to select plant and animal varieties used in agriculture
- How can major domestication traits be identified?
- Examples of domestication traits such as behaviour, seed shattering, taste (e.g. bitterness in cucumber), altitude adaptation, latitude adaptation, requirement for vernalization.

**SCIENTIFIC MEDIATION AND COMMUNICATION - SCIENTIFIC HANDS-ON
WORKSHOP MODULE**

Alain Kaufmann, Philippe Reymond

C	Opt	French	8
S	3.00		
TP	Opt	French	20
S			

N: Master

SUPPLEMENT : SEQUENCE A GENOME

Jan Roelof van der Meer

E	Opt	English	14
S	1.50		
TP	Opt	English	10
S			

N: Master

ADVANCED QUANTITATIVE GENETICS

Matthew Robinson

C	Opt	English	10
S	1.50		
E	Opt	English	7
S			

N: Master

ADVANCED POPULATION GENETICS

Anna Sapfo Malaspinas

C	Opt	English	14
S	3.00		
E	Opt	English	6
S			

N: Master

BIOINFORMATIC ALGORITHMS

Christophe Dessimoz

C	Opt	English	15
S	3.00		
E	Opt	English	15
S			

N: Master

COMPUTATIONAL THINKING IN CANCER GENOMICS

Giovanni Ciriello

C	Opt	English	7
S	1.50		
TP	Opt	English	7
S			

N: Master

EVOLUTION OF GENOME ARCHITECTURE

Roman Arguello

C	Opt	English	7
S	1.50		
E	Opt	English	7
S			

N: Master

P: Evolutionary biology, some statistics that involve probabilistic reasoning, basic molecular biology

O: - To investigate several of the outstanding topics in genome/molecular evolution
- To develop familiarity with several of the current debates within the field
- To develop familiarity with quantitative/computation approaches to addressing questions within the field

C: Primary literature (reviews and reports), simulation software, computational approaches

INDUSTRIAL BIOINFORMATICS

Ioannis Xenarios

C	Opt	English	14
S	1.50		

N: Master

PHYLOGENY AND COMPARATIVE METHODS

Nicolas Salamin

C	Opt	English	7
S	1.50		
E	Opt	English	14
S			

N: Master

P: none

O: Phylogenetic reconstruction methods and their application in evolutionary biology. To know and understand phylogenetic reconstruction methods in order to test the processes leading to genes and organisms evolution.

C: The subjects will be presented during lectures as well as practicals.

I. Reconstruction methods

- What is a phylogenetic tree and how to interpret it?

- Tree reconstruction:

- a) optimisation criteria and models of evolution

- b) search for the optimum tree

- c) Bayesian methods

- Can we trust the inferred tree?

II. Uses for phylogenetic trees

- Detecting positive selection in a coding gene

- Testing coevolution and cospeciation

- Macroevolution:

- a) dating evolutionary events

- b) tempo and mode of evolution

- c) testing for key innovations

- Phylogeny and conservation

B: Felsenstein, J. 2003. Inferring phylogenies. Sinauer Associates.

Page, R. 2003. Tangled trees: Phylogeny, cospeciation, and coevolution. University of Chicago Press.

Purvis, A., Gittleman, J.L. and Brooks, T. 2005. Phylogeny and conservation. Cambridge University Press.

Swofford, D.L., Olsen, G.K., Waddell, P.J. and Hillis, D.M. 1996. Phylogeny reconstruction. Pages 407-514 In Molecular Systematics (D.M. Hillis, C. Moritz, B.K. Mable, eds.). Sinauer Associates.

Yang, Z.H. 2006. Computational Molecular Evolution. Oxford University Press.

I: <http://www.unil.ch/phylo/teaching/pmc.html>

ANTI-INFECTIVE AGENTS

Dominique Sanglard

C	Opt	English	14
S	1.50		

N: Master

O: Description:

The aims of this class is to understand the mode of action and resistance to principal anti-infective agents used for the therapy of infectious diseases. Diverse classes of agents will be discussed which are used to combat bacterial, viral, fungal and parasitic infections. The molecular basis of resistance to these agents will be also illustrated by several examples.

The class is also associates with paper reading and presentations

Learning outcomes:

- to learn about the mode of actions of anti-infective agents
- to learn about molecular resistance mechanisms developing in microbial pathogens.

C: Part Ciuffi: Antiviral agents (2h)

Part Anthony Croxatto and Hauser: antibacterial and antiparasitic agents (4 each); paper discussion and presentation

Part Sanglard: Antifungal agents (3h)

BACTERIAL VIRULENCE AND PATHOGENESIS

Gilbert Greub

C	Opt	English	14
S	1.50		

N: Master

CHROMOSOME ORGANIZATION AND DYNAMICS

Stephan Gruber

E	Opt	English	10
S			
C	Opt	English	4
S	1.50		

N: Master

O: Getting to know a recent technological revolution in the study of chromosome organization and its current applications.

ENVIRONMENTAL MICROBIOLOGY

Jan Roelof van der Meer

C	Opt	English	14
S	1.50		

N: Master

P: none.

O: The goal of this class is to develop a small literature project independently on a topic of choice in environmental microbiology.

C: The topics of this class are chosen by the students individually, in discussion with the class tutor.

EPIDEMIOLOGY OF HUMAN PATHOGENS

Dominique Blanc

C	Opt	English	14
S	1.50		

N: Master

O: Acquire principles of epidemiology by the study of several examples of pathogens. Knowledge on molecular typing methods and their applications. Knowledge on bacterial population genetics.

C: General concepts. Molecular typing in epidemiology. Bacterial population genetics.
Viral infections: relation between the host range, timing of infection, mode of infection and the resulting epidemiology.
Epidemiology of *Staphylococcus aureus*.
Epidemiology of *Pneumocystis*.
Epidemiology of *Candida*.

MICROBES AS TOOLS IN EXPERIMENTAL BIOLOGY

Dominique Sanglard

C	Opt	English	10
S	1.50		
E	Opt	English	4
S			

N: Master

O: The general aim of this class is to get detailed knowledge on the use of microbial systems (including viruses, bacteria and yeast) as tools in several fields of experimental biology (microbial pathogenesis, genetic engineering applications, gene therapy).

The class is associated with reading and presentations of paper related to this topic.

C: Part Ciuffi

Description :

The aim of this class is to open up your mind and make you think out of the box, thereby making you look at viruses beyond their pathogenicity and more as potential tools that can be used for many diverse applications.

To appreciate the potential of viruses as tools in molecular biology, this class will give you a non-exhaustive list of applications in which viruses are used as tools.

Examples will include the use of viruses as pesticides, gene delivery vehicles, vaccines, tools in gene expression studies and in cellular biology studies.

Learning outcomes :

- To realize that viruses are not only pathogens.
- To realize that viruses can be used as tools in multiple applications.
- To understand that fundamental knowledge about viruses can be useful for secondary applications.
- To appreciate the diversity of viruses and their differences in replication, and thus the diversity of applications in which they can be exploited.
- To identify the viral steps that can be manipulated. To know how to manipulate these viral steps and why.
- To appreciate impact of viruses in the current society.

Part Sanglard

Description:

The aims of this class is to show the importance of genetic screens for the identification of novel biological functions related to microbial virulence and to therapeutic targets. Specifically, the aims are the following:

- To understand how genetic screens can contribute to identify virulence factors in bacteria and yeast.
- To show how genetic screens can serve the identification of genes involved in the recognition of fungal PAMP by the immune system.
- To show how genetic screens can contribute to identify novel therapeutic targets in pathogenic yeast.

Learning outcomes:

- To appreciate how methodologies can be employed in genetic screens.
- To realize how bacterial and yeast genetics can address and solve biological problems.

MICROBIAL CYTOSKELETON - A SCIENTIFIC WRITING CLASS

Sophie Martin

E	Opt	English	10
S			
C	Opt	English	4
S	1.50		

N: Master

P: A good knowledge of molecular and cellular biology Bachelor-level courses.
Curiosity for cellular processes.

O: The objectives of this course are to:
1) gain general knowledge on the organisation and function of the cytoskeleton in prokaryotes and eukaryotes
2) learn to read scientific articles in a critical manner, by discussing the strong and weak points of each article.
3) train de writing of scientific texts.

C: The course will introduce the following topics:
- general principles of the actin and microtubule cytoskeleton
- cytoskeletal dynamics (dynamic instability and treadmilling)
- motor proteins
- organisation and role of the cytoskeleton in bacteria
- organisation and role of the cytoskeleton in eukaryotic cells (several themes will be covered, depending on the choice of the articles to be discussed, for instance: mitotic spindle, cell division, cell polarity,...)
The exercises will consist of the reading of scientific articles and writing of their summary, including a session of summary correction and writing exercises.

B: Les papiers à lire et discuter seront annoncés lors du premier cours

VIRAL PATHOGENESIS AND EMERGING VIRUSES

Stefan Kunz

C	Opt	English	14
S	1.50		

N: Master

P: Cours Virologie BSc. 5th semester (S. Kunz)

O: To understand fundamental principles of viral pathogenesis at the cellular, systemic, and population level.
To cover the pathogenesis of major human viruses and emerging viral diseases.
To discuss the basic concepts of viral pathogenesis in the context of landmark papers in the field.

C: Teaching: Angela Ciuffi, Jérôme Gouttenoire, Stefan Kunz
Basic concepts in viral pathogenesis (S. Kunz)
Major human pathogenic viruses and emerging viral diseases (S. Kunz)
Viral hepatitis (J. Gouttenoire)
Human retroviral infections (A. Ciuffi)
Genome screening approaches in viral infectious diseases (A. Ciuffi)
Introductory lectures will be given by the teachers.
Landmark papers will be presented by students and discussed in the group.

B: Viral Pathogenesis and Immunity. Nathanson, N. (Ed), 2nd Ed. 2007, Academic Press.

