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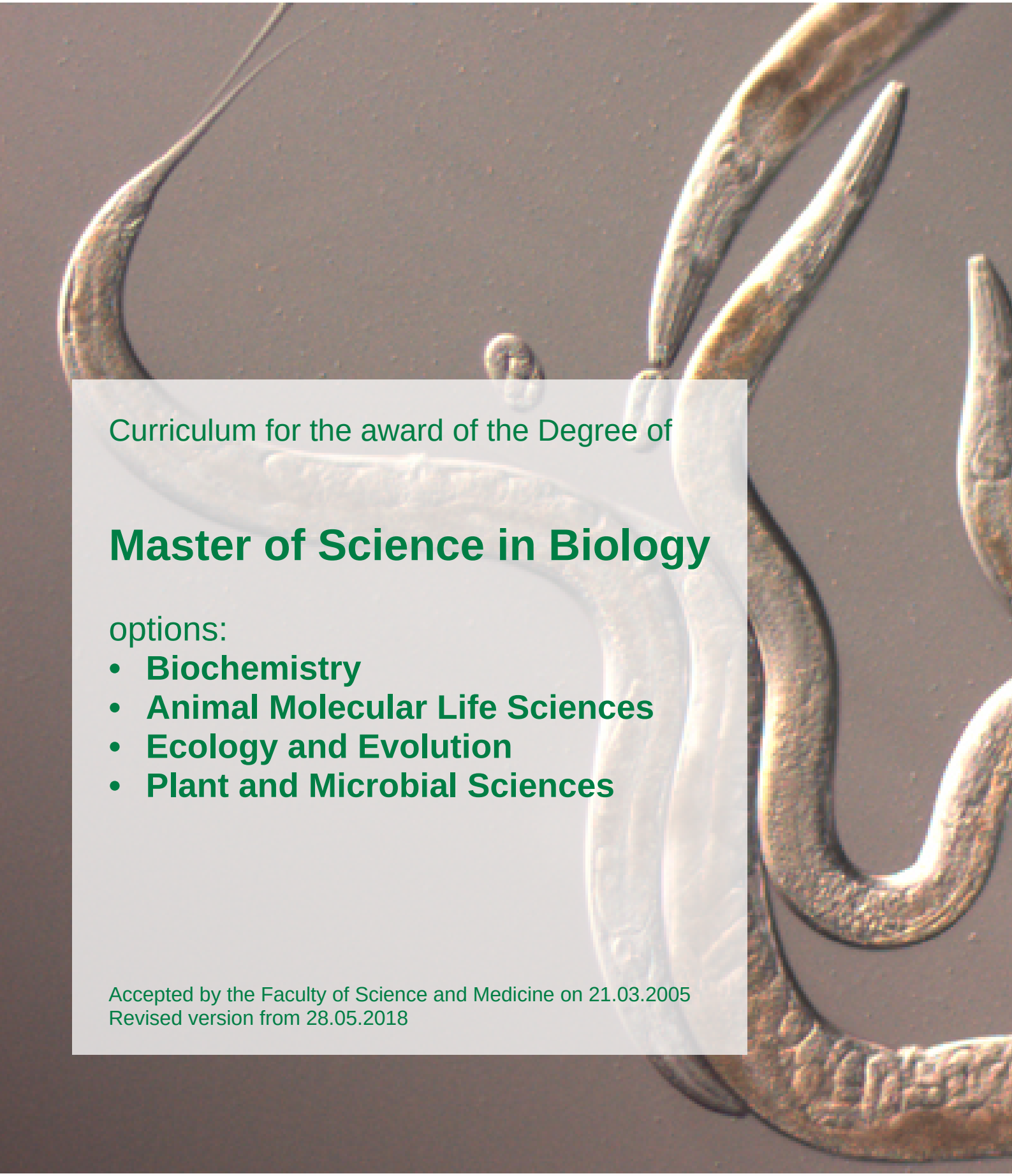

Curriculum for the award of the Degree of

Master of Science in Biology

options:

- **Biochemistry**
- **Animal Molecular Life Sciences**
- **Ecology and Evolution**
- **Plant and Microbial Sciences**

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FACULTÉ DES SCIENCES ET DE MÉDECINE
MATHEMATISCH-NATURWISSENSCHAFTLICHE UND MEDIZINISCHE FAKULTÄT

Contents

1 Introduction

The University of Fribourg offers a multidisciplinary study programme leading to the degree of Master of Science in Biology, with the four options **Biochemistry**, **Animal Molecular Life Sciences**, **Ecology and Evolution**, **Plant and Microbial Sciences**. The programme consists of 90 ECTS[1] credits and corresponds to 18 months of full-time study. English is the official language for all activities. However, the students may choose the language of the examinations (English, French or German).

A special emphasis is placed on the development of the student's scientific capabilities (independent thinking, problem-solving skills, critical evaluation of data, oral and written communication skills, ability to work in a team). The student will deepen her/his knowledge of a selected area of biological sciences and acquire techniques needed in basic research as well as in practical applications such as biomedical and pharmacological research, biotechnology, public health, crop protection, sustainable agriculture, environmental protection, wildlife management, etc. Courses are accompanied by discussions, student presentations and writing exercises in order to stimulate an active participation of students. Students are integrated in one of the research teams and have the opportunity to experience all aspects of the daily life of a research scientist. They will obtain extensive experience with academic research in biology and learn to plan, carry out, analyse and present research. The Master also paves the way to a potential PhD and an academic career in biology and related fields.

2 Overview

The programme consists of three modules:

- Master courses: 30 ECTS credits
- Master thesis-related activities: 15 ECTS credits
- Master thesis: 45 ECTS credits

13 specializations are offered among the following four options:

- Biochemistry
- Animal Molecular Life Sciences
- Ecology and Evolution
- Plant and Microbial Sciences

Every option offers several specializations as shown in the attached table *MSc Biology specializations*. This table indicates which teaching units are obligatory, recommended or elective for every specialization.

3 Acquired skills

The aim of the studies leading to the award of an MSc in Biology is to deepen knowledge and perfect competence in the chosen field and at the same time develop skills in scientific English. Thus, at the end of the course, a student will have shown that he/she can apply their knowledge to accomplish a research project and will have learned how to work independently and how to integrate into an interdisciplinary research team. The award of the degree requires creative and self-critical talents as well as the ability to communicate ideas and work both in English and in the student's native language.

[1] ECTS: *European Credit Transfer System*. One ECTS corresponds to 30 hours of effective work of the student

4 Master courses

For each option the University of Fribourg offers a number of obligatory, recommended, and elective[2] Master courses. Elective courses can also be chosen among Master level courses at the Universities of Berne and Neuchâtel (BeNeFri convention) or among activities of the "III^{e} Cycle Romand en Sciences Biologiques". An individual programme of elective courses according to the study programme is established by each student. The study advisor of the student's Master option may help in case of difficulties. An elective course not listed in the study programme of the four options (list below and attached table of the *Master in Biology specializations*) may also be taken. In this case, the student must consult the study advisor. Completing the Master programme requires a minimum of 30 ECTS credits for Master courses, 15 ECTS credits of Master's thesis-related courses/seminars, and 45 ECTS credits of Master's thesis project.

The mode of assessment of the courses is described in an appendix available at (http://www3.unifr.ch/scimed/plans).

Courses are evaluated with a grade between 6 (best mark) and 1 (worst mark) or with passed/failed, based on an oral or a written examination, or some other performance of the student. Although students are allowed to attend Master courses before admission to a Master programme, it is not possible to acquire any ECTS credits.

The table *MSc Biology specializations* (attached at the end of this document) provides an overview of the Master courses offered in the four options. "O" indicates a course that is obligatory for a given option. Most courses listed in the table can be taken as elective (E); "R" indicates a course recommended for a given option. A detailed course programme for each option is described below and at the end of this document.

5 Master's thesis-related activities

As members of a research team the Master students take part in various activities such as research group meetings, seminars, literature study/Journal club etc. Students are expected to participate in those activities throughout the duration of the study. The credits for these activities amount to 15 ETCS points. A detailed list of the activities required from students following a given option is given in section 11 (see below).

6 Master's thesis description and assessment

The Master's thesis is a scientific project carried out by a student under the supervision of a group leader within a research group of the Department of Biology. The details vary with the option and research group, but in general the student is expected to establish a research strategy, plan the project, carry out the research, analyse the results, present them in a formal seminar, and write them up in the form of a scientific paper. The written report in the form of a scientific paper, the oral presentation of the work and the practical work will be the objects of the final assessment of the Master thesis. A Master thesis is evaluated with a grade and corresponds to 45 ECTS credits.

Each student must choose a research group and be accepted during the first semester of her/his Master studies. The group leader will be his/her supervisor for the Master thesis.

To facilitate this choice, students are encouraged to familiarise themselves with the research carried out in the different research groups either before starting their studies or during the first weeks of their Master study, e.g., by taking part in their research group meetings. The student informs the student advisor of her/his choice.

[2] elective: student choice

If a thesis is evaluated as insufficient (less than 4.0), the student has the option to begin a new Master's thesis in another research group. In this case, the student has to continue to attend and participate to the Master thesis-related activities.

7 Validation

The teaching units of the Master programme can only be examined after the student has completed all requirements for her/his Bachelor degree.

The **Validation Package MScBL1** comprises the Master courses and the Master's thesis-related activities. **Validation Package MScBL2** comprises the Master thesis.

With the validation of the **MScBL1 and MScBL2** packages the student obtains the degree of Master of Science in Biology, option Biochemistry, Neuro- and Developmental Biology, Ecology and Evolution or Plant-Microbe Interactions.

8 Conditions of admission

The acceptance to a Master programme in Biology requires fulfilling the following conditions:

- being registered at the University of Fribourg (as defined in the "Règlement concernant l'admission à l'Université de Fribourg" / "Zulassungsreglement der Universität Freiburg")
- having completed the requirements for a Bachelor of Science in Biology or in Biochemistry at the University of Fribourg, or a similar degree acknowledged by the Faculty of Science and Medicine.

The Faculty of Science and Medicine establishes a list of recognized degrees. Candidates that hold a degree mentioned on this list are automatically accepted. Candidates holding a title not listed can be admitted by a decision of the Faculty of Science and Medicine upon submission of an application to the *Committee of student requests* (*Commission des requêtes des étudiant-e-s*) (address: Committee for student request, Dean's Office, Faculty of Science and Medicine, chemin du Musée 8, CH-1700 Fribourg, Switzerland). The Faculty may also request that a candidate takes additional courses or other complements. If the imposed courses amount to less than about 30 ECTS credits, the student may attend them during any of the 3 semesters of the Master programme. If the imposed courses amount to more than about 30 ECTS credits, the student will only be able to begin her/his studies once the prescribed conditions have been met.

9 Ethics and science

Ethical principles are an integral part of a scientific education. Accepted international conventions must be respected during research and while documenting all scientific work whether it be a project, a lecture, a thesis, or a report. In particular, every external source of information (articles, lectures, web pages, etc.) must be correctly cited. Every student of the Faculty of Science and Medicine has signed a formal commitment to restrain herself/himself from doing "plagiarism".

10 Regulations and Additional Information

Detailed information about studying Biology can be found in the documents referenced on the web page http://www3.unifr.ch/scimed/en/plans which can also be obtained from the Office of the Department of Biology, chemin du Musée 10, CH-1700 Fribourg.

11 Detailed programmes of the options

11.1 Option Biochemistry

[Version 2018, validation packages: PV-SBL.0000033, PV-SBL.0000035]

11.1.1 Study programme

Code		Semester, year	tot. h.	ECTS
Obligatory courses				
BL.0413	Gene regulatory networks	AS	8	1
BL.0415	Cell proliferation	SS	8	1
BC.4201	Cell cycle control	AS	12	1.5
BC.4202	Eucaryotic cell growth control	AS	12	1.5
BC.4203	Genotyping (practical course)	AS	90	2.5
BC.7106	Introduction to UNIX/Linux and scripting with Bash (lecture with exercises)	AS	5 days	2
BC.7107	Bioinformatics (practical + in silico) [3]	AS	42	3
Total ECTS credits in obligatory courses				**12.5**

[3] BC.7107 needs BC.7106 as prerequisite

Recommended and elective courses

–	Courses listed in the *MSc Biology specialization* table or approved by the study advisor, among suitable courses within or outside the University of Fribourg.*	All		
BL.0411	Signalling and transport	AS	8	1
BL.0412	Introduction to protein structure and function [§]	AS	8	1
BL.0414	Cell fate and tissue regeneration	AS	8	1
BL.0416	Biological rhythms	SS	8	1
BL.0417	Evolution on the bench	SS	8	1
BL.0418	Microbial metabolism and genetics	SS	8	1
BL.0419	Advanced imaging	SS	8	1
BC.7104	Introduction to protein structure and protein homology modelling [#]	SS	14	1.5
BC.7105	Introduction to docking of small molecules to large macromolecules and molecular graphics [#]	SS	14	1.5
BL.0216	Introduction to statistics with R – Model selection	Block in January	12	1
BL.0127	BeFri colloquium in cell and developmental biology I	SS	12	1.5
BL.0128	BeFri colloquium in cell and developmental biology II	SS	12	1.5
BL.0129	BeFri retreat in cell and developmental biology	SS	2 days	1
BL.0123	Cellular and genetic networks	AS	28	3
BL.0125	Light and fluorescence microscopy for life sciences	AS, block course	28	3
BL.0322	Exploring protein functionality	AS	18	2
BL.0318	Drugs and phytochemical analysis	SS	21	1.5
BL.0420	Career profiling in life sciences	SS	8	1
BL.0451	Introduction to mass spectrometry and proteomics	AS	8	1
BL.0452	Advanced quantitative proteomics (incl. practical course)	SS	12	1
BL.0453	Protein homeostasis: translation, quality control and degradation	SA	12	1
–	*English for Masters Students of Science I*	AS	–	3
–	*English for Masters Students of Science II*	SS	–	3
Minimum ECTS credits in elective courses				**17.5**

[#] Must be taken together
§ Recommended for BC.7104 and BC.7105
* BENEFRI or other MSc programmes can be chosen upon approval by the study advisor.

Thesis-related activities

BC.4402	Lab meetings	All	3x14	4.5
BL.0403	Research seminars in molecular life sciences	3 sem.	3x14	4.5
BL.0400	Seminars in biology	3 sem.	3x10	3x0.5
BL.0404	Journal club in molecular life sciences	3 sem.	3x14	3
ME.3001 ME.4001 ME.5001	Neurobiology seminars	3 sem.	3x5	3x0.5
Total ECTS points in thesis-related activities				**15**

BL.5000	**Master thesis**	**–**	**45**
TOTAL			**90**

11.2 Option Animal Molecular Life Sciences

[Version 2018, validation packages: PV-SBL.0000007, PV-SBL.0000017]

11.2.1 Study programme

Code		Semester, year	tot. h.	ECTS
Obligatory courses				
BL.0119	Molecular genetics of model organism development (BeFri lecture)	AS 1st	28	3
BL.0120	Topics in developmental biology	SS	28	3
BL.0127	BeFri research colloquium in cell and developmental biology I	SS	12	1.5
BL.0128	BeFri research colloquium in cell and developmental biology II	SS	12	1.5
BL.0129	BeFri retreat in cell and developmental biology	SS	2 days	1
BL.0420	Career profiling in life sciences	SS	8	1
Total ECTS credits in obligatory courses				**11**
Recommended and elective courses				
–	Courses listed in the *MSc Biology specialization* table or approved by the study advisor, among suitable courses within or outside the University of Fribourg.*	AS/SS		-
BL.0114	Experimental genetics	AS 1st	8	1
BL.0115	The RNA world	AS 1st	12	1.5
BL.0130	Nuclear organization and chromosome dynamics	AS 1st	8	1
BL.0117	Neurogenetics	AS 1st	28	3
BL.0118	BeNeFri workshop “Frontiers in neurosciences”	AS, block course	18	1.5
BL.0123	Cellular and genetic networks	AS	28	3
BL.0124	Marine biology workshop **	AS, block course	40	4
BL.0125	Light and fluorescence microscopy for life sciences	AS, block course	28	3
BL.0126	Established and emerging organisms for marine science	SS, block course	10d	6
BL.0216	Introduction to statistics with R – Model selection	Block in January	12	1
BL.0411	Signalling and transport	AS	8	1
BL.0412	Introduction to protein structure and function	AS	8	1
BL.0413	Gene regulatory networks	AS	8	1
BL.0414	Cell fate and tissue regeneration	AS	8	1
BL.0415	Cell proliferation	SS	8	1
BL.0416	Biological rhythms	SS	8	1
BL.0417	Evolution on the bench	SS	8	1
BL.0418	Microbial metabolism and genetics	SS	8	1
BL.0419	Advanced imaging	SS	8	1
BL.0421	Oceanography and marine ecosystems	AS	8	1
BL.0422	Molecular and cellular marine biology	SS	8	1
	Systems biology of the brain	SS	2d	1.5
	Introductory course in laboratory animal science	SS	5 days	3
	English for Masters Students of Science I	AS	–	3
	English for Masters Students of Science II	SS	–	3
Minimum ECTS credits in elective courses				**19**

Thesis-related activities				
BL.0400	Seminars in biology	3 sem.	3x10	1.5
BL.0403	Research seminars in molecular life sciences	3 sem	3x14	4.5
ME.5001§ ME.6001 ME.7001	Neurobiology seminars	3 sem.	3x5	3x0.5
BL.0401	Research group meetings	3 sem.	3x14	4.5
BL.0404	Journal club in molecular life sciences	3 sem.	3x14	3
Total ECTS credits in thesis-related activities				**15**

* BENEFRI or other MSc programmes can be chosen upon approval by the study advisor.
** This course is offered once every 2 years
§ If this course has been taken in a bachelor programme, it is replaced by 0.5 ECTS of elective

BL.5000	**Master thesis**	**–**	**45**
TOTAL			**90**

11.3 Option Ecology and Evolution

[Version 2018, validation packages: PV-SBL.0000022, PV-SBL.0000027]

11.3.1 Study programme

Code		Semester, year	tot. h.	ECTS
Obligatory courses				
BL.0201	Advanced topics in evolutionary genetics and ecology	AS 1st	42	4
BL.0202	Biological invasions and trophic interactions	AS 1st	33	4
BL.0203	Workshop in statistics and experimental design	SS 1st	28	3
BL.0205	Ecological field course	Block SS	80	5
BL.0208	Statistics and experimental design (lecture)	AS	28	3
BL.0216	Introduction to statistics with R – Model selection	Block in Jan.	12	1
BL.0410	Scientific writing	AS	28	3
Total ECTS credits in obligatory courses				**23**
Recommended and elective courses				
	Courses listed in the *MSc Biology specialization* table or approved by the study advisor, among suitable courses within or outside the University of Fribourg.*			
LA_BL.0207	Molecular genetics for ecologists (Uni Lausanne)	AS, block course	–	4
BL.0206	Evolutionary biology workshop "Guarda" ****	Block SS	56	4
BL.0213	Ecological networks	SS	20	2
BL.0219	The evolution of life histories and aging	SS	14	1.5
BL.0417	Evolution on the bench	SS	8	1
BL.0418	Microbial metabolism and genetics	SS	8	1
BL.0419	Advanced imaging	SS	8	1
BL.6002	Classical models in biology (lecture)	SS	28	3
BL.6003	Classical models in biology (exercises) **	SS	14	1
AF_BL.0210	Tropical biology (field course, Tropical biology association) *** and ****	Block Summer	28 days	10
–	*English for Masters Students of Science I*	AS	–	3
–	*English for Masters Students of Science II*	SS	–	3
Minimum ECTS credits in elective courses				**7**
Thesis-related activities				
BL.0400	Seminars in biology	3 sem.	3x10	3x0.5
BL.0211	Seminars in ecology and evolution	3 sem.	3x14	1.5
BL.0212	Research seminars in ecology and evolution	3 sem.	3x14	3
BL.0401	Research group meetings	All	3x14	4.5
BL.0402	Literature study/Journal club	All	3x14	4.5
	Total ECTS credits in thesis-related activities			**15**
BL.5000	**Master thesis**		–	**45**
TOTAL				**90**

* BENEFRI or other MSc programmes can be chosen upon approval by the study advisor.
** Cannot be taken without BL.6002
*** This course can be used as a replacement for BL.0205 (5 ECTS)
**** No guarantee that there will be space

11.4 Option Plant and Microbial Sciences

[Version 2018, validation packages: PV-SBL.0000028, PV-SBL.0000032]

11.4.1 Study programme

Code		Semester, year	tot. h.	ECTS
Obligatory courses				
BC.7106	Introduction to UNIX/Linux and scripting with Bash (lecture with exercises)	AS	5 days	2
BC.7107	Bioinformatics (practical + in silico)[1]	AS	42	3
BL.0307	Symbiosis: how plants and microbes communicate	AS 1st	12	1.5
BL.0318	Drugs and phytochemical analysis	SS	21	1.5
Total ECTS credits in obligatory courses				**8**
Recommended and elective courses				
	Courses listed in the *MSc Biology specialization* table or approved by the study advisor, among suitable courses within or outside the University of Fribourg.*			
BL.0125	Light and fluorescence microscopy for Life Sciences	AS, block course	28	3
BL.0216	Introduction to statistics with R – Model selection	Block in Jan.	12	1
BL.0308	Plant development: the life of a sessile organism	AS 1st	12	1.5
BL.0317	Molecular basis of innate immunity: theoretical and practical aspects	SS	28	3
BL.0322	Exploring protein functionality	AS 1st	18	2
BL.0323	Plant biotechnology	SS 1st	24	3
BL.0411	Signalling and transport	AS	8	1
BL.0412	Introduction to protein structure and function	AS	8	1
BL.0418	Microbial metabolism and genetics	SS	8	1
BL.0419	Advanced imaging	SS	8	1
	English for Masters Students of Science I	AS	-	3
	English for Masters Students of Science II)	SS	-	3
Minimum ECTS credits in elective courses				**22**
Thesis-related activities				
BL.0326	Current topics in plant and microbial sciences	All	3x14	6
BL.0400	Seminars in biology	3 sem.	3x10	3x0.5
BL.0401	Research group meetings	All	3x14	4.5
BL.0410	Scientific writing	AS 1st	28	3
Total ECTS points in thesis-related activities				**15**
BL.5000	**Master research and thesis**		**-**	**45**
TOTAL				**90**

* BENEFRI or other MSc programmes can be chosen upon approval by the study advisor.

12 Description of the teaching units

The lecture *Cell cycle control* (BC.4201) covers specific aspects of cell cycle control mechanisms in eucaryotes.

The course *Eucaryotic cell growth control* (BC.4202) covers the latest advances in our understanding on how nutrient signals are integrated to properly adjust cellular growth in eukaryotes.

The laboratory course *Genotyping* (BC.4203) teaches students molecular methods how to distinguish between different alleles. In principle, this laboratory course is performed on tissue samples from mice.

The two courses *Introduction to protein structure and protein homology modelling* and *Introduction to docking of small molecules to large macromolecules and molecular graphics* (BC.7104 and BC.7105) describe the methodologies for 3D protein structure modelling (ab initio and by homology), as well as how to dock small molecules or large macromolecules to proteins. They also describe basic methods for producing nice molecular graphics for publications.

Introduction to UNIX/Linux and scripting with Bash (BC.7106): This course is intended for students with a background in Biology, Biochemistry or Life Sciences and aims at familiarizing the students with installing and using Linux, becoming fluent with the UNIX command line, and introducing standard workflows and practices when developing and executing small programmes written in Python. This course is mostly “hands-on”. No prior knowledge of Linux or Python is necessary.

The course *Bioinformatics (practical + in silico)* (BC.7107) will allow the students to sequence a genome and analyse real genomic data. The goal is to identify potential mutations responsible for the phenotype.

The course *Signalling and transport* (BL.0411) will focus on the plant signal transduction at first place. By comparing bacterial and plant signalling pathways over membranes, students will learn functional differences between the cytokinin receptor and bacterial sensor histidine kinases. As a side effect they will be also taught how structural models can be visualized. Using the example of the ethylene-sensing pathway it will be illustrated how evolution has 'modernized' plant histidine kinases. By comparing typical mammalian signal transduction pathways, such as G-protein coupled receptors or Toll-like innate immune receptors, with leucine-rich repeat (LRR) receptor(-like) kinases, such as BRI1, it will explain how plants differently sense steroid hormones over membranes. This course will compare eukaryotic signal transduction in plant, bacterial and mammalian systems, and is thus also recommended for “non-plant” Master students.

The course *Introduction to protein structure and function* (BL.0412) will focus on the properties and functions of proteins and how to detect those using bioinformatics tools and databases. Due to its lateral chain properties, each amino acid of a peptide will adopt a specific orientation or fold driven by a series of non-covalent interactions such as ionic interactions, Van de Waals forces, hydrogen bonds and hydrophobic packing. These conformations are necessary for the proteins to perform their biological function. Based on the primary structure of a protein (the amino acid sequence), bioinformatics tools aim at predicting several possible secondary structure conformations such as alpha helices, beta sheets, coils, turns, signal peptides and localisation signals, transmembrane regions and their topologies, protein domains and motifs, metal binding sites, post translational modifications, to cite a few. Going further would reach the 3D modelling subject covered by another course. This course should be seen as an introduction to the courses BC.7104 "Introduction to protein 3D structure and protein homology modelling" and BC.7105 "Introduction to docking of small molecules to large macromolecules and molecular graphics". Prerequisite: course BC.7003 "Introduction to Bioinformatics and Genomics" or equivalent.

Students are kindly requested to bring a personal laptop computer (Windows, MacOS, or Linux). This course BL.0412 is recommended for those who intend to follow BC.7104 and BC.7105.

Gene regulatory networks (BL.0413). Even though the human genome consists of over 30'000 genes, each cell only expresses a defined subset of genes. Gene regulation at a global scale or whole genome scale is not dependent on a single transcription factor, but rather on complex gene regulatory networks. In the context of development, cell-cycle and function of differentiated cells different gene regulatory networks are at the core of what makes cells different from each other. Studies from bacteria, unicellular as well as complex, multicellular organisms are important for our understanding of how gene regulation occurs on a genome level. This lecture we will be dedicated on a specific subject in current research given by an expert in the area of gene regulatory networks.

Lecture course *Cell fate and tissue regeneration* (BL.0414). Tissues rely on stem cells for homeostasis and repair. Recent research shows that the fate and lineage potential of stem cells can change depending on whether a stem cell exists within its resident niche and responds to normal tissue homeostasis, whether it is mobilized to repair a wound, or whether it is taken from its niche and challenged to *de novo* tissue morphogenesis after transplantation. This course offers teaching in basics of stem cell biology, pluripotency and induced pluripotency. The particular focus will be given to the molecular control of mammalian stem cell fate decisions. It will be discussed how different populations of naturally lineage-restricted stem cells and committed progenitors can display remarkable plasticity and reversibility and reacquire long-term self-renewing capacities and multi-lineage differentiation potential during physiological and regenerative conditions. Finally, it will be also discussed what are the implications of cellular plasticity for regenerative medicine, as exemplified by cardiac and skeletal muscle differentiation.

The course *Cell proliferation* (BL.0415) covers a wide range of issues related to the regulation of cell proliferation in eukaryotic cells. These include fundamental aspects of cell cycle control and their coordination with environmental cues that are mediated by signal transduction pathways. Lectures will provide detailed information on both the recent conceptual and technical advances in the field of cell proliferation control.

The course *Biological rhythms* (BL.0416) focuses on the properties and functions of the circadian clock and other biological rhythms. The circadian clock is a cellular property defined by a set of clock genes that establish an auto-regulatory transcriptional/translational feedback-loop. These cellular clocks interact with each other via neuronal, hormonal and biochemical pathways to establish a coherent systemic hierarchy of physiological functions. This organizes body functions such as sleep and feeding in a temporal manner. Prerequisite: Basic understanding of biochemistry and physiology.

In the course *Evolution on the bench* (BL.0417) we will discuss the main processes and factors determining the rate of evolution of microorganisms and cell lines. We will compare the time scales of these processes to the time scales of experiments frequently carried out in cell biology and microbiology, and realize that evolution is in integral part of almost any such experiment. The goal of this course is then to develop an intuition for the expected evolutionary change over the course of your own experiments and to discuss how evolution may help or limit discovery and how the speed of evolution can be manipulated in the laboratory.

The course *Microbial genetics and metabolism* (BL.0418) treats various aspects of microbial genetics with the focus on bacteria, fungi, and oomycetes. It deals with fundamental aspects of microbial genetics and applied aspects related to disease or beneficial mutualistic interactions. Furthermore, important examples of metabolic pathways will be discussed in the context of microbial life and interactions with the biotic and/or abiotic environment.

Fluorescence light microscopy is a core technique to visualize biological processes in fixed and living tissue. With new development in microscope design and image acquisition progress was also

made in digital image analysis. The aim of the course *Advanced imaging* (BL.0419) is to give the students a theoretical background in digital image analysis and to train students to use state of the art software tools. In a first module the students obtain theoretical knowledge about principles of digital image analysis and learn about ethical aspect in image manipulation. In a second module, students are taught in workshops to use image analysis open source software ImageJ/Fiji and commercial software Bitplane Imaris and Huygens Deconvolution. In self-directed teaching tutorials student acquire basic image analysis skills (File formats, Metadata, Contrast adjustment, Background correction, Filtering). In workshops advanced techniques are learned such as image segmentation, 3D rendering, deconvolution, and co-localization. An introduction in batch processing and macro language will complete the session. The course will give practical guidelines that will help students with imaging projects in their line of research.

Career Profiling in life sciences (BL.0420): After having completed their Master degree, students start applying for jobs. In this interactive course, we present the curricula of several people who are now active in the professional world. We chose different paths, from academia to industry and even less related fields. From this course you will also learn how to write a CV, how to write an application, and how to prepare for a job interview. 15-minute interviews will be held in front of the other participants or in private. We also provide information on where to look for jobs in Switzerland.

Block course BL.0421, *Oceanography and marine ecosystems*: Oceans are home of a vast diversity of animal life forms from all animal phyla. Variable abiotic physical and chemical conditions as well as geographic location strongly impact the marine biosphere. This module will provide a comprehensive introduction into oceanography, diversity of marine biotopes and ecological interactions.

Block course BL.0422, *Molecular and cellular marine biology*: All existing animal life forms originated from common marine ancestors. Thus, the largest diversity of life forms and corresponding evolutionary, physiological molecular and cellular adaptations can be found in marine environments. This module will provide an overview of specific examples of molecular, genetic and cellular biological processes in marine organisms

The courses *Introduction to mass spectrometry and proteomics* and *Advanced quantitative proteomics* (BL.0451 and BL.0452) are each two days block courses at the end of respective semesters. The courses teach theoretical and practical principles of mass spectrometry (MS)-based proteomics. The first course BL.0451 introduces principals of MS analysis of peptides and proteins. Current mass analysers and underlying physical principals are introduced in lectures. Hands-on analyses of mass spectra are performed in a practical course. The second course BL.0452 introduces quantitative MS-based proteomics principles in lectures. In a practical course proteomics experiments are performed and data is analysed by current bioinformatics approaches. After both courses participants will be able to design and perform MS-based proteomics experiments and to analyse respective data. BL.0451 is a prerequisite to take part in BL.0452.

In the course *Protein homeostasis: translation, quality control and degradation* (BL.0453), we discuss molecular mechanisms regulating protein homeostasis. In the first part, we highlight co-translational and post-translational quality control mechanisms that ensure the synthesis of functional proteins. Once a protein has been made, how is its half-life determined? In the second part, we therefore outline the cellular protein degradation pathways focusing on the ubiquitin-proteasome-system (UPS) and autophagosomal /lysosomal protein degradation.

The course *Molecular genetics of model organism development* (BL.0119) is an introduction into some of the most popular model systems used for the study of development. These include *Xenopus*, Mouse, *C. elegans*, *Drosophila* and Zebrafish. The value of different technical approaches will be discussed. Further emphasis will be on presenting key experiments and the most recent findings for each system. Topics may vary from year to year but are likely to include transcriptional, translational, post-translational and epigenetic control of gene expression.

The course *"Topics in developmental biology"* (BL.0120) reviews specific topics in developmental biology, a central organizing discipline in biology that relates cell and molecular biology, anatomy, ecology, evolution and medicine to each other. The course provides the basic conceptual background of the anatomical, experimental, genetic, cellular, molecular and biotechnical approaches to modern developmental biology. Current topics are among others: limb formation, metamorphosis, aging, regeneration, germ line formation and sex determination, fertilization and implications of developmental biology on human medicine.

The RNA world (BL.0115): The flow of genetic information goes from DNA to RNA, and from RNA to proteins. Then how could the first proteins be made if they are needed for transcription and translation? The hypothesis of the RNA world suggests that catalytic RNAs (ribozymes) may have preceded proteins. This lecture will briefly describe the origins of life and emphasize the importance of ribozymes, their mode of action and their roles in today's world. The mechanism of RNAi interference, the importance of non-coding RNAs and the implications of RNA technology will be discussed.

The lecture course *Experimental genetics* (BL.0114) gives the theoretical background of the main techniques used in modern genetics. Students will learn how to localise genes using deletions, polymorphisms, recombination frequencies and the candidate gene approach. Furthermore, this course presents the design of forward genetic screens, reverse genetics, how to construct strains and the use of sequence databases. This lecture is intended for students who are interested in pursuing their education on genetic model organisms such as *S. cerevisiae*, *Drosophila*, *C. elegans*, Zebrafish and *Arabidopsis*.

The course *Neurogenetics* (BL.0117) consists of an introduction into developmental genetics of *Drosophila* followed by a comprehensive coverage of neurogenetics, the key discipline of developmental neurobiology. The neurogenetic part begins with an overview of modern genetic and neurobiological methods in *Drosophila* and then focuses on the major highlights of neurogenetic research in *Drosophila, C. elegans* and vertebrates. Topics include: early neurogenesis, nervous system regionalization, tissue specification, axonal pathfinding, neuromuscular specificity, biological rhythms, learning and memory, mechanosensation, and olfaction. The topics are covered by an up-to-date script. This lecture is also accessible to MSc students from Berne.

The BeNeFri workshop *Frontiers in neurosciences* (BL.0118) is intended to make students familiar with current frontiers in neurobiological research. The course is given by national and international experts working in very diverse fields of neuroscience. Previous block courses included topics such as brain mapping, hypothalamus, motor systems, neurogenetic model systems, neuroinformatics, olfaction, sensory systems, synaptic function, and visual cortex.

The course *Cellular and genetic networks* (BL.0123) describes how genes and cells function in a complex web of networks to regulate any biological system. Opposite to the reductionist approach to understand life sciences, the systems level approach is much needed and has been emphasized in recent years. In this course, we will cover the cutting-edge topics including transcriptional regulatory networks, neuronal networks, interactions between environment and cellular metabolisms, as well as mathematical modelling. The goal of this course is to learn and discuss how to approach systems-level biological problems by integrating different experimental methods.

Marine biology workshop (BL.0124): The scientific themes will cover an initial general introduction to the marine environment and its diverse ecosystems followed by theoretical and practical introductions to plankton, oceanic nekton, intertidal organisms, and subtidal benthic animals. In subsequent practical comparative work, the morphology and diversity of major invertebrate phyla, including sponges, cnidarians, arthropods, echinoderms and tunicates, and of teleost fish will be explored. Experimental benchwork will focus on fundamental aspects of developmental biology and neurobiology of marine animals. Developmental processes such as fertilization, cell lineage, cell differentiation, organogenesis and larval development will be

analysed in representative marine organisms (echinoderms, ascidians, annelids). Comparative neurobiological experiments will elucidate major sense organ types, central nervous system organization and behavioural control systems in marine organisms. Developmental evolutionary (EvoDevo) aspects will be emphasized in both experimental areas by demonstrations and theoretical presentations. Independent practical work and literature reports by the participating students will be encouraged. This two weeks course will be credited with 4 ECTS.

Light and fluorescence microscopy for life sciences (BL.0125): Fluorescence microscopy has become one of the core techniques in biological research. Its applications range from the study of the expression of specific molecular markers with high spatial resolution in single cells to the probing of cell functions in living organisms. Constant progress in microscope design and in fluorescent probe development has led to a large choice of applications based on the principles of fluorescence microscopy. This course will aim at giving an understanding of key concepts of the main techniques used in life sciences. It will also insist on practical issues essential for a productive use of these techniques in biological and biomedical research.

The practical course, *established and emerging organisms for marine science* (BL.) presents modern experimental and scientific approaches to study marine organisms. The location is Roscoff Biological Station in Brittany, France. Students will be actively involved in practical laboratory work. They also participate in discussions and debates on selected topics from published scientific articles. The number of participants is limited. Please contact the responsible professor, as indicated in the timetable (http://www.unifr.ch/timetable).

Nuclear organization and chromosome dynamics (BL.0130): DNA associated processes, such transcription, replication, recombination, but also chromosome pairing during meiosis occur in the context of the highly organized cell nucleus. Several structural elements of the nucleus such as the nuclear lamina or special nuclear compartments are known to regulate these processes. Changes in the nuclear organization are accompanying development and differentiation processes and defects in the nuclear architecture are known to be responsible for several human diseases. This course will focus on the elements that are shaping the nuclear architecture and their role in the activity of the genome, such as transcription, replication and DNA recombination. Since meiotic nuclei are the home of a beautiful chromosome choreography and an intense nuclear reorganization, this course will also include an overview of the mechanisms underlying these processes. Understanding the molecular mechanisms underlying nuclear organization and chromosome dynamics is essential for human health and fertility. Key concepts of the lecture are nuclear architecture, chromatin domains, nuclear compartment, chromosome territories and pairing, recombination and genome stability.

BeFri Research colloquium in cell and developmental biology I and *II* (BL.0127, BL.0128) consist in half day meetings with 6 presentations by PhD students or junior post-docs of participating groups from the Universities of Fribourg and Bern. MSc students are requested to attend the meetings, to participate to discussions and to provide a short summary of 4 presentations for BL.0127, and four presentations for BL.0128. The meetings will alternatively be held in Fribourg and Bern. The two-day retreat (BL.0129) gives the opportunity to MSc students to present their projects or related topics.

The workshop Systems Biology of the Brain will give a wide overview of various aspects of the systems biology of the brain. Lectures will include large-scale approaches to understand genes, neurons and synaptic connections in the brain. We will provide a broad overview on the evolving fields and reveal solutions of data handling. Moreover various genetic model systems from simple invertebrates such as insects and nematodes to higher mammals will be presented. The goal of the course consists in giving the students an overview into the emerging fields in neurosciences. Thus to provide all basic information of how novel techniques move the border of science and directly impact the approaches of how the complexity brain can be unveiled.

The *Introductory Course in Laboratory Animal Science* takes place in Lausanne in July **(**www.unil.ch/resal/home.html). Summary: This education gives expertise and practical skills for a responsible and gentle handling of laboratory vertebrate animals. Theoretical and practical parts take about 20 hours each, and include the following topics: ethics and legislation, 3R concept, nutrition, transport, husbandry, breeding, transgenic techniques, observation of behaviour, anaesthesia and euthanasia, surgeries, treatments, collection of samples. This course is officially recognized by the Federation of Swiss Cantonal Veterinary Officers (VSKT) as requested by legislation (Swiss ordinance N° 455.171.2, October 1998) to get the accreditation to perform animal experimentation. This training module is relevant to all students working with vertebrate animals. Conditions for registration to this module: 1) The host laboratory must have permission to work with vertebrate animals. 2) Students must be announced to the cantonal veterinary office by the supervisor.

Advanced topics in evolutionary genetics and ecology (BL.0201): the course will cover selected topics, including evolutionary demography, life history evolution, quantitative genetics, meta-population genetics, and genetic analysis of adaptation. It will be largely based on original literature and analysis of data.

The course *Biological invasions and trophic interactions* (BL.0202) builds on knowledge of population biology and plant-insect interactions. We will discuss both ecological and evolutionary explanation of plant invasions and review recent theory and practical applications for their control. The topic will also be highlighted in the context of future climate change conditions.

In the W*orkshop in statistics and experimental design* (BL.0203) students will learn basic and advanced techniques in statistical data analysis and they will perform exercises with data from ecological experiments. In addition, they will propose various experimental designs and discuss their advantages and disadvantages.

Ecological field course (BL.0205): a project-oriented field course taking place at a research field station. With the support of the teachers, the students learn to develop their own research projects, carry them out, and present and write up the results.

Evolutionary biology workshop "Guarda" (BL.0206) is an extramural block course (1 week) involving Swiss and foreign graduate students, as well as invited professors. As part of groups centred on common scientific interest, and in interaction with the teachers, the students design research projects, and write and present grant proposals. The goal is to learn to discuss science, develop criticism and arguments, interact in a scientific team, and write research proposals.

The course *Statistics and experimental design* (BL.0208) aims to introduce basic concepts of statistics and experimental design. The course will cover topics from the description of data set to multilinear regression analysis.

Classical models in biology (BL.6002): the use of simple models to describe the behaviour of biological phenomena has been of great help for their understanding and has often driven researchers to new ideas. Here we will show how to go from the phenomenon to a model and what can be learned using this process. The lecture is illustrated with exercises (BL.6003).

Ecological networks (BL.0213): The course will give an introduction to graph theory and to the historical development of the research on ecological networks. It will tackle key studies on the structure and dynamics of ecological networks, with a special focus on food webs.

Introduction to statistics with R – Model selection **(**BL.0216): Many of us are interested in questions like "which factors influence a certain biological phenomenon?", but are unsure which statistical test to apply. The purpose of the course is to understand which test is appropriate for your data. I'll cover the standard statistical tests and explain in easy-to-understand terms how to use the R software to analyse your data. We cover linear and non-linear regression, t-tests, anova, ancova, multiple regression and other model- fitting techniques. This course provides a short introduction into the R environment, model fitting and then tackles in more depth the problem of model selection (the task

of selecting “good” models from a set of candidate models). The open source software R (http://www.r-project.org) has revolutionized the statistical data analysis for most bioscience disciplines. The R environment is completely free and runs on all common operating systems.

The evolution of life history traits and aging (BL.0219) is an advanced course for students with a solid background in evolutionary ecology, evolutionary genetics and quantitative genetics with a strong interest in understanding Darwinian fitness and natural selection. The basic evolutionary problem the course addresses is how natural selection "designs" organisms to achieve optimal survival and reproductive success. The course will be strongly based on the book "The evolution of life histories”, by Stephen C. Stearns, *Oxford University Press 1992*. The course requires proficiency in English and the willingness to actively engage in discussing, asking questions, reading, presenting material, etc. An understanding of basic statistics and mathematics (including calculus) is helpful.

Tropical ecology (AF_BL.0210) is a project-oriented international field course in tropical Africa, organised by the Tropical Biology Association.

The course with laboratory work *Molecular genetics for ecologists* (LA_BL.0207) is an intensive, practical course on molecular methods.

The course *Symbiosis: how plants and microbes communicate* (BL.0307) deals with the mutual recognition between the plant and the microbial partner, and with the coordination of their development. In general, the course consists of short introductory lectures followed by critical examination of the recent literature on the topic. The goal is to show how scientific knowledge is generated and interpreted.

The course *Plant development: the life of a sessile organism* (BL.0308) describes central issues of developmental programmes involved in embryogenesis, root, shoot, and flower development. The emphasis will be on hormonal control of morphogenesis and pattern formation, and on the determinants of organ identity.

The course *Molecular bases of innate immunity: theoretical and practical aspects* (BL.0317) gives an overview about the basis of plant innate immunity, with a special focus on the molecular aspects. The lectures are combined with a practical course that introduces the students to the most common techniques applied in the field of plant-pathogen interactions, such as plant inoculation, disease resistance scoring, gene expression analysis, and quantification of antimicrobial secondary metabolites and proteins

The course *Drugs and phytochemical analysis* (BL.0318) is a theoretical and practical introduction to the accurate quantification of compounds such as vitamins, drugs and nutrients from complex matrices (cell samples, plant extracts, food, beverage and drugs). It covers extraction methods, the use of internal standards, techniques of purification and chromatography, detection procedures and data analysis, as well as a practical part on Gas Chromatography and Ultra High Performance Liquid Chromatography.

In the lecture *Exploring protein functionality* (BL.0322) we aim at exploring state-of-the-art tools needed to conduct a timely investigation of protein functionality using transporter proteins as example. Beside a critical evaluation on these technical tools given the teacher and the students (via a presentation of technical publications), the course will also offer a practical part that deals with database mining.

In the lecture *Plant biotechnology* (BL.0323) your memory of the basic methods and associated problems of plant transformation will be refreshed. This is followed by an introduction of new methods and technology related to genome engineering. Finally, we will have a look at selected examples of plant biotechnology in commercial applications as well as basic science.

The course Current topics in plant and microbial sciences (BL.0326) comprises three different types of events: i) seminars with external speakers presenting recent work in the fields of plant and microbial sciences, ii) progress reports from master students, PhD students and postdocs,

and iii) a journal club series where recent advances published in international journals are presented and discussed. In the course of the master thesis duration, students are expected to regularly attend and actively participate in the seminars and progress reports, to present their master project at least once and to discuss at least one paper in the journal club.

Scientific writing (BL.0410): In a first part consisting of a few lectures the student will be introduced to the art of writing scientific articles. In a second part, she/he will practice writing a publication.

Master thesis-related activities in the option **Biochemistry** (BL.0400, BL.0403, BL.0404, BC.4402): these consist of different activities comprising seminars with national and international speakers presenting their research and seminars organized by the different groups in relation to their research activities. Literature study/Journal Club (BL.0404) are meetings where researchers and students report and debate recently published articles. BC.4402 are laboratory meetings where members of a research group expose and discuss their current work. BL.0404 and BC.4402 take place within the respective research groups. BL.0403 are research seminars given in front of a larger audience by Master students, doctoral students and post-doctoral fellows.

Master thesis-related activities in the option **Animal Molecular Life Sciences**: (BL.0400, BL.0401, BL.0403, BL.0404): these consist of different activities comprising seminars with national and international speakers presenting their research and seminars organized by the different groups in relation to their research activities. Literature study/Journal Club (BL.0404) are meetings where researchers and students report and debate recently published articles. BL.0401 are laboratory meetings where members of a research group expose and discuss their current work. BL.0401, BL.0404 takes place within the respective research groups. BL.0403 are research seminars given in front of a larger audience by Master students, doctoral students and post-doctoral fellows.

Master thesis-related activities in the option **Ecology and Evolution** (BL.0400; BL.0211, BL.0212, BL.0401, BL.0402): these courses consist of different activities comprising seminars where national and international speakers present their research, Literature study/Journal Club where researchers and students report and debate recently published articles, and research group meetings where the members of the research group expose and discuss their current work.

Master thesis-related activities in the option **Plant and Microbial Sciences** (BL.0400, BL.0401): these courses consist of different activities comprising seminars and discussions where Master students, PhD students, and national and international speakers present their research.

The *Neurobiology seminars* (ME.3001, ME.4001, ME.5001, ME.6001, ME.7001) are given by invited speakers and give an overview on recent developments. Students will have to attend and document their participation by submitting in writing what they think are relevant questions or criticisms after each seminar. This usually requires that they read a small review or some publication abstracts on the presented topic beforehand.

English for Masters Students of Science I: this elective course aims to help Master's students in scientific disciplines develop the English language skills relevant to their studies and future careers. The emphasis will be placed on oral presentation skills, academic writing, strategies for reading comprehension and analysis of texts, and academic listening skills. Target level is B2-C2.

English for Masters Students of Science II: this elective course is a follow-up to *English for Masters Students of Science I*. As such, it will focus more heavily on issues surrounding the writing and oral defence of the Master's thesis. Target level is B2-C2.

During the *Master thesis* (BL.5000) the student familiarizes herself/himself with modern techniques and executes a research project under the guidance of a group leader within a research group of the unit Plant-Microbe Interactions or, upon approval by the study advisor within another research group. This work requires designing and carrying a research strategy, keeping a clear lab journal and data analysis. The results will be written in the form of a scientific article.

Appendix

Master programme option			Anim.Mol. Life Sci.				Biochem.			Ecol. & Evolution			Pl. & Mic. Sciences			PERIODICITY	SEMESTER
Specialization			Molecular and behavioural neuroscience	Regeneration	Developmental biology	Marine biology	Cell cycle and growth control	Biological rhythms	Protein homeostasis	Theoretical and community ecology	Applied ecology	Evolutionary and population genetics	Crop health (interdisciplinary)	Plant molecular biology	Microbiology		
Code	**Title of the teaching unit**	**ECTS**															
BC.4201	Cell cycle control	1.5	E	R	R	E	O	O	O	E	E	E	E	E	E	weekly	Fall
BC.4202	Eucaryotic cell growth control	1.5	E	R	R	E	O	O	O	E	E	E	E	E	E	weekly	Fall
BC.4203	Genotyping (practical course)	2.5	E	E	R	R	O	O	O	E	E	E	E	E	E	block	Fall
BC.7106	Introduction to UNIX/Linux and scripting with Bash	2	E	E	E	R	O	O	O	E	E	O	O	O	O	block	Fall
BC.7107	Bioinformatics (practical + in silico) (requires BC.7106)	3	E	E	E	R	O	O	O	E	E	O	O	O	O	block	Fall
BC.7104	Introduction to protein structure and protein homology modelling	1.5	E	E	E	E	R	O	O	E	E	E	E	O	R	weekly	Spring
BC.7105	Intro. docking small to large mol./molecular graphics (with BC.7104)	1.5	E	E	E	E	R	O	O	E	E	E	E	O	E	weekly	Spring
BL.0114	Experimental genetics	1	R	R	O	E	R	E	E	E	E	E	E	E	E	weekly	Fall
BL.0115	The RNA world	1.5	R	E	O	E	R	R	R	E	E	E	E	E	E	weekly	Fall
BL.0130	Nuclear organization and chromosome dynamics	1	R	R	O	E	O	R	E	E	E	E	E	E	E	weekly	Fall
BL.0117	Neurogenetics	3	O	O	O	R	E	O	E	E	E	E	E	E	E	weekly	Fall
BL.0118	BENEFRI workshop "Frontiers in neurosciences"	1.5	O	E	R	R	E	R	E	E	E	E	E	E	E	block	Fall
BL.0119	Molecular genetics of model organism development	3	O	O	O	O	E	R	E	E	E	E	E	E	E	weekly	Fall
BL.0120	Topics in developmental biology	3	O	O	O	O	E	E	E	E	E	E	E	E	E	weekly	Spring
BL.0127	BeFri colloquium in cell and developmental biology I	1.5	O	O	O	O	R	R	R	E	E	E	E	E	E	block	Spring
BL.0128	BeFri colloquium in cell and developmental biology II	1.5	O	O	O	O	R	R	R	E	E	E	E	E	E	block	Spring
BL.0129	BeFri research retreat in cell and developmental biology	1	O	O	O	O	R	R	R	x	x	x	x	x	x	2 days	Spring
BL.0123	Cellular and genetic networks (BeFri)	3	R	R	R	R	R	R	R	E	E	E	E	E	E	weekly	Fall
BL.0124	Marine biology workshop	4	E	E	E	O	x	x	x	E	E	E	E	E	E	block	Fall
BL.0125	Light and fluorescence microscopy for Life Sciences	3	O	R	R	R	R	R	R	E	E	E	R	R	R	block	Fall
BL.0126	Established and Emerging Organisms for Marine Science	6	E	E	E	O	x	x	x	x	x	x	x	x	x	block	Spring
BL.0421	Oceanography and Marine Ecosystems	1	E	E	E	O	E	E	E	E	E	E	E	E	E	block	Fall
BL.0422	Molecular and Cellular Marine Biology	1	E	E	E	O	E	E	E	E	E	E	E	E	E	block	Spring
UniL	Introductory Course in Laboratory Animal Science	3	E	R	E	E	E	R	E	E	E	E	E	E	E	block	spring
CUSO	Systems Biology of the brain	1.5	R	E	E	E	E	O	E	E	E	E	E	E	E	block	Spring
BL.0201	Advanced topics in evolutionary genetics and ecology	4	E	E	E	E	x	x	x	O	O	O	E	E	E	weekly	Fall
BL.0202	Biological invasions and trophic interactions	4	E	E	E	E	x	x	x	O	O	O	R	E	E	weekly	Fall
BL.0203	Workshop in statistics and experimental design	3	x	x	x	x	x	x	x	O	O	O	O	E	O	weekly	Spring
BL.0205	Ecological field course	5	x	x	x	x	x	x	x	O	O	O	E	E	E	block	Spring
BL.0206	Evolutionary biology workshop "Guarda"	4	x	x	x	x	x	x	x	E	E	R	E	E	E	block	Spring
BL.0213	Ecological networks	2	E	E	E	E	x	x	x	O	R	R	E	E	E	weekly	Spring
BL.0208	Statistics and experimental design	3	E	E	E	E	E	R	R	O	O	O	E	E	E	weekly	Fall
BL.0216	Introduction to statistics with R – Model selection	1	R	R	R	R	R	R	O	O	O	O	O	R	O	block	Fall
BL.0219	The evolution of life histories and aging	1.5	E	E	E	E	E	E	E	E	E	O	E	E	E	weekly	Spring
LA_BL.020	Molecular genetics for ecologists	4	E	E	E	R	x	x	x	E	E	R	E	E	E	block	Fall
AF_BL.021	Tropical biology (TBA field course)	10	E	E	E	E	x	x	x	R	R	R	E	E	E	block	Spring
BL.0307	Symbiosis: how plants and microbes communicate	1.5	E	E	E	E	x	x	x	E	E	E	O	O	O	weekly	Fall
BL.0308	Plant development: the life of a sessile organism	1.5	E	E	E	E	E	E	E	E	E	E	O	O	R	weekly	Fall
BL.0317	Molecular bases of innate immunity: theoretical and practical aspects	3	E	E	E	E	E	E	E	E	E	E	O	R	O	weekly	Spring
BL.0318	Drugs and phytochemical analysis	1.5	E	E	E	E	E	E	R	E	E	E	O	O	O	weekly	Spring
BL.0326	Current topics in plant and microbial sciences	6	E	E	E	E	E	E	E	E	E	E	O	O	O	weekly	Both
BL.0322	Exploring protein functionality	2	E	E	E	E	E	R	E	E	E	E	R	O	R	weekly	Fall
BL.0323	Plant biotechnology	3	E	E	E	E	E	E	E	E	E	E	O	O	R	weekly	Spring
BL.0411	Signalling and Transport	1	R	R	E	E	O	R	R	E	E	E	R	O	R	block	Fall
BL.0412	Introduction to protein structure and function	1	E	E	E	E	O	R	O	E	E	E	R	O	R	block	Fall
BL.0413	Gene regulatory networks	1	R	R	E	R	O	O	O	E	E	E	E	E	E	block	Fall
BL.0414	Cell fate and tissue regeneration	1	R	O	R	E	O	R	R	E	E	E	E	E	E	block	Fall
BL.0415	Cell proliferation	1	E	O	R	R	O	O	O	E	E	E	E	E	E	block	Spring
BL.0416	Biological rhythms	1	O	O	R	R	R	O	O	E	E	E	E	E	E	block	Spring
BL.0417	Evolution on the bench	1	E	E	E	O	R	R	R	E	E	R	E	E	R	block	Spring
BL.0418	Microbial metabolism and genetics	1	E	E	R	R	R	R	R	E	E	E	R	R	O	block	Spring
BL.0419	Advanced imaging (Prerequisite BL.0125)	1	O	R	R	R	R	R	R	E	E	E	R	R	R	block	Spring
BL.0451	Introduction to mass spectrometry and proteomics	1	E	E	E	E	E	E	O	E	E	E	E	E	O	block	Fall
BL.0452	Advanced quantitative proteomics (prerequisite BL.0451)	1	E	E	E	E	E	E	O	E	E	E	E	E	O	block	Spring
BL.0453	Protein homeostasis: translation, quality control, degradation	1	E	E	E	E	E	E	O	E	E	E	E	E	E	weekly	Fall
BL.6002	Classical models in biology (lecture)	3	E	E	E	E	x	x	x	O	R	R	E	E	E	weekly	Spring
BL.6003	Classical models in biology (exercises)	1	E	E	E	E	x	x	x	O	R	R	E	E	E	weekly	Spring
UniFR	*English for Masters Students of Science I*	3	E	E	E	E	E	E	E	E	E	E	E	E	E	weekly	Fall
UniFR	*English for Masters Students of Science II*	3	E	E	E	E	E	E	E	E	E	E	E	E	E	weekly	Spring
BL.0400	Biology seminars	0.5	O	O	O	O	O	O	O	O	O	O	O	O	O	weekly	Both
BL.0420	Career profiling in life sciences	1	O	O	O	O	R	R	R	E	E	E	E	E	E	weekly	Spring
BL.0410	Scientific writing	3	E	E	E	E	n	n	n	O	O	O	O	O	O	weekly	Fall
BL.5000	Master thesis	45	O	O	O	O	O	O	O	O	O	O	O	O	O	block	Both

x	Possible, if prerequisites are met
E	Elective
R	Recommended
O	Obligatory
n	not possible

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