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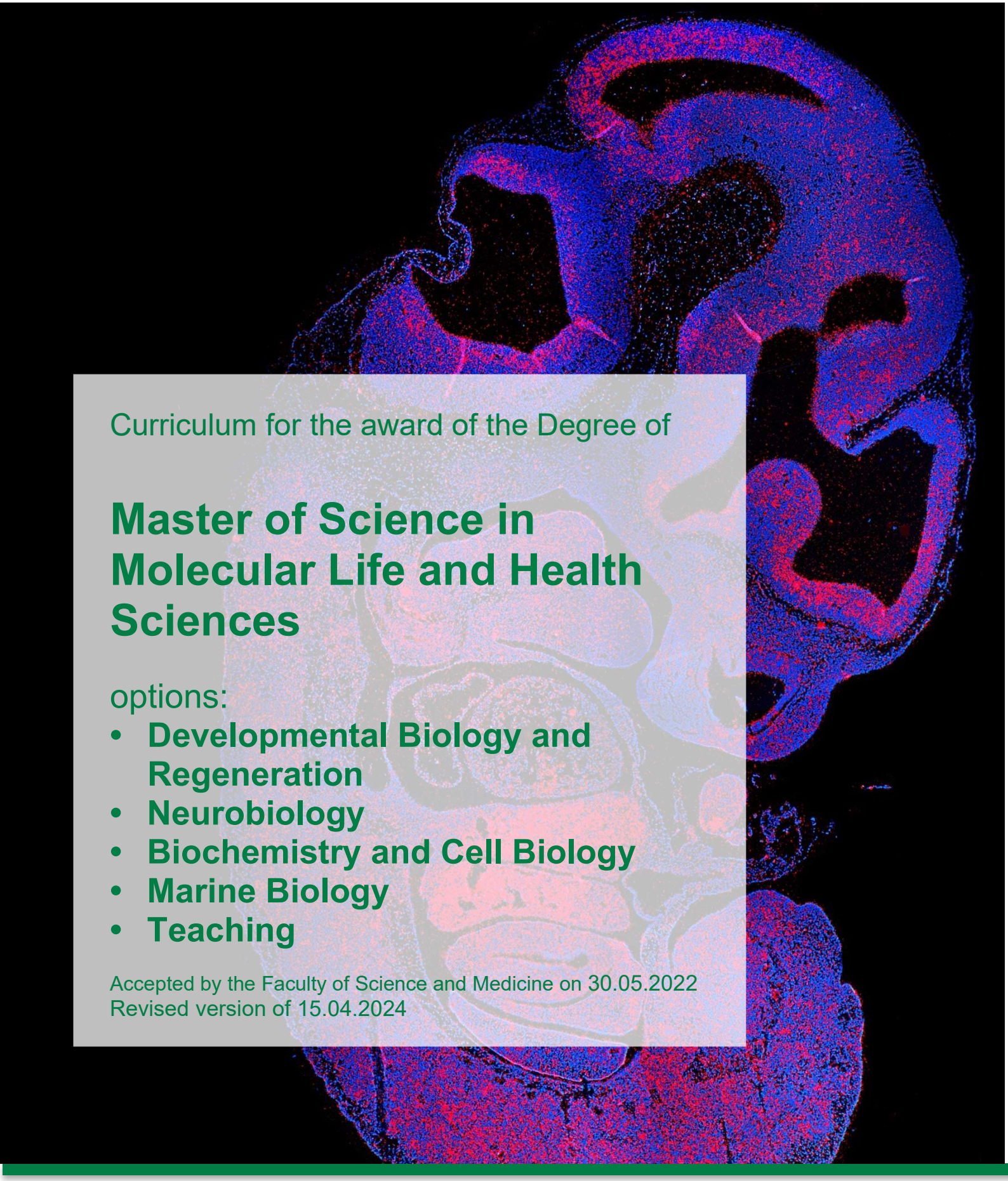

Curriculum for the award of the Degree of

Master of Science in Molecular Life and Health Sciences

options:

- **Developmental Biology and Regeneration**
- **Neurobiology**
- **Biochemistry and Cell Biology**
- **Marine Biology**
- **Teaching**

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

CONTENTS

1 General Remarks

Molecular mechanisms govern the fate and the function of every cell, from archaea living in the remotest trench in the ocean, to the highly connected cells of our brain. Interestingly, cells of various origins share common genes, and therefore use similar proteins and molecular pathways. These can be explored in a variety of model organisms and cultured cells, which you will discover in this exciting Master programme that bridges fundamental molecular science and its potential application to understanding human health and disease.

This curriculum introduces the course structure of the MSc study programme in molecular life and health sciences, which offers five options of specialization. It is based on the regulations of the Faculty of Science and Medicine governing the acquisition of the title of Master of Science (hereafter called Regulations).

The Regulation of 30 May 2022 for the award of the Bachelor of Science and Master of Science degrees establishes a limit on the duration of Bachelor's and Master's studies, as well as of the minor study programmes (see articles 11, 13 and 14) (https://www.unifr.ch/scimed/fr/rules/regulations).

1.1 Academic Titles and Programme of Study

The Faculty of Science and Medicine of the University of Fribourg awards the official academic title of **Master of Science in Molecular Life and Health sciences**, subsequently called **MSc,** to students who have successfully completed their respective study programme and obtained the title of Bachelor of Science (BSc) or a recognized equivalent.

The Department of Biology of the Faculty of Science and Medicine offers a multidisciplinary study programme leading to the degree of Master of Science in Molecular Life and Health Sciences, with the four research options **Developmental Biology and Regeneration, Neurobiology, Biochemistry and Cell Biology,** and **Marine Biology**. The programme consists of 120 ECTS[1] credits and corresponds to 24 months of full-time study. Students aiming at becoming high school teachers and having to acquire 30 additional ECTS credits in a different study domain, can choose the option **Teaching** consisting of 90 ECTS (18 months). English is the official language for all activities. However, 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 theoretical, conceptual and practical knowledge of a selected area of molecular biological sciences and acquire techniques needed in basic research as well as in practical applications such as biomedical and pharmacological research, biotechnology, public health, and teaching at secondary level II. Courses are accompanied by discussions, seminars. oral presentations by students and writing exercises in order to stimulate active participation. 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. Other MSc graduates also find job opportunities as laboratory manager in the academic or private sectors. When accompanied by a subsidiary subject in a discipline figuring on higher secondary school curricula, the MSc, option Teaching, allows students to follow a complementary didactics programme leading to the qualification as a higher

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

secondary school teacher (*Diplôme d'enseignement pour les écoles de maturité (DEEM) / Lehrdiplom für Maturitätsschule (LDM)*).

Candidates in possession of a BSc in Biology or Biochemistry of the University of Fribourg or any other Swiss university judged equivalent are admitted to the MSc course of studies (Art. 8 of the Regulation). Candidates in possession of a BSc degree from abroad, in a different subject or of equivalent degrees (e.g. after graduating from an engineering school) can also be admitted to the MSc study programme by a decision of the Faculty of Science and Medicine to be made in each individual case. Provisional admission can be granted and depends on the fulfilment of additional requirements set by the Faculty (cf. Section 2.4).

1.2 Course Structure

The MSc in Molecular Life and Health Sciences programme allows to choose between 5 options:

- Developmental Biology and Regeneration (DBR), 120 ECTS
- Neurobiology (NEU), 120 ECTS
- Biochemistry and Cell Biology (BCB), 120 ECTS
- Marine Biology (MAR), 120 ECTS
- Teaching (TE), 90 ECTS

The four first options are oriented toward research, while the latter is suited for students who aim at becoming teachers at the secondary level II (DEEM/LDM/KLD).

Completing a Master programme requires minimal amounts of ECTS credits as follows:

- Master courses: 49 ECTS for DBR, NEU, BCB, MAR and 36.5 ECTS for TE.
- Master thesis related activities: 11 ECTS for DBR, NEU, BCB, MAR and 8.5 ECTS for TE.
- Master thesis: 60 ECTS for DBR, NEU, BCB, MAR and 45 ECTS for TE.

The course language is English. An agreement with the Universities of Bern and Neuchâtel (BeNeFri convention) allows students to take elective courses in these institutions and to have them credited for the study program in Fribourg.

The MSc courses can only be assessed and recognized after successful completion of the BSc.

1.2.1 Description of the options

Developmental Biology and Regeneration: This option is centred on the molecular mechanisms that govern animal development in various model systems including the fruit fly *Drosophila melanogaster*, the nematode *Caenorhabditis elegans* and the zebrafish *Danio rerio*. Research groups investigate molecular aspects of regeneration, cell differentiation, epigenetics, gamete formation and aging. Research focuses on fundamental aspects of molecular genetics and cell biology, and often correlates with perspectives on understanding human diseases. The tools employed are among others, molecular genetics, molecular biology, protein analysis, microscopy and imaging, and morphology.

Biochemistry and Cell Biology: This option puts special emphasis on molecular mechanisms regulating health and their dysregulation in disease. Biomolecules regulating the internal clock, nutrient sensing and growth control, lipid metabolism and membrane biogenesis, ribosome biogenesis, and stress responses are analysed by classical biochemical, "omics", and

computational biology approaches. In addition to mammals, especially human cell culture lines, the organisms studied are the mouse and the unicellular eukaryotic fungus *Saccharomyces cerevisiae* (Baker's yeast). The combination of model systems and approaches allows fascinating and detailed studies of gene functions, regulation of cell homeostasis and its dysregulation in human diseases.

Neurobiology: The brain remains one of the biggest unresolved mysteries in life sciences. This orientation focuses on the nervous system, exploring how it functions on different conceptual levels, ranging from genes and genetics, over behaviour and circuits to neurodegeneration. The animal models used include the fruit fly *Drosophila melanogaster*, the nematode *Caenorhabditis elegans*, the cnidarian *Nematostella vectensis*, cephalopods, and the mouse. Research groups engage integrative approaches to investigate neural stem cells and cancer, cell differentiation and connectivity, sensory systems, behaviour, learning & memory and neurodegeneration. The tools employed are molecular genetics, molecular biology, protein analysis, microscopy and imaging, behavioural analysis and many more.

Marine Biology: Oceans harbour the largest diversity of animals, are the core ecosystem impacting climate and are of large economic importance for food production. However, much remains unknown on the biodiversity of marine animals and particularly about the genomes, physiological and molecular adaptions in diverse environments. This option focuses on animals in the marine environment, their biodiversity, and investigates how relevant features emerged in evolution. It provides an overview on behavioural, molecular, physiological, neuronal and developmental mechanisms in Xenocoelomorpha, Cnidarians, and Cephalopods. The curriculum includes several hands-on courses and workshops at leading Marine Stations in Europe.

Teaching: This option combines core courses from the 4 research options and aims at giving a general overview of the MLHS Master programme. It is strictly reserved for students who need to acquire 30 additional ECTS credits in another domain to apply for the education as teachers at secondary level II (DEEM/LDM). These students can also choose one of the 120 ECTS options, or change from the 90 ECTS to a 120 ECTS option while still in their 1st or 2nd semester of Master studies. While the option Teaching also gives access to PhD studies, a complement consisting of approximatively 30 ECTS might be required, depending on the laboratory and University.

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, once the MSc programme completed, students will have shown that they can apply their knowledge to accomplish a project by working independently in a 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

1.4 Assessment of Courses and Acquisition of ECTS Credits

Acquisition of ECTS credits occurs in three steps: assessment of the courses, grouping of courses into validation package, and awarding the respective credits.

Exercises are assessed following the criteria given at the beginning of the course. Admission to the exam corresponding to a lecture course can be subject to meeting the requirements of the corresponding exercise class. **Assessment** of lectures is made by an oral and/or written exam, whose type and duration are regulated in an appendix of this curriculum. Exams take place during the semester, or during the official exam periods (sessions) in winter, summer, and autumn. Students register to session exams via the students' web portal MyUniFR (https://my.unifr.ch), within the stipulated delays for each exam according to the on-line procedure. The marks range

from 6 (highest mark) to 1 (lowest mark). An exam marked below 4 can be repeated once at the next exam session at the earliest.

Validation packages comprise multiple, separately assessed courses. Art. 24 and 27 of the Regulation determines the number of these package whereas this curriculum determines their content. There are two validation packages:

- The *first package* (60 ECTS or 45 ECTS credits) consists of the master courses and the master thesis related activities;
- The *second package* (60 ECTS or 45 ECTS credits) consists of the Master Thesis Module.

The conditions for validation of ECTS credits are described in Art. 25 of the Regulation.

Students can acquire more ECTS credits than needed for the *first package* (45 or 60 ECTS), provided these do not exceed 20% of the credits foreseen for a given package. Further additional ECTS credits will be validated separately (Art.25). The chronological order of validation is decisive.

Changing from one option to another is possible provided that:

1) the average of the grades acquired in the current validation package is at least 4.0.
2) the prerequisites to access the new option are met.

After the validation, upon request, the Dean's office will issue transcripts of records in which exam results and awarded credits are acknowledged (Art. 28 and 30 of the Regulation,), provided the exam fee has been paid.

1.5 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”.

1.6 Regulations and Additional Information

Detailed information about studying Biology can be found in the documents referenced on the web page http://www.unifr.ch/scimed/en/plans which can also be obtained from the Office of the Department of Biology.

2. Master of Science

2.1 Courses Units

For each option, the MSc programme offers a number of obligatory and recommended courses. If prerequisites are met, credits for recommended courses can be replaced by elective[2] Master courses offered in both the MSc in Molecular Life and Health Sciences and the MSc in Environmental Biology programmes (see the appropriate study plan:

https://www.unifr.ch/scimed/en/plans/master).

Elective courses can also be chosen among Master level courses at the Universities of Berne and Neuchâtel (BeNeFri convention). An individual programme of elective courses according to the study programme is established by each student. In this case, the student must consult the study advisor before taking the course.

Students who are close to completing their Bachelor can ask for an anticipated Master (via MyUniFr). If admitted to an anticipated Master, such students are allowed to attend Master courses, but cannot acquire any ECTS credits.

[2] elective: student's choice

2.1.1 Option Developmental Biology and Regeneration

[Version 2024, validation packages : PV-SBL.0000097, PV-SBL.0000098]

Code		Semester	tot. h.	ECTS
General skills (obligatory)				
SBL.00427	Visual communication of data	SS	8	1
Obligatory courses				
SBL.00114	Experimental genetics	AS	8	1
SBL.00115	The RNA world	AS	12	1.5
SBL.00117	Neurogenetics (BeFri lecture)	AS	28	3
SBL.00119	Molecular genetics of model organism development (BeFri lecture)	AS	28	3
SBL.00125	Light and fluorescence microscopy for life sciences	AS	28	3
SBL.00127	BeFri research colloquium in cell and developmental biology I	SS	12	1.5
SBL.00129	BeFri research retreat in cell and developmental biology	SS	2 days	1
SBL.00130	Nuclear organization and chromosome dynamics	AS	8	1
SBL.10001	Modelling human diseases in experimental genetic systems	SS	20	2
SBL.10002	From bench to bedside	SS	5	0.5
SBL.10003	Health-related topics in developmental biology	SS	20	2
SBL.10004	Ethics in stem cell research	SS	8	1
SBL.10006	Developmental biology of marine animal models	AS	8	1
SBL.00414	Cell fate and tissue regeneration	AS	8	1
SBL.00415	Cell proliferation	SS	8	1
SBL.00429	Animal models of regeneration	SS	20	2
Total ECTS credits in obligatory courses				**26.5**

Recommended and elective courses				
–	Courses listed in the table in section 3. Upon approval by the study advisor, courses from the MSc in Environmental Biology or outside the University of Fribourg.			
Recommended courses				
SBL.10007	Polar biology	SS	8	1
SBL.10008	Omics approaches in marine sciences	AS	8	1
SBL.10009	Advanced marine biology practical course	AS, block course	40	4
SBL.00411	Signalling and transport	AS	8	1
SBL.00416	Biological rhythms	SS	8	1
SBL.00418	Microbial metabolism and genetics	SS	8	1
SBL.00419	Advanced imaging	SS	8	1
SBL.00420	Career profiling in life sciences	SS	8	1
SBL.00421	Oceanography and marine ecosystems	AS	8	1

SBL.00428	Optogenetics and photopharmacology	SS	8	1
SBL.00123	Cellular and genetic networks (BeFri lecture)	SS	28	3
SBL.00126	Established and emerging organisms for marine science	SS, block course	10 days	6
SBL.00128	BeFri research colloquium in cell and developmental biology II	SS	12	1.5
SBL.00451	Introduction to mass spectrometry and proteomics	AS	8	1
SBL.00452	Advanced quantitative proteomics (incl. practical course)	SS	12	1
SBL.00453	Protein homeostasis: translation, quality control and degradation	AS	12	1
SBL.00504	Basics in biostatistics [#]	AS	14	1.5
SBL.30001	Introduction to R	AS	3 days	2
SBC.04202	Eucaryotic cell growth control	AS	12	1.5
SBC.04203	Genotyping (practical course)	AS	90	2.5
SBC.07110	Introduction to UNIX and BASH	AS	5 days	2.5
SBL.10013	Zebrafish License course (practical)	AS, SS	3 days	1
UNIL	Introductory course in laboratory animal science	AS	14	1
Language Center UniFr	Select 1-2 English courses with B2 as a minimum target level	AS/SS	–	max 6
Elective courses from the section medicine *				
SME.07100	Models for human diseases	AS	28	3
SME.07200	Infection, inflammation and cancer	AS	28	3
SME.07300	Central nervous system regeneration and repair	AS	28	3
SME.07215	Hot topics in cancer research, Metabolic health and Regenerative biomedicine	SS	28	3
Minimum ECTS credits from recommended and elective courses				**22.5**

Thesis-related activities				
SBL.10103	Research group meetings	3 sem.	3x14	3
SBL.10105	Research seminars in molecular life and health sciences	3 sem.	3x14	3
SBL.00431	Seminars in biology	4 sem.	4x10	2
SBL.10100	Journal club in molecular life sciences	3 sem.	3x14	3
Total ECTS points in thesis-related activities				**11**

SBL.05001	**Master thesis**	3 sem.	**60**
TOTAL			**120**

[#] not possible if SBL.00075 has already been taken during the Bachelor

* prerequisites: human physiology and anatomy (see section 3)

2.1.2 Option Neurobiology

[Version 2024, validation packages : PV-SBL.0000099, PV-SBL.0000100]

Code		Semester	tot. h.	ECTS
General skills (obligatory)				
SBL.00427	Visual communication of data	SS	8	1
Obligatory courses				
SBL.00114	Experimental genetics	AS	8	1
SBL.00115	The RNA world	AS	12	1.5
SBL.00117	Neurogenetics (BeFri lecture)	AS	28	3
SBL.00118	BeNeFri workshop "Frontiers in neurosciences"	AS block	18	1.5
SBL.00119	Molecular genetics of model organism development (BeFri lecture)	AS	28	3
SBL.00123	Cellular and genetic networks (BeFri lecture)	SS	28	3
SBL.00125	Light and fluorescence microscopy for life sciences	AS	28	3
SBL.00127	BeFri research colloquium in cell and developmental biology I	SS	12	1.5
SBL.00128	BeFri research colloquium in cell and developmental biology II	SS	12	1.5
SBL.00129	BeFri research retreat in cell and developmental biology	SS	2 days	1
SBL.10001	Modelling human diseases in experimental genetic systems	SS	20	2
SBL.10002	From bench to bedside	SS	5	0.5
SBL.00416	Biological rhythms	SS	8	1
SBL.00428	Optogenetics and photopharmacology	SS	8	1
SME.05001	Neurobiology seminars	AS	5	0.5
SME.06001	Neurobiology seminars	SS	5	0.5
Total ECTS credits in obligatory courses				**26.5**

Recommended and elective courses				
	– Courses listed in the table in section 3. Upon approval by the study advisor, courses from the MSc in Environmental Biology or outside the University of Fribourg.			
Recommended courses				
SBL.10003	Health-related topics in developmental biology	SS	20	2
SBL.10004	Ethics in stem cell research	SS	8	1
SBL.10006	Developmental biology of marine animal models	AS	8	1
SBL.10008	Omics approaches in marine sciences	AS	8	1
SBL.00126	Established and emerging organisms for marine science	SS, block course	10 days	6
SBL.00130	Nuclear organization and chromosome dynamics	AS	8	1
SBL.00411	Signalling and transport	AS	8	1

SBL.00412	Introduction to protein structure and function	AS	8	1
SBL.00414	Cell fate and tissue regeneration	AS	8	1
SBL.00415	Cell proliferation	SS	8	1
SBL.00419	Advanced imaging	SS	8	1
SBL.00420	Career profiling in life sciences	SS	8	1
SBL.00429	Animal models of regeneration	SS	20	2
SBL.00451	Introduction to mass spectrometry and proteomics	AS	8	1
SBL.00452	Advanced quantitative proteomics (incl. practical course)	SS	12	1
SBL.00453	Protein homeostasis: translation, quality control and degradation	AS	12	1
SBL.00504	Basics in biostatistics[#]	AS	14	1.5
SBL.30001	Introduction to R	AS	3 days	2
SBC.04202	Eucaryotic cell growth control	AS	12	1.5
SBC.04203	Genotyping (practical course)	AS	90	2.5
SBC.07104	Introduction to protein structure and protein homology modelling[§]	SS	14	1.5
SBC.07105	Introduction to docking of small molecules to large macromolecules and molecular graphics[§]	SS	14	1.5

Elective courses from the section medicine *

SME.07100	Models for human diseases	AS	28	3
SME.07200	Infection, inflammation and cancer	AS	28	3
SME.07300	Central nervous system regeneration and repair	AS	28	3
SME.07215	Hot topics in cancer research, Metabolic health and Regenerative biomedicine	SS	28	3

Minimum ECTS credits from recommended and elective courses	**22.5**

[#] not possible if SBL.00075 has already been taken during the Bachelor
[§] must be taken together
* prerequisites: human physiology and anatomy (see section 3)

Thesis-related activities

SBL.10103	Research group meetings	3 sem.	3x14	3
SBL.10105	Research seminars in molecular life and health sciences	3 sem.	3x14	3
SBL.00431	Seminars in biology	4 sem.	4x10	2
SBL.10100	Journal club in molecular life sciences	3 sem.	3x14	3
Total ECTS points in thesis-related activities				**11**

SBL.05001	**Master thesis**	3 sem.	**60**

TOTAL	**120**

2.1.3 Option Biochemistry and Cell Biology

[Version 2024, validation packages : PV-SBL.0000105, PV-SBL.0000106]

Code		Semester	tot. h.	ECTS
General skills (obligatory)				
SBL.00427	Visual communication of data	SS	8	1
Obligatory courses				
SBC.04202	Eucaryotic cell growth control	AS	12	1.5
SBC.04203	Genotyping (practical course)	AS	90	2.5
SBC.07104	Introduction to protein structure and protein homology modelling§	SS	14	1.5
SBC.07105	Introduction to docking of small molecules to large macromolecules and molecular graphics§	SS	14	1.5
SBC.07110	Introduction to UNIX and BASH	AS	5 days	2.5
SBL.10001	Modelling human diseases in experimental genetic systems	SS	20	2
SBL.10002	From bench to bedside	SS	5	0.5
SBL.10010	Altered carbohydrate metabolism in disease	SS	8	1
SBL.20004	Introduction to metabolomics: data acquisition and processing	SS	30	2
SBL.00451	Introduction to mass spectrometry and proteomics	AS	8	1
SBL.00452	Advanced quantitative proteomics (incl. practical course)	SS	12	1
SBL.00453	Protein homeostasis: translation, quality control and degradation	AS	12	1
SBL.00415	Cell proliferation	SS	8	1
SBL.00416	Biological rhythms	SS	8	1
SBL.00418	Microbial metabolism and genetics	SS	8	1
SBL.00428	Optogenetics and photopharmacology	SS	8	1
SBL.00115	The RNA world	AS	12	1.5
SBL.00125	Light and fluorescence microscopy for life sciences	AS	28	3
Total ECTS credits in obligatory courses				**27.5**

Recommended and elective courses				
	– Courses listed in the table in section 3. Upon approval by the study advisor, courses from the MSc in Environmental Biology or outside the University of Fribourg.			
Recommended courses				
SBL.10011	Structure, function and diseases of lipid metabolism	SS	8	1
SBL.10004	Ethics in stem cell research	SS	8	1
SBL.00114	Experimental genetics	AS	8	1
SBL.00117	Neurogenetics (BeFri lecture)	AS	28	3

SBL.00119	Molecular genetics of model organism development (BeFri lecture)	AS	28	3
SBL.00123	Cellular and genetic networks (BeFri lecture)	SS	28	3
SBL.00127	BeFri research colloquium in cell and developmental biology I	SS	12	1.5
SBL.00128	BeFri research colloquium in cell and developmental biology II	SS	12	1.5
SBL.00129	BeFri research retreat in cell and developmental biology	SS	2 days	1
SBL.00130	Nuclear organization and chromosome dynamics	AS	8	1
SBL.00411	Signalling and transport	AS	8	1
SBL.00412	Introduction to protein structure and function	AS	8	1
SBL.00414	Cell fate and tissue regeneration	AS	8	1
SBL.00419	Advanced imaging	SS	8	1
SBL.00420	Career profiling in life sciences	SS	8	1
SBL.00425	Metagenomics data analysis	SS	14	1
SBL.00504	Basics in biostatistics[#]	AS	14	1.5
SBL.30001	Introduction to R	AS	3 days	2
UniBe	Introduction to high-performance computing	AS	2 days	1
SBC.07107	Bioinformatics (practical + in silico)	AS	42	3
SBL.20001	Biostatistics I – generalized linear models and mixed effects models	AS	28	3
UniL	Introductory course in laboratory animal science	AS	14	1
Language Center UniFr	Select 1-2 English courses with B2 as a minimum target level.	AS/SS	–	max 6

Elective courses from the section medicine *

SME.07100	Models for human diseases	AS	28	3
SME.07200	Infection, inflammation and cancer	AS	28	3
SME.07300	Central nervous system regeneration and repair	AS	28	3
SME.07215	Hot topics in cancer research, Metabolic health and Regenerative biomedicine	SS	28	3

Minimum ECTS credits from recommended and elective courses	**21.5**

Thesis-related activities

SBL.10103	Research group meetings	3 sem.	3x14	3
SBL.10105	Research seminars in molecular life and health sciences	3 sem.	3x14	3
SBL.00431	Seminars in biology	4 sem.	4x10	2
SBL.10100	Journal club in molecular life sciences	3 sem.	3x14	3
Total ECTS points in thesis-related activities				**11**

[#] not possible if SBL.00075 has already been taken during the Bachelor

[§] must be taken together

* prerequisites: human physiology and anatomy (see section 3)

SBL.05001	**Master thesis**	3 sem.	**60**
TOTAL			**120**

2.1.4 Option Marine Biology

[Version 2024, validation packages : PV-SBL.0000107, PV-SBL.0000108]

Code		Semester	tot. h.	ECTS
General skills (obligatory)				
SBL.00427	Visual communication of data	SS	8	1
Obligatory courses				
SBL.10006	Developmental biology of marine animal models	AS	8	1
SBL.10007	Polar biology	SS	8	1
SBL.10008	Omics approaches in marine sciences	AS	8	1
SBL.10009	Advanced marine biology practical course	AS, block course	40	4
SBL.00421	Oceanography and marine ecosystems	SS	8	1
SBL.00126	Established and emerging organisms for marine science	SS, block course	10 days	6
SBL.00125	Light and fluorescence microscopy for life sciences	AS	28	3
SBL.20001	Biostatistics I – generalized linear models and mixed effects models	AS	28	3
Language Center UniFr	Select 1-2 English courses with B2 as a minimum target level	AS/SS	–	max 6
Total ECTS credits in obligatory courses				**27**

Recommended and elective courses				
–	Courses listed in the table in section 3. Upon approval by the study advisor, courses from the MSc in Environmental Biology or outside the University of Fribourg.			
Recommended courses				
SBL.00114	Experimental genetics	AS	8	1
SBL.00117	Neurogenetics (BeFri lecture)	AS	28	3
SBL.00119	Molecular genetics of model organism development (BeFri lecture)	AS	28	3
SBL.00123	Cellular and genetic networks (BeFri lecture)	SS	28	3
SBL.00127	BeFri research colloquium in cell and developmental biology I	SS	12	1.5
SBL.00128	BeFri research colloquium in cell and developmental biology II	SS	12	1.5
SBL.00129	BeFri research retreat in cell and developmental biology	SS	2 days	1
SBL.00416	Biological rhythms	SS	8	1

SBL.00418	Microbial metabolism and genetics	SS	8	1
SBL.00419	Advanced imaging	SS	8	1
SBL.00420	Career profiling in life sciences	SS	8	1
SBL.00428	Optogenetics and photopharmacology	SS	8	1
SBL.00451	Introduction to mass spectrometry and proteomics	AS	8	1
SBL.00452	Advanced quantitative proteomics (incl. practical course)	SS	12	1
SBL.10011	Structure, function and diseases of lipid metabolism	SS	8	1
SBL.20032	Population and evolutionary dynamics	SS	28	3
SBL.20036	Global change	AS	28	3
SBL.00504	Basics in biostatistics[#]	AS	14	1.5
SBL.30001	Introduction to R	AS	3 days	2
SBC.07110	Introduction to UNIX and BASH	AS	5 days	2.5
UniBe	Introduction to high-performance computing	AS	2 days	1
SBC.07107	Bioinformatics (practical + in silico)	AS	42	3
Minimum ECTS credits from recommended and elective courses				**22**

Thesis-related activities				
SBL.10103	Research group meetings	3 sem.	3x14	3
SBL.10105	Research seminars in molecular life and health sciences	3 sem.	3x14	3
SBL.00431	Seminars in biology	4 sem.	4x10	2
SBL.10100	Journal club in molecular life sciences	3 sem.	3x14	3
Total ECTS points in thesis-related activities				**11**

[#] not possible if SBL.00075 has already been taken during the Bachelor

SBL.05001	**Master thesis**	3 sem.	**60**
TOTAL			**120**

2.1.5 Option Teaching

[Version 2024, validation packages : PV-SBL.0000095, PV-SBL.0000096]

This option combines obligatory courses from the 4 research options and aims at giving a general overview of the MLHS Master programme. This 90-ECTS option is for students who need to acquire 30 additional ECTS credits in another domain.

Code		Semester	tot. h.	ECTS
General skills (obligatory)				
SBL.00427	Visual communication of data	SS	8	1
Obligatory courses				
SBL.00114	Experimental genetics	AS	8	1
SBL.00115	The RNA world	AS	12	1.5
SBL.00119	Molecular genetics of model organism development (BeFri lecture)	AS	28	3
SBL.00414	Cell fate and tissue regeneration	AS	8	1
SBL.00415	Cell proliferation	SS	8	1
SBL.00416	Biological rhythms	SS	8	1
SBL.00502	General concepts for biology teachers	SS	8	1
SBL.00421	Oceanography and marine ecosystems*	SS	8	1
	or			
SBL.10007	Polar biology*	SS	8	1
SBL.00453	Protein homeostasis: translation, quality control and degradation	AS	12	1
SBL.10001	Modelling human diseases in experimental genetic systems	SS	20	2
SBL.10002	From bench to bedside	SS	5	0.5
SBL.10004	Ethics in stem cell research	SS	8	1
SBL.10006	Developmental biology of marine animal° models	AS	8	1
	or			
SBL.10008	Omics approaches in marine sciences°	AS	8	1
Total ECTS credits in obligatory courses				**17**

* only one course is obligatory, the other is elective
° only one course is obligatory, the other is elective

Recommended and elective courses

– Courses listed in the table in section 3. Upon approval by the study advisor, courses from the MSc in Environmental Biology or outside the University of Fribourg.

Recommended courses

SBL.10003	Health-related topics in developmental biology	SS	20	2
SBL.10007	Polar biology	SS	8	1
SBL.10008	Omics approaches in marine sciences	AS	8	1
SBL.00117	Neurogenetics (BeFri lecture)	AS	28	3
SBL.00123	Cellular and genetic networks (BeFri lecture)	SS	28	3
SBL.00125	Light and fluorescence microscopy for life sciences	AS	28	3

SBL.00130	Nuclear organization and chromosome dynamics	AS	8	1
SBL.00127	BeFri research colloquium in cell and developmental biology I	SS	12	1.5
SBL.00128	BeFri research colloquium in cell and developmental biology II	SS	12	1.5
SBL.00129	BeFri research retreat in cell and developmental biology	SS	2 days	1
SBL.00411	Signalling and transport	AS	8	1
SBL.00418	Microbial metabolism and genetics	SS	8	1
SBL.00420	Career profiling in life sciences	SS	8	1
SBL.00428	Optogenetics and photopharmacology	SS	8	1
SBL.00429	Animal models of regeneration	SS	20	2
SBL.00451	Introduction to mass spectrometry and proteomics	AS	8	1
SBL.00452	Advanced quantitative proteomics (incl. practical course)	SS	12	1
SBL.00504	Basics in biostatistics[#]	AS	14	1.5
SBC.30001	Introduction to R	AS	3 days	2
SBC.07110	Introduction to UNIX and BASH	AS	5 days	2.5
UniL	Introductory course in laboratory animal science	AS	14	1

Minimum ECTS credits from recommended and elective courses	**19.5**

[#] not possible if SBL.00075 has already been taken during the Bachelor

Thesis-related activities				
SBL.10104	Research group meetings	2 sem.	2x14	2
SBL.10105	Research seminars in molecular life and health sciences	3 sem.	3x14	3
SBL.00432	Seminars in biology	3 sem.	3x10	1.5
SBL.10102	Journal club in molecular life sciences	2 sem.	2x14	2
Total ECTS points in thesis-related activities				**8.5**

SBL.05002	**Master thesis**	2 sem.	**45**
TOTAL			**90**

2.2 Course Contents of the Master Programme

2.2.1 Lecture Courses

2.2.1.1 Statistics, genomics and bioinformatics

- *Basics in biostatistics* (SBL.00504). This course aims at teaching basic knowledge in data management, statistics, and analysis. Specifically, it introduces fundamental concepts such as population, sample, standard error, confidence interval, Type I and Type II errors and p-value. We then look at the statistical tools most commonly used in biology, such as Student's t-test, ANOVA (1 and 2 factors; repeated measures), correlation, linear

regression, sample size determination, and more. This course cannot be taken together with SBL.00075, or if SBL.00075 has already been validated.

- *Introduction to R* (**SBL.30001**)*:* This course introduces the basic usage of the statistical programming language R. The focus will be on data structures (vectors, matrices and data frames), import / export of data, basic plotting, writing of functions and scripts for reproducible data analysis. The course will be largely "hands-on" and does not require any prior knowledge on R.
- *Introduction to UNIX and BASH* (**SBC.07110**): The students will learn the basics of computing and programming, with an emphasis on UNIX operating system and command-line examples. They will learn BASH scripting using modern tools, including regular expressions.
- *Introduction to high-performance computing* (1 ECTS; also listed as "HPC" in this study plan). This lecture with exercises introduces the use of high-performance computing centres, with a focus on the IBU cluster. Prerequisite: SBC.07110, *Introduction to UNIX and BASH.*
- The course *Bioinformatics (practical + in silico)* (**SBC.07107**) will allow the students to sequence a genome and analyse real genomic data. The goal is to identify potential mutations responsible for the phenotype. Prerequisite: SBC.07110, *Introduction to UNIX and BASH* and *Introduction to high-performance computing* (UniBe).
- *Biostatistics I - generalized linear models and mixed effects models* (**SBL.20001**). From this lecture with exercises, students will learn basic and advanced techniques in biostatistics, they will perform exercises with data from ecological experiments. Specifically, the following topics will be introduced: linear, Poisson, and Binomial regression; AIC, BIC, model selection, and model averaging; random effects and mixed effects models; correlation structure (e.g., time series, spatial, phylogeny). This course is given biennially.
- The block course **SBL.30004** *Organisation and annotation of eukaryote genomes* examines the main evolutionary processes shaping the organization plant and animal genomes. It compares and operates complementary approaches to characterize gene models as well as transposable element in model and non-model organisms. Using adequate tools to identify duplicated sequences and 'junk DNA', it will also address how to benefit from genomic variation. A mix of lectures and practical exercises will enable students to take advantage of current approaches to robustly describe and understand Eukaryote genomes. SBC.07110 is a prerequisite for this course.
- The lecture with exercises **SBL.00425** teaches *Metagenomics data analysis*. Students will learn the basic principles of metagenomics data analysis and their associated methods. The course will cover the targeted methods (16S, ITS) as well as the Whole Genome/Transcriptome Sequencing methods, both in prokaryotes and eukaryotes. Students will learn which kind of data could be extracted from metagenomics analysis and how to analyse and represent these data. BC.7106 or equivalent is a prerequisite to access this course.

2.2.1.2 General skills

- The goal of the course *Visual communication of data* (**SBL.00427**) is to provide students with the theoretical background and practical skills needed to design and create efficient graphics that fairly present quantitative data. The course content includes an overview of classical and less classical graphic types available, guidelines on how to choose the best representation based on the type of data, tricks to emphasize specific messages without

inducing bias, as well as major pitfalls to avoid. Practical exercises are carried out using Excel and other simple software.

- *Career Profiling in life sciences* (**SBL.00420**): 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 get prepared 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.
- The teaching unit *General concepts for biology teachers* (**SBL.00502**) consists in a personal work aimed at refreshing the knowledge in biology acquired at Bachelor and Master levels. The student reviews his or her course notes with the aim of being able to explain general concepts **simply, concisely and clearly**. The questions are of a general nature and cover the following teaching units: SBL.00001 ; SBL.00002 ; SBL.00040 ; SBL.00041 ; SBL.00074; SBL.00013, SBL.00021 ; SBL.00045 ; SBL.00063 ; SBL.00014 and SBL.00019. The exam can also be taken in German or in French.
- *English course for Master students*. We do not provide a specific title, as this can vary depending on the current offer from the Language Center and the student's proficiency. The selected course(s) help(s) Master's students in scientific disciplines develop the English language skills relevant to their studies and future careers. Target level must be B2-C2. An online placement test is necessary to find the right course for your level.

  More info: https://www.unifr.ch/centredelangues/en/courses/semester/

2.2.1.3 Technical skills

- *Light and fluorescence microscopy for life sciences* (**SBL.00125**): 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.
- Fluorescence microscopy has become the preferred imaging tool for biological systems due to its capability to visualize specifically the target biomolecules under conditions compatible with life, like room temperature, liquid environment and irradiation with visible light. Fluorescence microscopy also provides very high sensitivity down to the detection of single molecules. As drawback, as it happens with any a far-field optical technique, the spatial resolution is limited by the wavelength of light to a few hundreds of nanometres (the so-called diffraction limit). Remarkably, in the mid 2000s, a series of imaging methods using fluorescence readout were developed that deliver images with resolution beyond the diffraction limit. These methods, called super-resolution fluorescence microscopy or far-field fluorescence nanoscopy and whose pioneers were awarded with the Nobel Prize in Chemistry in 2014, have revolutionized biological imaging and continued to be developed until the present day. In the lecture *Advanced imaging* (**SBL.00419**), we will revise the working principles of super-resolution microscopy and its development from the first generation of methods up to the newest methods capable of achieving 1 nm resolution under ambient conditions. We will discuss the performance and technical aspects of the necessary hardware and sample preparation for each one of the different modalities of

super-resolution microscopy existing today. Also, we will perform experiments hands-on to obtain super-resolved fluorescence images, including the acquisition and analysis of data. SBL.00125 is a prerequisite for SBL.00419.

- The laboratory course *Genotyping* (**SBC.04203**) teaches students molecular methods how to distinguish between different alleles. In principle, this laboratory course is performed on tissue samples from mice.

- The courses *Introduction to mass spectrometry and proteomics* and *Advanced quantitative proteomics* (**SBL.00451** and **SBL.00452**) 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 SBL.00451 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 SBL.00452 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. SBL.00451 is a prerequisite to take part in SBL.00452.

- **Zebrafish License Course** is composed of a three-day practical part (SBL.10013, 20 hours, 1 ECTS), organized by the laboratory of Prof. Anna Jazwinska, and a theoretical part (*Introductory course in laboratory animal science*, see below).
  The workshop *Zebrafish license course* (practical, **SBL.10013**) is a three-day laboratory course. This course is offered in the frame of legally certified education, called "Zebrafish Module 1", which is coordinated and supervised by ResAL (Réseau des animaleries lémaniques) in the French speaking part of Switzerland. The completion of the course leads to obtaining an official license that is mandatory for people conducting research with zebrafish.
  MSc or PhD students, as well as technicians, postdoctoral researcher, and group leaders, working on a zebrafish project are required to possess "Zebrafish Module 1" license. SBL.10013 covers fish housing, feeding, breeding, health monitoring, animal procedures, surgeries, sampling, transgenic techniques, and necropsy. SBL.10013 is offered every semester to students taking the option "Developmental Biology and regeneration". Please register to the practical course at least one month before the beginning of the semester (anna.jaswinska@unifr.ch). SBL.10013 cannot be taken without the theoretical ResAL course (see below).

- The *Introductory course in laboratory animal science* takes place online with a Zoom link that is provided by the University of Lausanne (www.unil.ch/resal/home.html). This education gives expertise and practical skills for a responsible and gentle handling of laboratory vertebrate animals. The theoretical part takes about 14 hours, is worth 1 ECTS, and includes the following topics: ethics in animal research, legislation, 3R principle, analgesia, pain evaluation, anaesthesia housing and breeding. 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.

- *Introduction to metabolomics: data acquisition and processing* **(SBL.20004)**: This lecture with a practical part is an introduction to metabolomics (the large-scale study of small molecules in complex mixtures). It will cover extraction methods, sample preparation, separation techniques and chromatography, detection procedures and data analysis

(quantitative and qualitative). A particular focus will be given to mass spectrometry-based metabolomics of specialized metabolomes and its applications in environmental biology and natural products research. The course includes a practical part on GC or LC-MS (Gas Chromatography or Liquid Chromatography coupled to Mass Spectrometry) and data processing.

2.2.1.4 Molecular sciences

- The course *Eucaryotic cell growth control* (**SBC.04202**) covers the latest advances in our understanding on how nutrient signals are integrated to properly adjust cellular growth in eukaryotes.
- The two courses *Introduction to protein structure and protein homology modelling* and *Introduction to docking of small molecules to large macromolecules and molecular graphics* (**SBC.07104** and **SBC.07105**) 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. SBC.07104 and SBC.07105 must be taken together.
- *Altered Carbohydrate Metabolism in Disease* (**SBL.10010**). This course covers disease-relevant changes of glycosylation. Glycans play important roles in energy generation, protein folding and generation of molecular structures, cell-cell interactions and signalling. Here we discuss how these processes are dysregulated in diseases including cancer, autoimmune disease and cardiovascular disorders. The course has a specific focus on how to target disease-associated glycosylation for therapeutic approaches.
- *Structure, function and diseases of lipid metabolism* (**SBL.10011**). Lipids are fundamental building blocks of cellular membranes, serve to store metabolic energy, and play key roles in signal transduction and membrane trafficking. Here we discuss the different types of lipids made by eukaryotic cells, their specific structure, function, synthesis and turnover, and diseases associated with defects in lipid metabolism, both at the cellular and organismal level.
- *The RNA world* (**SBL.00115**): 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. Other themes include the discovery and mechanism of RNA interference, the importance of small and long non-coding RNAs, RNA-based technologies including RNA vaccines, the evolution of RNA-based adaptive CRISPR immunity.
- The course *Signalling and transport* (**SBL.00411**) 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* (**SBL.00412**) 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. Students are kindly requested to bring a personal laptop computer (Windows, MacOS, or Linux). This course is recommended for those who intend to follow SBC.07104 and SBC.07105.

- The course *Microbial genetics and metabolism* (**SBL.00418**) 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.
- In the course *Protein homeostasis: translation, quality control and degradation* (**SBL.00453**), 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.

2.2.1.5 Developmental biology and regeneration

- The lecture course *Experimental genetics* (**SBL.00114**) 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, and CRISPR technology for gene editing. 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 *Molecular genetics of model organism development* (**SBL.00119**) 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 *Cellular and genetic networks* (**SBL.00123**) 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.

- *BeFri Research colloquium in cell and developmental biology I* and *II* (**SBL.00127**, **SBL.00128**) 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 SBL.00127, and four presentations for SBL.00128. The meetings will alternatively be held in Fribourg and Bern. The two-day research retreat (**SBL.00129**) gives the opportunity to MSc students to present their projects or related topics.
- *Nuclear organization and chromosome dynamics* (**SBL.00130**): 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.
- The course *Health-related topics in developmental biology* (**SBL.10003**) provides the basic conceptual background of the anatomical, experimental, genetic, cellular, molecular and biotechnical approaches to modern developmental biology. For every topic, examples related to human health and disease will be presented. Current topics are limb formation, aging, germ line formation, sex determination, and fertilization.
- Lecture course *Cell fate and tissue regeneration* (**SBL.00414**). 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* (**SBL.00415**) 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* (**SBL.00416**) 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.

- The lecture **SBL.00429** *Animal models of regeneration* describes the processes of wound healing following injury. The ability to recreate a fully functional copy of the missing organ is a rare and fascinating phenomenon occurring in certain groups of animals. This course deals with conceptual models of regenerative principles in animals, as well as cellular and molecular mechanisms underlying efficient regeneration of body parts in various invertebrates and vertebrates. The course offers microscopic and molecular experiments aiming to assess regeneration in several model organisms. The techniques include animal procedures in hydra, tunicates and zebrafish embryos, live analysis of fin regeneration in adult zebrafish, collection and fixation of regenerating adult organs for molecular analysis, histological preparation, fluorescent visualization of specific tissues, microscopic imaging, and data interpretation

2.2.1.6 Neurosciences

- The course *Neurogenetics* (**SBL.00117**) 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* (**SBL.00118**) 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.

- *Optogenetics and photopharmacology* (**SBL.00428**) are two modern, fast-developing fields that use light-responsive molecules as tools for scientific research and hold promises for medical interventions. The lecture course will present ‘sensors’ used to monitor specific molecular events, as well as light-controlled molecules used to manipulate the activity of specific cells within a cellular network or the activity of specific signaling pathways within a cell. Richly illustrated with examples, the course covers the principles of these approaches, their main advantages and limitations, as well as current challenges for their application in translational medicine

2.2.1.7 Health sciences

- **SBL.10001** *Modelling human diseases in experimental genetic systems*. Model organisms have long served for research on fundamental aspects of basic biology. More recently, they have also proven helpful in modeling human diseases, in the identification of drug targets, and in the evaluation of potential therapeutic agents. In this context, this course provides an overview on the most commonly used model organisms (ranging from simple eukaryotes such us budding yeast to more complex ones including nematodes, flies, zebrafish, and mice) and model systems (such as human cell cultures and organoids). We will discuss the specific advantages and limitation of each of these organisms and systems for modeling human diseases including neurodegenerative, cardiovascular, respiratory, muscular, skin, and hyperproliferative diseases including cancer. In addition, we will also

delineate how these model systems can be exploited to identify molecular mechanisms and therapeutic strategies for the treatment of diverse human diseases. This lecture requires knowledge of the main genetic organisms (SBL.00119).

- The lecture **SBL.10002** *From bench to bedside* presents a broad overview of the many steps separating fundamental biomedical discoveries from therapeutic applications. Covered aspects include drug development, clinical trials, drug repurposing, as well as the use of biomarkers in the emerging field of precision medicine.
- The course **SBL.10004** *Ethics in stem cell research* provides an overview of this wide-ranging and fast-moving field of biomedical sciences. We will address ethical implications and policy issues that are the most significant for this research domain, including controversy surrounding human embryonic stem cells, human-animal chimeras, and gametes. We will discuss the importance of information disclosure, the risk for overpromising and the therapeutic misconception of stem cells.
- The course *Models for human diseases* (**SME.07100**) presents relevant experimental models and integrative approaches for understanding physio-pathological processes of human diseases, including aging and age-related diseases such as heart failure, atherosclerosis, metabolic disorders and renal disease. Advantages and pitfalls of the models for the human diseases will be analysed. Prospective translational aspects of modifying the disease process by nutrition, therapeutics, gene/stem cell therapy, development of new drug candidates as well as choice of the best animal model for the targeted therapeutic area will be discussed.
- The course *Infection, inflammation and cancer* (**SME.07200**) provides a comprehensive theoretical basis to the understanding of novel paradigms and emerging areas of research in the field of infection diseases, inflammation and cancer. The course will cover topics such as mechanisms of initiation of inflammation, perception of inflammation, the role of inflammation in cancer initiation and progression and novel pathogens and emerging resistance in infection diseases. Emphasis will be put on highlighting the significance of recently acquired knowledge in these areas and its relevance to experimental research and clinical medicine.
- The course *Central nervous system regeneration and repair* (**SME.07300**) provides the conceptual background necessary for understanding major approaches for helping the brain recover from neural pathologies. The importance of behavioural characterization, functional measurements as well as therapeutic interventions such as psychopharmacology or electrical brain stimulation is illustrated by relevant examples drawn from clinical and basic science.
- The course *Hot topics in Cancer research, Metabolic health and Regenerative biomedicine* **(SME.07215**), comprises a selection of current topics at the forefront of biomedical research presented by experts in each field. Topics vary each year and usually include, among others, cancer immunotherapy, biomarkers in cancer, vaccines, oxidative stress, tissue fibrosis, regeneration and nanomedicine. The course consists of overview lectures, scientific workshops, and demonstrations in the lab. Students will gain insights into some of the hottest and rapidly evolving research topics in the field as well as experience in critical discussion of emerging scientific questions.

2.2.1.8 Evolution

- The lecture *Population and evolutionary dynamics* (**SBL.20032**) focuses on the ecological and evolutionary dynamics of populations. In the 1st part students will study basic and advanced concepts of population dynamics, including population growth and growth rates, age-structured models (Leslie matrix; Euler-Lotka equation), limiting factors and density-dependence, and demographic principles of life-history evolution. In the 2nd part, students

will be introduced to evolutionary dynamics, including replicator dynamics in population genetics, the principles of evolutionary game theory and adaptive dynamics. Students will learn, for example, the key concept of fitness landscapes and how they are defined from the underlying population dynamics. They will then study the evolution of fitness landscapes and, in particular, how selection acts on different evolutionary strategies. The students are expected to have a basic knowledge (BSc level) of ecology, evolutionary biology, and population genetics. This course is given biennially and alternates with *Community ecology.*

- Lecture *Global change* (**SBL.20036**): How is biodiversity affected by environmental challenges? Describing the evolutionary ecology of organisms from local to global scales, this course provides an overview of processes that shape the origin, expansion and extinction of species in space and time. Through series of lectures and personal work, it compares the biodiversity and biogeography of varied ecosystems such as drought-related deserts, long-populated Mediterranean regions and alpine ranges in order to organize main drivers of variation in a coherent framework. Such an integrated approach to species responses to environmental changes is key to interpret the current distribution of biodiversity and to appraise and manage future challenges. This course is given biennially and alternates with *Invasion biology.*

2.2.1.9 Marine sciences

- *Developmental biology of marine animal models* **(SBL.10006**). Classical studies in developmental biology were often making use of the abundancy of live eggs and embryos of marine organisms. Pioneering studies in sea urchins and sea squirts have paved the way to fundamental biological concepts. The advent of molecular techniques as well as modern imaging techniques has further made such models a corner stone of modern approaches in developmental biology but also in marine biology. Moreover, the diversity of different animal species and phyla allow direct comparison of mechanisms underlying developmental processes and pathways and thus are link to evolution in a field often referred to as Evo-Devo.

- The course *Polar Biology* **(SBL.10007**) is focused on the biological specialties and particularities of animals and ecosystems at the poles. We will introduce similarities and differences between fauna of the arctic and Antarctica. Since the poles are severely affected by climate change, we will also, put phenomena currently occurring in the polar regions into a global context.

- *Omics approaches in marine sciences* (**SBL.10008).** During the past decade life science has experienced impacting technical and methodological advances. While initially molecular techniques allowed the study of a single molecule or gene, we are now able to study entire systems in a single experiment. Next generation sequencing as well as proteomic technologies allow scientist to identify the genomes, transcriptomes and proteomes. Similar approaches on metabolomics allow to identify and characterize metabolites with unprecedented precision. While this technical revolution has impacted the canonical laboratory model organisms it had an even more profound impact on the study of non-model organisms, since these approaches typically can be used for virtually any species. The current course will provide an introduction on recent developments and advances on omics approaches in various domains of research connected and related to the marine environment and marine species.

- *Advanced practical course in marine biology* (**SBL.10009**): 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 (Evo-Devo) 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-week course will be credited with 4 ECTS.

- The practical course, *Established and emerging organisms for marine science* (**SBL.00126**) 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 Timetable (http://www.unifr.ch/timetable/en/).
- Block course **SBL.00421**, *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.

2.2.2 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 11 or 8.5 ETCS points, respectively.

Master thesis-related activities in the options **DBR, NEU, BCB, MAR**: these consist of different activities comprising seminars with national and international speakers presenting their research and seminars organized in common, or within the different laboratories in relation to their research activities. *Journal Club in molecular life sciences* (**SBL.10100**) are meetings where PhD and MSc students report and debate recently published articles. **SBL.10103** are laboratory meetings where members of a research group expose and discuss their current work. SBL.10100 and SBL.10103 take place within the respective research groups. **SBL.10105** are research seminars given in front of a larger audience by Master students, doctoral students and post-doctoral fellows. *Biology seminars* (**SBL.00431**) are given by external speakers on a 1-2 weekly basis and should be taken from the start of the MSc studies.

The *Master thesis-related activities* in the option **TE** consist of different activities: *Journal Club in molecular life sciences* (**SBL.10102**) are meetings where PhD and MSc students report and debate recently published articles. **SBL.10104** are laboratory meetings where members of a research group expose and discuss their current work. SBL.10102 and SBL.10104 take place within the respective research groups. **SBL.10105** are research seminars given in front of a larger audience by Master students, doctoral students and post-doctoral fellows. *Biology seminars* (**SBL.00432**) are given by external speakers on a 1-2 weekly basis and should be taken from the start of the MSc studies.

The *Neurobiology seminars* (**SME.05001, SME.06001**) 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.

2.2.3 The Master Thesis

The *Master thesis* (**SBL.05001; SBL.05002**) 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. Except for the option TE, the topic of the Master thesis must be relevant to the specific research option. 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, write a complete and clear lab journal, analyse the results, present them in a formal seminar, and write them up in the form of a scientific paper (abstract, introduction, results, methods, and discussion). 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 30-40-minute final presentation in English is mandatory. A Master thesis is evaluated with a grade in an independent validation package, and corresponds to 60 ECTS credits (SBL.05001, 3 semesters) or 45 ECTS credits (SBL.05002, 2 semesters). The duration of the Master thesis work is counted according to the calendar year, not the academic year: SBL.05001 takes 18 months and SBL.05002 takes 12 months full time, including 5 weeks of vacation per year, and the time that students spend to take lectures and seminars of the corresponding study plan.

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

For the options DBR, NEU, BCB, and TE, students have the possibility to carry out their Master thesis within a research group of the Medicine section of the Faculty of Science and Medicine, University of Fribourg. This requires however the approval of the hosting group, the study advisors of Biology and Biomedical Sciences, and furthermore needs a summary describing the prospective project and the techniques that will be used. Such Master thesis carried out in the Section Medicine must include molecular techniques

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 months of their Master study, e.g., by taking part in their research group meetings. The beginning of the second semester is the latest deadline for the choice of a research group. Students inform the department secretary of their 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. The limitation of the duration of MSc studies described in Art.13 applies and refers to the beginning of the first attempt.

The duration of the Master thesis can be slightly extended, provided that both the student and the group leader mutually agree, and that the achievement of the project requires an extension of a few months.

2.3 Examinations of the MSc and 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 Molecular Life and Health Sciences, option Developmental Biology and Regeneration, Neurobiology, Biochemistry and Cell Biology, Marine Biology, or Teaching.

2.4 Admission Procedure to the Master Programme

The acceptance to a Master programme in Molecular Life and Health Sciences may be granted provided the following two conditions have been met by the applicant:

- Satisfying the University admission requirements as defined in the *Règlement concernant l'admission à l'Université de Fribourg* (https://www.unifr.ch/apps/legal/fr/document/274904),
- The student possesses a Bachelor of Science in Biology or in Biochemistry from the University of Fribourg or an academic degree judged equivalent by the Faculty of Science and Medicine.

Based on the candidate's academic qualification for the specific option of the MSc in Molecular Life and Health Sciences, the Commission for Students' Requests can accept the application on the condition that additional requirements are fulfilled, provided they are of a minor scope and can be completed simultaneously with the Master studies. Otherwise, access is denied or applicants can be admitted to a "pre-master programme" and begin the actual Master programme only after having fulfilled the requirements initially set for the pre-master. Final acceptance to the Master programme for a qualifying student depends on the successful completion of the additional requirements. (*Commission des requêtes des étudiant·e·s*, Dean's Office, Faculty of Science and Medicine, Chemin. du Musée 8, CH-1700 Fribourg, Switzerland).
The MSc in Molecular Life and Health Sciences and the MSc in Environmental Biology are formally considered as two specific programmes of a **MSc in Biology**. Students who have been excluded from either a Master in Biology, a MSc in Molecular Life and Health Sciences, a MSc in Environmental Biology, or equivalent, are not eligible to apply.

3. Appendix: Table summarizing all master courses

The teaching units are shown as O (obligatory), R (recommended), E (elective), - not possible,
A: Obligatory, but alternating every year.
AS, Autumn semester; SS, Spring semester.
Options are:
• Developmental Biology and Regeneration (**DBR**); • Neurobiology (**NEU**);
• Biochemistry and Cell Biology (**BCB**); • Marine Biology (**MAR**); • Teaching (**TE**)

Teaching units from the MSc in Environmental Biology or the Master of Bioinformatics and Computational Biology can replace recommended teaching units if prerequisites are met.

Some teaching units are given every two years:
Biennial A: given for the 1st time during the academic year 2023/2024 and then every two years
Biennial B: given for the 1st time during the academic year 2022/2023 and then every two years

Code	Title	DBR	NEU	BCB	MAR	TE	Occurrence	Prerequisites # / Comments
SBL.10001	Modelling human diseases in experimental genetic systems	O	O	O	E	O	Annual; SS	SBL.00119 recommended
SBL.10002	From bench to bedside	O	O	O	E	O	Annual; SS	SBL.10001 obligatory
SBL.10003	Health-related topics in developmental biology	O	R	E	E	R	Biennial B; SS	SBL.00119 recommended
SBL.10004	Ethics in stem cell research	O	R	R	E	O	Annual; SS	
SBL.10006	Developmental biology of marine animal species	E	R	E	O	A	Biennial A; AS	Alternates with SBL.10008
SBL.10007	Polar biology	R	E	E	O	A	Biennial B; SS	Alternates with SBL.00421
SBL.10008	Omics approaches in marine sciences	R	R	E	O	A	Biennial B; AS	Alternates with SBL.10006
SBL.10009	Advanced marine biology practical course	R	E	E	O	E	Annual; AS	
SBL.10010	Altered carbohydrate metabolism in disease	E	E	O	E	E	Annual; SS	
SBL.10011	Structure, function and diseases of lipid metabolism	E	E	R	R	E	Biennial A; SS	
SBL.10013	Zebrafish license course	R	-	-	-	E*	All semesters	*Only if MSc thesis in a DBR laboratory
SBL.10100	Journal club in molecular life sciences (3 semesters)	O	O	O	O	-	All semesters	
SBL.10102	Journal club in molecular life sciences (2 semesters)	-	-	-	-	O	All semesters	
SBL.10103	Research group meetings (3 semesters)	O	O	O	O	-	All semesters	
SBL.10104	Research group meetings (2 semesters)	-	-	-	-	O	All semesters	
SBL.10105	Research seminars in molecular life and health sciences	O	O	O	O	O	All semesters	
SBL.20001	Biostatistics I – generalized linear models and mixed effects models	E	E	R	O	E	Biennial A; AS	SBL.00075 obligatory
SBL.20004	Introduction to metabolomics: data acquisition and processing	E	E	O	E	E	Annual; SS	SBL.00075 obligatory
SBL.20032	Population ecology and evolutionary dynamics	E	E	E	R	E	Biennial B; SS	
SBL.20036	Global change	E	E	E	R	E	Biennial A; AS	
SBL.30001	Introduction to R	R	R	R	R	R	Annual; AS	
SBL.30004	Organization and annotation of eukaryote genomes	E	E	E	E	E	Annual; AS	SBC.07110 obligatory
SBC.04202	Eucaryotic cell growth control	R	R	O	E	E	Annual; AS	
SBC.04203	Genotyping	R	R	O	E	E	Annual; AS	
SBC.07104	Intro. Protein structure and homology modelling	E	R	O	E	E	Annual; SS	With SBC.07105 SBL.00412
SBC.07105	Intro. Docking of small molecules, molecular graphics	E	R	O	E	E	Annual; SS	SBC.07104 obligatory

Code	Title	DBR	NEU	BCB	MAR	TE	Occurrence	Prerequisites # / Comments
SBC.07107	Bioinformatics	E	E	R	R	E	Annual; AS	SBC.07110; HPC (UniBe) are obligatory
SBC.07110	Introduction to UNIX and BASH	R	E	O	R	R	Annual; AS	
UniBe	Introduction to high-performance computing (HPC)	E	E	R	R	E	Annual; AS	SBC.07110 obligatory
SBL.00114	Experimental genetics	O	O	R	R	O	Annual; AS	
SBL.00115	The RNA world	O	O	O	E	O	Annual; AS	
SBL.00117	Neurogenetics	O	O	R	R	R	Annual; AS	
SBL.00118	BeNeFri workshop "Frontiers in neurosciences"	E	O	E	E	E	Annual; AS	
SBL.00119	Molecular genetics of model organism development	O	O	R	R	O	Annual; AS	
SBL.00123	Cellular and genetic networks	R	O	R	R	R	Annual; SS	
SBL.00125	Light and fluorescence microscopy for life sciences	O	O	O	O	R	Annual; AS	
SBL.00126	Established and emerging organisms for marine science	R	R	E	O	E	Annual; SS	
SBL.00127	BeFri research colloquium in cell and developmental biology I	O	O	R	R	R	Annual; SS	
SBL.00128	BeFri research colloquium in cell and developmental biology II	R	O	R	R	R	Annual; SS	
SBL.00129	BeFri research retreat in cell and developmental biology	O	O	R	R	R	Annual; SS	
SBL.00130	Nuclear organization and chromosome dynamics	O	R	R	E	R	Annual; AS	
SBL.00411	Signalling and transport	R	R	R	E	R	Annual; SS	
SBL.00412	Introduction to protein structure and function	E	R	R	E	E	Annual; AS	SBC.07003
SBL.00414	Cell fate and tissue regeneration	O	R	R	E	O	Annual; AS	
SBL.00415	Cell proliferation	O	R	O	E	O	Annual; SS	
SBL.00416	Biological rhythms	R	O	O	R	O	Annual; SS	
SBL.00418	Microbial metabolism and genetics	R	E	O	R	R	Annual; SS	
SBL.00419	Advanced imaging	R	R	R	R	E	Annual; SS	SBL.00125 obligatory
SBL.00420	Career profiling in life sciences	R	R	R	R	R	Biennial B; SS	
SBL.00421	Oceanography and marine ecosystems	R	E	E	O	A	Biennial A; SS	Alternates with SBL.10007
SBL.00425	Metagenomics data analysis	E	E	R	E	E	Annual; SS	SBC.07110 obligatory
SBL.00427	Visual communication of data	O	O	O	O	O	Annual; SS	
SBL.00428	Optogenetics and photopharmacology	R	O	O	R	R	Biennial B; SS	
SBL.00429	Animal models of regeneration	O	R	E	E	R	Annual; SS	
SBL.00431	Biology seminars (4 semesters)	O	O	O	O	-	All semesters	
SBL.00432	Biology seminars (3 semesters)	-	-	-	-	O	All semesters	
SBL.00451	Introduction to mass spectrometry and proteomics	R	R	O	R	R	Annual; AS	
SBL.00452	Advanced quantitative proteomics	R	R	O	R	R	Annual; SS	SBL.00451 obligatory
SBL.00453	Protein homeostasis: translation, quality control and degradation	R	R	O	E	O	Annual; AS	
SBL.00504	Basics in biostatistics	R	R	R	R	R	Annual; AS	Cannot be taken with SBL.00075

Code	Title	DBR	NEU	BCB	MAR	TE	Occurrence	Prerequisites # / Comments
SBL.00502	General concepts for biology teachers	-	-	-	-	O	Annual, SS	
SBL.05001	Master thesis (3 semesters)	O	O	O	O	-	All semesters	
SBL.05002	Master thesis (2 semesters)	-	-	-	-	O	All semesters	
SME.05001	Neurobiology seminars	E	O	E	E	E	All semesters	
SME.06001	Neurobiology seminars	E	O	E	E	E	All semesters	
SME.07100	Models for human diseases*	E	E	E	-	-	Annual; AS	SPY.00110; SPY.00111; SMO.00004
SME.07200	Infection, inflammation and cancer*	E	E	E	-	-	Annual; AS	
SME.07300	Central nervous system regeneration and repair*	E	E	E	-	-	Annual; AS	
SME.07215	Hot topics in cancer research, Metabolic Health and Regenerative biomedicine*	E	E	E	-	-	Annual; SS	
UniFr Language Center	English course(s) for Master students	R	E	R	O	E	All semesters	Maximum 6 ECTS Check your English level online
UniL	Introductory course in laboratory animal science	R	E	R	E	R	Annual; AS	

Some elective courses are shared with the *Master in Environmental Biology and the Master in Bioinformatics and Computational Biology. For details please refer to the corresponding study plan:* *https://www.unifr.ch/scimed/fr/plans/master*
**** Courses from the specialized EBR Master are accessible only if space allows and if prerequisites are met. Evaluation modalities are found in the corresponding annex of the EBR study plan in biomedical sciences.***
 # Important: prerequisites concern Master-level courses to be taken in parallel.