UNIVERSITÉ DE FRIBOURG SUISSE
FACULTÉ DES SCIENCES

UNIVERSITÄT FREIBURG SCHWEIZ
MATHEMATISCH-NATURWISSENSCHAFTLICHE FAKULTÄT

Curriculum for the obtention of the Degree of

Master of Science in Biology

options:

- Biochemistry
- Developmental & Cell Biology
- Ecology & Evolution
- Plant Biology

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Contents

1 Master of Science (MSc)

1.1 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**, **Developmental & Cell Biology**, **Ecology & Evolution**, **Plant Biology**. 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, analyze and present research. The Master also paves the way to a potential PhD and an academic career in biology and related fields.

1.2 Overview

The programme consists of three modules:

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

Four options (specialisations) are offered:

- Biochemistry
- Developmental & Cell Biology
- Ecology & Evolution
- Plant Biology

1.3 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

1.4 Master courses

For each option the University of Fribourg offers a number of obligatory 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) 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.

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 following table provides an overview of the Master courses offered in the four options. "O" indicates a course that is obligatory for a given option. All other 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 in section 8 of this study plan.

Code	Course	ECTS	BC[1]	D&C[2]	E&E[3]	PB[4]
BC.4101 to BC.4130	Blocks of 8-10 lectures = 1.0 ECTS on topical research issues: •01.Cancer Biology, •02.Gene therapy, •03.Epigenetics, •04.HIV virus, •05.Gene regulation, •06.Cell cycle regulation, •07.Yeast genetics, •08.Post-transcriptional control of gene expression, •09.Vesicular transport and organelle biogenesis, •10.Membrane lipid biosynthesis, •11.Lipids as second messengers, •12.Protein lipidation, •13.Protein glycosylation, •14.Autoimmune diseases, •15.Obesity and diabetes mellitus, •16.PI3 Kinases, •17.Chaperones, •18.Protein aggregation diseases, •19.Neurobiology of drug addiction, •20.Molecular clocks and circadian rhythms, •21.Synaptic Plasticity	1 per block	O	E	E	E
BC.4403	Conceptualisation of the master thesis report	4.5	O	-	-	-
BL.0101	Developmental biology I	3	E	O	E	E
BL.0102	Developmental biology II	3	E	O	E	E
BL.0107	Developmental- and neurogenetics	3	E	O	E	E
BL.0108	BENEFRI workshop "Frontiers in Neurosciences"	3	E	O	E	E
BL.0103	The RNA world	0.75	R	O	E	E
BL.0104	Experimental genetics	0.75	E	O	E	E
BL.0106	DNA damage response pathways	0.75	R	O	E	E
BL.0201	Advanced topics in evolutionary genetics and ecology	4	E	E	O	E
BL.0202	Biological invasions and trophic interactions	4	E	E	O	E
BL.0205 or	Ecological field course or	5	E	E	O	E

[2] elective: student choice

BL.0206	Evolutionary biology workshop “Guarda”	4				
BL.0203	Workshop in statistics and experimental design	3	E	E	O	E
AF_BL.0210	Tropical biology (TBA field course)	10	E	E	R	E
BL.0213	Ecological Networks	2	E	E	O	E
BL.0214	Speciation	2	E	E	O	E
GG.0408	Conservation Biogeography	3	E	E	R	E
LA_BL.0207	Molecular genetics for ecologists	4	E	E	R	E
BL.0301	Molecular bases of innate immunity	1.5	E	E	E	O
BL.0309	Diagnostics of fungal diseases of plants	1.5	E	E	R	O
BL.0310	Mycology	1.5	E	E	R	O
BL.0311	Plant bacteria and viruses	1.5	E	E	E	O
BL.0307	Symbiosis: how plants and microbes communicate	1.5	E	E	E	O
BL.0308	Plant development: the life of a sessile organism	1.5	E	E	E	O
BL.0302	Plant biotechnology	1.5	E	E	E	O
BL.0305	Survival of plants in a hostile environment	1.5	E	E	E	O
BL.0303	Methods in cell biology	1.5	E	E	R	O
BL.0306	Cell biology: how the cell modulates the life of a plant	1.5	E	E	E	O
MA.6001	Modelling	3	E	E	O	O
BL.0315	Plant secondary metabolites: biosynthesis and function	1.5	E	E	E	O
–	*English for Master's Students of Science I*	3	E	E	R	E
–	*English for Master's Students of Science II*	3	E	E	R	E
BL.0410	Scientific writing	3	-	O	O	O

[1] option Biochemistry, [2] option Developmental & Cell Biology, [3] option Ecology & Evolution, [4] option Plant Biology

1.5 Master 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 1.4 (see below).

1.6 Master thesis description and assessment

The Master 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 or the Division of Biochemistry. 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 points.

Each student should have chosen and have been accepted by her/his thesis supervisor at the latest by the 4th week (option Biochemistry) or 8th week (all other options) of the first semester of her/his Master studies.

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.

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

1.7 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 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, Developmental & Cell Biology, Ecology & Evolution or Plant Biology.

1.8 Conditions of admission

The acceptance to a Master programme in Biology requires fulfilling both of 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 Freibourg)
- having completed the requirements for a Bachelor of Science degree in Biology or in Biochemistry at the University of Fribourg, or a similar degree acknowledged by the Faculty of Science.

The Faculty of Science 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 upon submission of an application to the *Committee of student requests* (*Commission des requêtes des étudiant-es*) of the Faculty of Science (address: Committee of student request, Dean's Office, Faculty of Science, 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, 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, the student will only be able to begin her/his studies once the prescribed conditions have been met.

1.9 Detailed programmes of the options

1.9.1 Option Biochemistry

[Version 2008, validation packages: MSc1-BL.0402, MSc2-BL.5000]

1.9.1.1 Study programme

Code		Assessment	Semester, year	Hours/ week	ECTS
Obligatory courses					
BC.4101 to BC.4130	Topical research issues, see table under 1.4*	P/F**	3 sem	2	3x3
ME.3001 or ME.4001	Neurobiology Seminars (only molecular topics)	P/F***	AS or SS	0.5	0.5
BC.4020	Biochemistry Lunch Seminars***	P/F****	3 sem	3x1	3x1
BL.0400	Seminars in Biology	P/F	3 sem	1	3x0.5
	Total ECTS credits in obligatory courses				***14***
Elective courses					
	Courses chosen from the table in section 1.4, or from BENEFRI or other MSc programmes.*****		All	6	16
	Minimum ECTS credits in elective courses				***16***
Thesis-related activities					
BC.4401	Literature reading and presentation (in relationship to the master's thesis)	P/F	All	1	3x2
BC.4402	Lab meetings (also takes place during semester breaks)	P/F	All	1	3x1.5
BC.4403	Conceptualisation of the Master thesis report	P/F	All	1	3x1.5
	Total ECTS points in thesis-related activities				***15***
BL.5000	**Master thesis**				**45**
	TOTAL				**90**

* Three blocks are given each semester. Any block is not presented more than once in 2.5 years.

** P/F, passed/failed examination. Students are asked to investigate particular aspects and submit a written summary of their investigations. Validation takes place after the last course has been passed.

*** P/F, passed/failed examination. Students are asked to submit what they think to be relevant questions or criticisms after each seminar.

**** P/F, passed/failed examination. Students must make two presentations

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

1.9.1.2 Description of the courses of the option Biochemistry

The course *Topical research issues* (BC.4101-BC.4130) consists of block courses of 1.0 ECTS (8-10 hours). They intend to give an overview on current research topics in molecular medicine, cell- and molecular biology, in which major advances are made and new concepts and technologies are emerging. Courses are given by teachers who do research on the same or a related topic, and in every semester at least one block is given by an invited scientist from outside Fribourg. The topics are: •01.Cancer Biology, •02.Gene therapy, •03.Epigenetics, •04.HIV virus, •05.Gene regulation, •06.Cell cycle regulation, •07.Yeast genetics, •08.Post-transcriptional control of gene expression, •09.Vesicular transport and organelle biogenesis, •10.Membrane lipid biosynthesis, •11.Lipids as second messengers, •12.Protein lipidation, •13.Protein glycosylation, •14.Autoimmune diseases, •15.Obesity and diabetes mellitus, •16.PI3 kinases, •17.Chaperones, •18.Protein aggregation diseases, •19.Neurobiology of drug addiction, •20.Molecular clocks and circadian rhythms, •21 Synaptic plasticity. These topics may change with time but are usually repeated regularly at ca. 2.5 year intervals. After each block the students will have to further explore a particular aspect by reading the relevant literature and writing a report, which will be assessed by passed or failed criterion. At the end of her/his Master studies, the student will have to pass a written exam that evaluates her/his ability to respond to, question and put into perspective new findings related to the blocks she/he attended.

The *Neurobiology Seminars* (only molecular topics) (ME.3001, ME.4001) 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.

The *Biochemistry Lunch Seminars* (BC.4020) consist of journal clubs on important research articles and of talks by invited speakers. They also take place during semester breaks. During her/his Master studies, each student is required to give two journal club presentations on topics outside the realm of her/his own master thesis work.

The *Master thesis related activities* are as follows: Through *Literature reading and presentation* (BC.4401) the student will familiarize herself/himself with her/his research topic in order to acquire sufficient knowledge on the theoretical background and the available technology for the intended research. She/he will report about this activity during *Lab meetings* (BC.4402) and through writing the introduction and discussion parts of her/his Master thesis. Master students fully participate in the *Lab meetings* (BC.4402), where all students (PhD, postdocs and master students) regularly share their research progress and comment upon recent advances in their field. *Conceptualisation of the Master thesis report* (BC.4403) requires the student to write a project related to her/his thesis work, following the logical outlines of a scientific research project, i.e. containing an abstract, introduction, methods and hypothesis section. He is helped in this by the thesis supervisor who will correct her/his drafts and give advice.

During the *Master thesis* (BL.5000) the student familiarizes herself/himself with modern techniques and executes a research project under the guidance of a qualified investigator within a research group of the Biochemistry Unit or, upon approval by the study advisor, within another research group of the Department of Medicine or of Biology. Generally, the lab work starts during the first weeks of the MSc studies and extends over 3 semesters. 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.

1.9.2 Option Developmental & Cell Biology

[Version 2008, validation packages: MSc1-BL.0103, MSc2-BL.5000]

1.9.2.1 Study programme

Code		Evaluation*	Semester, year	Hours/ week	ECTS
Obligatory courses					
BL.0101	Developmental biology I	OE 30**	AS 1st	2	3
BL.0102	Developmental biology II	OE 30**	SS	2	3
BL.0103	The RNA world	OE 10	AS 1st	1-2	0.75
BL.0104	Experimental genetics	OE 10	AS 1st	1-2	0.75
BL.0106	DNA damage response pathways	OE 20	AS 1st	1	0.75
BL.0107	Developmental- and neurogenetics	WE 90	AS 1st	2	3
BL.0108	BENEFRI workshop "Frontiers in Neurosciences"	P/F	AS	Block course	3
BL.0410	Scientific writing	P/F	AS 1st		3
	Total ECTS credits in obligatory courses				***17.25***
Elective courses					
	Courses chosen from the table in section 1.4 or from BENEFRI or other MSc programmes		AS or SS		-
–	*English for Master's Students of Science I*		AS	2	3
–	*English for Master's Students of Science II*		SS	2	3
	Minimum ECTS credits in elective courses				***12.75***
Thesis-related activities					
BL.0400	Seminars in Biology	P/F	3 sem	1	3x0.5
BL.0111	Research Seminars and Seminars in Zoology	P/F	1.5 y	1	3x1
ME.3001 ME.4001 ME.5001	Neurobiology Seminars	P/F	3 sem	1	3x0.5
BL.0401	Research group meetings	P/F	1.5 y	2	4.5
BL.0402	Literature study/Journal club	P/F	1.5 y	1	4.5
	Total ECTS points in thesis-related activities				***15***
BL.5000	**Master thesis**				**45**
	TOTAL				**90**

* OE 30, oral examination 30 minutes
WE 60, written examination 60 minutes
P/F: passed or failed

** these two courses are examined together

[1] courses of 7 h total

1.9.2.2 Description of the courses of the option Developmental & Cell Biology

The courses *Developmental biology I* and *II* (BL.0101, BL.0102) represent an overview on developmental biology, a central organizing discipline in biology that relates cell- and molecular biology, anatomy, ecology, evolution and medicine to each other. The courses provide the basic conceptual background of the anatomical, experimental, genetic, cellular, molecular and biotechnical approaches to modern developmental biology. They integrate the discussion of the early development of several important model organisms into concise units that detail cleavage, gastrulation and axis formation simultaneously.

The RNA world (BL.0103): nowaday, it is widely known and accepted that the flow of genetic information is based on DNA that is transcribed into RNA, and RNA that is translated into proteins. However, for the origin of life, one compelling question remains: how could proteins appear if they are needed for transcription and translation? The hypothesis of the RNA world suggests that nucleic acids may have preceded the existence of proteins. The discovery of catalytic RNAs (ribozymes) in 1982 has added much to the theory of the RNA world. This lecture course will briefly describe the origins of life and emphasize the importance of ribozymes, their mechanisms of action and their roles in today's world.

The lecture course *Experimental genetics* (BL.0104) describes the theoretical background of the main techniques that are used in modern experimental genetics. Students will learn how to localise genes using deletions, polymorphisms, recombination frequencies and the candidate gene approach. Furthermore, this course will also present the design of forward genetic screens, the reverse genetics approach, and the use of sequence databases. This lecture is intended for students who are interested in pursuing their education on model organisms such as *S. cerevisiae*, *Drosophila*, *C. elegans* and *Arabidopsis*.

The course *DNA damage response pathways* (BL.0106) will focus on the elements of the DNA damage-induced responses, as components of the cell cycle control machinery or the repairing process. It will mainly describe the signalling network of these responses in the nematode *C. elegans*, as well as in yeast and humans and the important links to cancer and other genetic abnormalities. Since double-strand breaks occur not only following genotoxic stress, but also during meiotic prophase, the course will also include mechanisms underlying the meiotic recombination process.

The course *Developmental- and neurogenetics* (BL.0107) 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 path-finding, neuromuscular specificity, biological rhythms, learning and memory, mechanosensation, and olfaction. The topics are covered by an up-to-date script. The BENEFRI workshop *Frontiers in Neurosciences* (BL.0108) 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.

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.

English for Master's 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.

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

Master thesis-related activities (BL.0400; BL.0111, BL.0112, BL.0401, BL.0402): these course consist of different activities comprising seminars where national and international speakers present their research and seminars organized by the different groups in relation to their research activities, 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.

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 Developmental & Cell Biology or, upon approval by the study advisor within a research group of the Department of Medicine. 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.

1.9.3 Option Ecology & Evolution

[Version 2008, validation packages: MSc1-BL.0203, MSc2-BL.5000]

1.9.3.1 Study programme

Code		Assessment*	Semester, year	Hours / week	ECTS
Obligatory courses					
BL.0201	Advanced topics in evolutionary genetics and ecology	OE, 30	AS 1st	3	4
BL.0202	Biological invasions and trophic interactions	OE, 30	AS 1st	3	4
BL.0203	Workshop in statistics and experimental design	P/F	SS 1st	1	3
BL.0205	Ecological field course**			12 d.	5
or	or	P/F	Block SS		
BL0206	Evolutionary biology workshop *Guarda***			7 d.	4
BL.0213	Ecological Networks	OE, 20	SS	2	2
BL.0214	Speciation	OE, 20	SS	2	2
MA.6001	Modelling	OE, 20 or WE, 45	SS	3	3
BL.0410	Scientific writing	P/F	AS		3
	Total ECTS credits in obligatory courses				***25-26***

Recommended elective courses					
LA_BL.0207	Molecular genetics for ecologists (Uni Lausanne)	–	AS	Block course	4
BL.0303	Methods in cell biology	OE, 20	AS	1***	1.5
GG.0408	Conservation biogeography	WE, 60	AS	2	3
BL.0309	Diagnosis of fungal disease	OE, 20	SS	1	1.5
BL.0310	Mycology	OE, 20	SS	1	1.5
BL.0206	Evolutionary biology workshop *Guarda***			7 days	4
or	or	P/F	Block SS	or	
BL.0205	Ecological field course**			12 days	5
AF_BL.0210	Tropical biology (field course, Tropical biology association)	P /F	Block Summer	28 days	10
–	*English for Master's Students of Science I*		AS	2	3
–	*English for Master's Students of Science II*		SS	2	3
	Other elective courses chosen from the table in section 1.4 or from BENEFRI or other Master programmes		AS or SS		
	Minimum ECTS credits in elective courses				***4-5***
Thesis-related activities					
BL.0400	Seminars in Biology	P/F	3 sem	1	3x0.5
BL.0211	Seminars in Ecology and Evolution	P/F	All	1	1.5
BL.0212	Research seminars in Ecology and Evolution	P/F	All	1.5	3
BL.0401	Research group meetings	P/F	All	2	4.5
BL.0402	Literature study/Journal club	P/F	All	1	4.5
	Total ECTS points in thesis-related activities				***15***
BL.5000	**Master research and thesis**				**45**
	TOTAL				**90**

* OE 30, oral exam 30 minutes
WE 60, written examination 60 minutes
P/F: passed or failed

** These two courses take place in alternating years. One is obligatory; the other is recommended as elective and can be taken in the spring before beginning of the Master study.

*** course of 12h total

1.9.3.2 Description of the courses of the option Ecology & Evolution

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 in population biology and plant-insect interactions. We will discuss both ecological and evolutio-

nary 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. In groups centered on a 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.

Modelling (MA.6001): 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 course is illustrated with exercises.

Ecological Networks (BL.0213): [summary in preparation]

Speciation (BL.0214): [summary in preparation]

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.

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.

The lecture course *Methods in cell biology* (BL.0303) will present selected methods e.g. electron microscopy, cell fractionation, etc., together with practical demonstrations.

Students enrolled in the class *Diagnostics of fungal diseases of plants* (BL.0309) will use simple tools (microscope, histochemical stains, internet resources) to determine the major fungal plant diseases.

The class *Mycology* (BL.0310) will present the important features of phytopathogenic fungi.
English for Master's 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.
English for science II: this elective course is a follow-up to *English for Master's Students of Science I*. As such, it will focus more heavily on issues surrounding the writing and oral defence of the Master's thesis.

Master thesis-related activities (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.

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 Ecology & Evolution. 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.

1.9.4 Option Plant Biology

[Version 2007, validation packages: MSc1-BL.0302, MSc2-BL.5000]

1.9.4.1 Study programme

Code		Assessment*	Semester, year	Hours/ week	ECTS
Obligatory courses					
BL.0301	Molecular basis of innate immunity	OE, 20	AS 1st	1**	1.5
BL.0302	Plant biotechnology	OE, 20	AS 1st	1**	1.5
BL.0303	Methods in cell biology	OE, 20	AS 1st	1**	1.5
BL.0315	Plant secondary metabolites: biosynthesis and function	P/F	AS 1st	1**	1.5
BL.0305	Survival of plants in a hostile environment	OE, 20	AS 1st	1**	1.5
BL.0306	Cell biology: how the cell modulates the life of a plant	OE, 20	AS 1st	1**	1.5
BL.0307	Symbiosis: how plants and microbes communicate	OE, 20	AS 1st	1**	1.5
BL.0308	Plant development: the life of a sessile organism	OE, 20	AS 1st	1**	1.5
BL.0309	Diagnostics of fungal diseases of plants	OE, 20	SS	1	1.5
BL.0310	Mycology	OE, 20	SS	1	1.5
BL.0311	Plant bacteria and viruses	OE, 20	SS	1	1.5
MA.6001	Modelling	OE, 20 or WE, 45	SS	2	3
BL.0410	Scientific writing	P/F	AS 1st		3
	Total ECTS credits in obligatory courses				***22.5***
Elective courses					
	Elective courses chosen from the table in section 1.4 or from BENEFRI or other Master programmes		AS or SS		–
–	*English for Master's Students of Science I*		AS	2	3
–	*English for Master's Students of Science II*		SS	2	3
	Minimum ECTS credits in elective courses				***7.5***
Thesis-related activities					
BL.0400	Seminars in Biology	P/F	3 sem	1	3x0.5
BL.0313	Seminars in Plant Biology	P/F	All	1	4.5
BL.0401	Research group meetings	P/F	All	2	4.5
BL.0402	Literature study/Journal club	P/F	All	1	4.5
	Total ECTS points in thesis-related activities				**15**

BL.5000	**Master research and thesis**	**45**
	TOTAL	**90**

* OE 30, oral examination 30 minutes
WE 60, written examination 60 minutes
P/F: passed or failed
** courses of 12 h total

1.9.4.2 Description of the courses in the option Plant Biology

In the course *Molecular bases of innate immunity* (BL.0301), a series of articles will be read, presented and discussed by the participants. The selected articles are major contributions that have shaped our current concepts on the defence of plants to pathogens.

Students enrolled in the class *Diagnostics of fungal diseases of plants* (BL.0309) will use simple tools (microscope, histochemical stains, internet resources) to determine the major fungal plant diseases.

The class *Mycology* (BL.0310) will present the important features of phytopathogenic fungi.

The course *Plant bacteria and viruses* (BL.0311) consists of a series of lectures on phytopathogenic bacteria and viruses.

In the lecture *Survival of plants in a hostile environment* (BL.0305) we will discuss the strategies that allow plants to cope with conditions of abiotic stress caused e.g. by cold, heat, salinity, drought, waterlogging, radiation or wind.

In the lecture *Plant biotechnology* (BL.0302) your memory of the basic methods and associated problems of plant transformation will be refreshed followed by a discussion of various examples of plant biotechnology.

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 *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.

Plant secondary metabolites: biosynthesis and function (BL.0315): Although many of the molecules produced by plants have been attributed roles *in planta*, these molecules are also significant to our own life style. The biogenesis and role of these molecules in plants and the significance to man of some of the more important will be discussed.

The lecture *Methods in cell biology* (BL.0303) will present selected methods e.g. electron microscopy, cell fractionation, etc, together with practical demonstrations.

The course *Cell biology: how the cell modulated the life of a plant* (BL.0306) will present selected topics. A special emphasis will be given, when possible, to the link between cellular processes and the organism.

Modelling (MA.6001): 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 course is illustrated with exercises.

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

Master thesis-related activities (BL.0400, BL.0313, BL.0401, BL.0402): these course consist of different activities comprising seminars where national and international speakers present their research, 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.

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 Biology 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.