Continuing Training Offer of the Fribourg Graduate School of Life Sciences and Medicine (FGLM) University of Fribourg

1. The FGLM – An Overview

The Fribourg Graduate School of Life Sciences and Medicine (FGLM) is an interdisciplinary graduate school in life science, which offers – on a voluntary and participatory basis – a coordinated doctoral program in life sciences at the University of Fribourg. It addresses all doctoral students in the life sciences (including biology, medicine, biochemistry, bioinformatics, but also doctoral students in chemistry, physics, statistics and mathematics with a life science focus). The aim of the FGLM is to complement the regular training of PhD / MD students in the life sciences by fostering and offering continuing education opportunities on a voluntary basis; it aims to prepare the next generation of life scientists for future challenges in academia and society. It is open to all PhD/MD students performing research in the life sciences at UniFR.

The Faculty of Sciences at UniFR offers the following degrees related to life sciences / biology:

- PhD in Biology
- PhD in Biochemistry
- PhD in Bioinformatics
- PhD in Medicine
- MD in Medicine

The FGLM offers to its member doctoral students a voluntary program of continuing training and course activities. By signing, together with their supervisor, the agreement mentioned in Article 2 of the FGLM bylaws they voluntarily agree to follow the FGLM training program.

The program consists of the following:

(1) Each year, FGLM doctoral students commit themselves voluntarily to attending courses covering at least 2 ECTS per year (see below). Courses should be divided between scientific / methodological courses and "soft skills" courses (see below for an

overview of courses). The FGLM doctoral students are encouraged to take the course exams but they are not obliged to do so; if they do take the exam, they need to be enrolled for the exams and pay the exam fees. The FGLM does not formally accredit ECTS points.

(2) In addition, FGLM doctoral students must have followed during the duration of their thesis work at least three courses, conferences, or symposia designed specifically for postgraduate studies. Such courses are offered, among others, by the following societies and doctoral schools:

- FEBS: http://www.febs.org/index.php?id=86;
- EMBO: http://www.embo.org/events/calendar.html
- LS2 (Life Sciences Switzerland): http://www.usgeb.ch
- SGM/SSM: http://www.swissmicrobiology.ch
- StarOmics (CUSO, doctoral school): http://biologie.cuso.ch/accueil/
- Microbiology (CUSO, doctoral school): http://biologie.cuso.ch/accueil/
- Swiss Chronobiology Meeting: http://www.unifr.ch/biology/events/chrono4/
- Doctoral School Ecology & Evolution (CUSO): http://biologie.cuso.ch/ecologie-evolution/welcome/
- Interuniversity Doctoral Program in Organismal Biology: http://www2.unine.ch/dp-biol

(3) FGLM doctoral students are also expected to have participated in and presented a poster or talk at least one international congress. Participation in any of the above mentioned events should be discussed beforehand with, and approved by the PhD supervisor, who has to judge if a given scientific conference or course will be appropriate for the training of the doctoral student. FGLM doctoral students should try to participate in congresses also beyond the required minimum, especially if they take place in Switzerland, if the supervisor agrees with this.

(4) If a doctoral student wishes to participate in another specialized education program or doctoral school of CUSO, she/he can ask for accreditation of these courses. Participation in any specialized education program or doctoral school requires the consent of the PhD supervisor.

(5) The regular and active participation in progress reports, journal clubs, conferences and seminars organized by the Departments of Biology or Medicine form an integral part of the education of FGLM doctoral students (see recommended course schedule).

(6) To support cross-disciplinary approaches, the FGLM encourages doctoral students to undertake short-term laboratory rotations, in which interested PhD students have the opportunity to carry out up to two rotations in another laboratory associated with the FGLM.

(7) FGLM doctoral students commit themselves to actively participating in student-organized FGLM activities (e.g., the FGLM retreat, etc.).

For FGLM doctoral students who perform their thesis work at another university or research institution in cooperation with FGLM, it is the duty of the PhD supervisor to define an equivalent training program and to make sure that the requirements are equivalent to the ones of the FGLM and the University of Fribourg.

At the end of the thesis work the student submits documentation of the completed coursework to the FGLM administrative office; the head of the FGLM then issues a signed postgraduate study report which confirms that the required FGLM coursework has been completed. This document represents simply a confirmation; it does not formally accredit coursework or ECTS points and it does not represent a formal certificate or diploma.

Contacts:

- FGLM administrative office: Adeline Guélat (DepBL): adeline.guelat@unifr.ch; Office: DepBL, building PER 04, room number 0.108, Rue A.-Gockel 3. Tel.: +41 26 300 8810
- Co-heads of the FGLM: Prof. Thomas Flatt (thomas.flatt@unifr.ch; DepBL) and Prof. Jens Stein (jens.stein@unifr.ch; Section Medicine, OMI)

2. Requirements for completion of the FGLM curriculum

Also see the detailed regulations in the FGLM bylaws; also see the list of courses below. All successfully completed courses have to be recorded on the FGLM record sheet.

At the end of their doctoral studies, students must have taken at least:

- 6 ECTS of courses (e.g. modules A.1 and A.2, see below), to be taken over three years
- 2 ECTS of soft skills (e.g. organizing meetings, mentoring of Master and Bachelor students, Soft Skills CUSO courses). Typically,
    - 1 ECTS for mentoring one Master student (1 year)
    - 1 ECTS for mentoring two BSc students (3 months each), or rotation students (6 weeks each)
    - 0.5 ECTS / 4 hours per week / one semester for assisting BSc and MSc students and preparing workshops ("travaux pratiques")
- 3 conferences and/or workshops (e.g. module B.2, see below)
- Seminars and meetings held in Fribourg (module B.1, see below)

The completed FGLM record sheets and thesis committee meeting reports are kept centrally by the FGLM administrative office (currently at the DepBL: Adeline Guelat, adeline.guelat@unifr.ch).

PhD students are responsible for updating and managing these documents and for submitting them to the administrative office in a timely fashion.

The completed record sheet has to be verified and signed by the PhD student, the PhD supervisor and handed over to the FGLM secretary.

The completed FGLM record sheet is signed by the head of the FGLM and will be given to the student after the successful PhD defence as a confirmation of the successfully completed FGLM curriculum. This attestation by the FGLM does not represent a formal accreditation of ECTS.

3. Recommended course schedule

Throughout the PhD:

- Literature study: e.g., SBL.00404, SBL.00326; SBL.00402, SBC.07111 (typically involving at least 1 presentation every 2 years)
- Progress reports: e.g., SBL.00403, SBL.00326, SBL.00212, SBC.07111 (typically involving 1 presentation per year)
- Laboratory group meetings: e.g., SBL.00401, SBC.04402, SBL.00401, SBC.07111 (presentations according to the research group)
- Seminars: e.g., SBL.00400

1st year of PhD:

- 2 ECTS from UniFR or other programs in Switzerland

2nd, 3rd, 4th year of PhD:

- 3 courses / symposia from national and/or international programs
- 4 ECTS from UniFR or external courses
- 2 ECTS of soft skills

4. Continued training offer proposed to PhD students in the FGLM program

Below are examples of courses that can be taken by FGLM students; other courses may be egligible, especially from the Masters programs in biology and/or medicine. See here: https://www3.unifr.ch/bio/en/studies/ and https://www3.unifr.ch/med/de/section/platforms/.

		Semester	hours	ECTS
Module A.1 Topical courses				
(Themes remain, but contents can change year after year)				
SBL.00411	Signalling and transport	AS	8	1
SBL.00412	Introduction to protein structure and function	AS	8	1
SBL.00413	Gene regulatory networks	AS	8	1
SBL.00414	Cell fate and tissue regeneration	SS	8	1
SBL.00415	Cell proliferation	SS	8	1
SBL.00416	Biological Rhythms	SS	8	1
SBL.00417	Evolution on the bench	SS	8	1
SBL.00418	Microbial metabolism and genetics	SS	8	1
SBL.00419	Advanced imaging	SS	8	1
-	Other courses from Fribourg, Bern or Freiburg PhD programs, or other Universities and programmes.			

Module A.2	Elective courses from UniFR Master programmes (cannot be taken if credited during the MSc)	Semester	hours	ECTS
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.07108	Introduction to R	AS	3 days	2.5
SBC.07109	Programming with R	AS	2 days	1
SBC.07110	Introduction to UNIX and BASH	AS	5 days	2.5
SBL.00317	Molecular basis of innate immunity: theoretical and practical aspects	SS	28	3
SBL.00318	Drugs and phytochemical analysis	SS	21	1.5
SBL.00420	Career profiling in life sciences	SS	8	1
SBL.00421	Oceanography and marine ecosystems	AS	8	1
SBL.00422	Molecular and cellular marine biology	SS	8	1
SBL.00424	Microbiomes: from plants to humans	SS	14	1.5
SBL.00425	Metagenomic data analysis	SS	14	1
SBL.00427	Visual communication of data	SS	8	1
SBL.00428	Optogenetics and photopharmacology	SS	8	1
SBL.00429	Animal models of regeneration (lecture with workshop)	SS	24	2
SBL.00451	Introduction to mass spectrometry and proteomics §	AS	8	1
SBL.00452	Advanced quantitative proteomics (including lab course)	SS	12	1
SBL.00453	Protein homeostasis: translation, quality control, degradation	AS	8	1
SBL.00125	Light and fluorescence microscopy for Life Sciences	AS	28	3
SBL.00203	Workshop in statistics and experimental design	SS	28	3
SBL.00221	Biostatistics	AS	18	2
SBL.00216	Introduction to statistics with R – Model selection	AS	12	1
-	Introductory course in laboratory animal science	SS	40	3
ULA.00376	Molecular methods in Ecology and Evolution	AS	8 days	4

- Other courses from Fribourg, Bern or Freiburg PhD programmes, or other Universities and programmes.

AS Fall semester; SS Spring semester; #Must be taken together; §Prerequisite for SBL.00452

	Module B.1: Seminars and meetings in Fribourg (examples)	Semester	hours	ECTS
SBL.00401	Lab meetings (SBC.04402 for Biochemistry)*	All	14	0.5
SBL.00403	Progress report (Biochemistry / Neuro- and Developmental Biology)*	All	14	0.5
SBL.00326	Current topics in plant and microbial sciences*	All	14	2
SBL.00212	Research seminars (Ecology and Evolution only)*	All	14	0.5
SBL.00400	Seminars in biology (all programs)*	All	10	0.5
SBL.00402	Literature study/Journal club (Ecology and Evolution)*	All	14	1
SBL.00404	Literature study/Journal club (Biochemistry / Neuro- and Developmental Biology)*	All	14	0.5
SBC.07101	Lecture and Journal Club series (Bioinformatics)*	SS	28	2
SBL.00127	BeFri research colloquium in cell and developmental biology I	SS	15	1.5
SBL.00128	BeFri research colloquium in cell and developmental biology II	SS	15	1.5
SBL.00129	BeFri research retreat in cell and developmental biology	SS	20	1
-	Chronobiology Meeting	AS	8	0.5
-	Fribourg Ecology & Evolution Days	AS	14	1
-	Peer Reviewing in Natural- and Life Sciences: From Submission to Retraction (CUSO)	SS	12	1

	Module B.2: Seminars & meetings outside Fribourg			
-	Basel Worm Meeting	SS	8	0.5
-	LS2 Meeting	SS	12	0.5
-	FEBS meetings	#		
-	EMBO courses, workshops and meetings	#		
-	SGM/SSM (microbiology)	#		
-	StarOmics (CUSO)	#		
-	Microbiology (CUSO)	#		

-	Doctoral Program in Molecular Plant Sciences (CUSO)	#		
-	Doctoral Program in Ecology and Evolution (CUSO)	#		
-	(Soft) Skills for your PhD (CUSO)	#		
-	Interuniversity Doctoral Program in Organismal Biology	#		
-	Biology XX: the annual Swiss conference on organismic biology	SS	#	
SBL.00206	Evolutionary Biology Workshop "Guarda"	SS	56	4

* obligatory, students choose according to the orientation of their PhD (refer to course schedule on the last page).

\# check for additional information on the respective web sites listed on page 10.

5. Description of courses

For up-to-date descriptions of these and other courses please consult the concerned course webpages.

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.

This course *Introduction to R* SBC.07108 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.

The course SBC.07109 introduces advanced topics in R programming, with a focus on S3 classes and R packages. The course will be largely "hands-on". Basic knowledge of R as taught in SBC.07108 is required.

With the course SBC.07110 *Introduction to UNIX and BASH* 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

SBL.00127, SBL.00128 and SBL.00129*: BeFri research colloquium in cell and developmental biology* consist in half day meetings with 6 presentations by PhD students or junior post-docs of participating groups from the Universities of Bern (*Be*) and Fribourg (*Fri*). 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 retreat (SBL.00129) gives the opportunity to MSc students to present their project as a poster or as a talk.

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

In the *Workshop in statistics and experimental design* (SBL.00203) 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. Students understand the philosophy of statistical tests and are able to solve problem-oriented questions. They are able to apply classical and Monte Carlo techniques. They are introduced to carry out statistical tests with the program R.

The *Evolutionary Biology Workshop* "Guarda" (SBL.00206) is a project-oriented international summer school in the alpine village of Guarda, Grisons, Switzerland, organized by Prof. Dieter Ebert, University of Basel and Prof. Sebastian Bonhoeffer (ETHZ) (see: http://www.evolution.unibas.ch/teaching/guarda/). This is a recommended and elective MSc course in Biology for the option Ecology and Evolution; it amounts to 56 hours and counts for 4 ECTS points. There is no guaranteed admission to this course (see below). The course is a 1-week long workshop for Master students and early PhD students with a keen interest in evolutionary biology. Costs: Every participant has to finance his travel and accommodation him/herself. The costs for accommodation are CHF 450.-. That includes food. This money has to be paid in advance. The exact costs can only be calculated closer to the event, but will not change much. Accommodation is in flats with 4

to 8 people (mostly double bed-rooms). People sharing a flat cook for themselves. Application: There is no guaranteed admission to this course. The application deadline (announced on http://www.evolution.unibas.ch/teaching/guarda/) is usually in February, with the course taking place in June. Students who are interested in attending the Guarda course and who would like more information on this course should please contact and make an appointment with Prof. Thomas Flatt ahead of time. Further information can be found at the Tropical Biology Association. For application deadlines see the course website.

Introduction to statistics with R – Model selection (SBL.00216) introduces the open source software R), which has revolutionized the statistical data analysis for most bioscience disciplines. R environment covers an unmatched spectrum of statistical tools including an efficient programming language for automating time-consuming analysis routines. Due to its popularity, R is continuously updated and extended with the latest analysis tools that are available in the different research fields. The R environment is completely free and runs on all common operating systems. This course provides a short introduction into the R environment and then tackles in more depth the problem of model selection (the task of selecting a statistical model from a set of candidate models)

The course *Biostatistics* (SBL.00221) aims at going into the topic data analysis in greater depth. The course introduces the fundamentals in statistics and experimental design. It covers topics from the fundamental concepts of statistics such as p-value, Type I and Type II error, multifactor ANOVA to multilinear regression, and an introduction to experimental design concepts such as replication, randomisation, nested and factorial design. Access requires an introductory course to R.

ULA.00376 *Molecular methods in ecology and evolution* is held at the University of Lausanne (taught by Prof. Ian Sanders, Prof. Nicolas Salamin, Dr. Luca Fumagalli), taking place each year in the autumn semester. This labor- and time-intensive block course is for motivated MSc students in ecology and evolution who are interested in learning about how one can use molecular techniques to answer questions in evolution, population genetics and ecology. The course is split into a classroom part and a wet lab and dry lab part. It takes 8 days and lectures are inter-dispersed between lab classes. The first 4 days are class plus wet lab and the last 4 days are computer analyses and class. Class times can change if something does not work as expected in the lab. MSc students in ecology and evolution from Fribourg who would like to take this course should please contact Prof. Thomas Flatt (thomas.flatt@unifr.ch) for further information ahead of time. MSc students in ecology and evolution from UniFR are allowed to attend the class if there are open spots left. To ask if there are any free spots and to sign up for the course please send an e-mail in due to time to: biologie-etudiants@unil.ch, and please put thomas.flatt@unifr.ch in cc.

https://applicationspub.unil.ch/interpub/noauth/php/Ud/ficheCours.php?v_ueid=284&v_semposselected=-1&v_langue=en&v_isinterne=&v_enstyid=72961

The course *Molecular bases of innate immunity: theoretical and practical aspects* (SBL.00317) gives an overview about the basis of plant innate immunity, with a special focus on the molecular aspects. The lectures are combined with a practical course that introduces the students to the most common techniques applied in the field of plant-pathogen interactions, such as plant inoculation, disease resistance scoring, gene expression analysis, and quantification of antimicrobial secondary metabolites and proteins

The course *Drugs and phytochemical analysis* (SBL.00318) is a theoretical and practical introduction to the accurate quantification of compounds such as vitamins, drugs and nutrients from complex matrices (cell samples, plant extracts, food, beverage and drugs). It covers extraction methods, the use of internal standards, techniques of purification and chromatography, detection procedures and data analysis, as well as a practical part on Gas Chromatography and Ultra High Performance Liquid Chromatography.

The course *Signaling and transport* (SBL.00411) will focus on the plant signal transduction at first place. By comparing bacterial and plant signaling 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 explained 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 localization signals, transmembrane regions and their topologies, protein domains and motifs, metal binding sites, post translational modifications, to cite a few. Going further would reach the 3D modelling

subject covered by another course. This course should be seen as an introduction to the courses SBC.07104 "Introduction to protein 3D structure and protein homology modelling" and SBC.07105 "Introduction to docking of small molecules to large macromolecules and molecular graphics". Prerequisite: course SBC.07003 "Introduction to Bioinformatics and Genomics" or equivalent. Students are kindly requested to bring a personal laptop computer (WinOS, MacOS, or Linux). This course SBL.00412 is recommended for those who intend to follow SBC.07104 and SBC.07105.

Gene regulatory networks (SBL.00413). Even though the human genome consist of over 30'000 genes, each cell only expresses a defined subset of genes. Gene regulation at a global scale or whole genome scale is not dependent on a single transcription factor, but rather on complex gene regulatory networks. In the context of development, cell-cycle and function of differentiated cells different gene regulatory networks are at the core of what makes cells different from each other. Studies from bacteria, unicellular as well as complex, multicellular organisms are important for our understanding of how gene regulation occurs on a genome level. This lecture we will be dedicated on a specific subject in current research given by an expert in the area of gene regulatory networks.

Lecture course *Cell fate and tissue regeneration* (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 multilineage 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. This cellular clocks interact with each other via neuronal, hormonal and biochemical pathways to establish a coherent systemic hierarchy of physiological functions. This organizes body functions such as sleep, and feeding in a temporal manner. Prerequisite: Basic understanding of biochemistry and physiology.

In the course *Evolution on the bench* (SBL.00417) we will discuss the main processes and factors determining the rate of evolution of microorganisms and cell lines. We will compare the time scales of these processes to the time scales of experiments frequently carried out in cell biology and microbiology, and realize that evolution is in integral part of almost any such experiment. The goal of this course is then to develop an intuition for the expected evolutionary change over the course of your own experiments and to discuss how evolution may help or limit discovery and how the speed of evolution can be manipulated in the laboratory.

The course *Microbial genetics and metabolism* (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.

Fluorescence light microscopy is a core technique to visualize biological processes in fixed and living tissue. With new development in microscope design and image acquisition progress was also made in digital image analysis. The aim of the course *Advanced imaging* (SBL.00419) is to give the students a theoretical background in digital image analysis and to train students to use state of the art software tools. In a first module the students obtain theoretical knowledge about principles of digital image analysis and learn about ethical aspect in image manipulation. In a second module students are taught in workshops to use image analysis open source software ImageJ/Fiji and commercial software Bitplane Imaris and Huygens Deconvolution. In self-directed teaching tutorials student acquire basic image analysis skills (File formats, Metadata, Contrast adjustment, Background correction, Filtering). In workshops advanced techniques are learned such as image segmentation, 3D rendering, deconvolution, and co-localization. An introduction in batch processing and macro language will complete the session. The course will give practical guidelines that will help students with imaging projects in their line of research.

Career Profiling in Life Sciences (SBL.00420): After having completed their Master or PhD degree, students start applying for jobs. In this interactive course, we present the curricula of several biology students from Fribourg who are now active in the professional world. We chose different paths, from academia to industry and even less related fields. Students will also learn how to write a CV, how to write an application letter, and how to prepare for

a job interview. 10-minute interviews will be held in front of the other participants. We also provide information on where to look for jobs in Switzerland.

The block course *Oceanography and Marine Ecosystems* (SBL.00421) teaches about the diversity of animal life forms from all animal phyla in the oceans. Variable abiotic physical and chemical conditions as well as geographic location strongly impact the marine biosphere. This course will provide a comprehensive introduction into oceanography, diversity of marine biotopes and ecological interactions.

In the course *Molecular and Cellular Marine Biology* (SBL.00422), students will learn that all existing animal life forms originated from common marine ancestors and that the largest diversity of life forms and corresponding evolutionary, physiological molecular and cellular adaptations can be found in marine environments. This module will provide an overview of specific examples of molecular, genetic and cellular biological processes in marine organisms.

SBL.00424 *Microbiomes: from plants to humans*. Students will be introduced to the concept of holobionts and metaorganisms. They will learn how microbiomes are assembled and structured in different host organisms, including plants, animals and humans. They will discover the functions these microbiomes fulfil for their hosts and how we can leverage on these microbiome-encoded functions to address current challenges, e.g. in plant and human health. SBL.00063 or an equivalent course on bacteriology has to be taken before.

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. SBC.07106 or equivalent is a prerequisite to access this course.

SBL.00427 *Visual communication of data*. The goal of the course 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.

The lecture course SBL.00428 *Optogenetics and photopharmacology* describes two modern, fast-developing fields that use light-responsive molecules as tools for scientific

research and hold promises for medical interventions. The 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.

SBL.00429 *Animal models of regeneration* (lecture with workshop). Wound healing following injury is a fundamental property of multicellular organisms. 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.

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 analyzers 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 analyzed by current bioinformatics approaches. After both courses participants will be able to design and perform MS-based proteomics experiments and to analyze respective data. SBL.00451 is a prerequisite to take part in SBL.00452.

Protein homeostasis: Translation, quality control and degradation (SBL.00453). In this course, 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.

Introductory Course in Laboratory Animal Science: This training offered in July gives expertise and practical skills for a responsible and gentle handling of laboratory

vertebrate animals. Theoretical and practical parts take about 20 hours each, and include the following topics: ethics and legislation, 3R concept, nutrition, transport, husbandry, breeding, transgenic techniques, observation of behaviour, anaesthesia and euthanasia, surgeries, treatments, collection of samples. This course is officially recognized by the Federation of Swiss Cantonal Veterinary Officers (VSKT) as requested by legislation (Swiss ordinance N° 455.171.2, October 1998) to get the accreditation to perform animal experimentation. This training module is relevant to all students working with vertebrate animals.

Meetings and seminars (SBL.00400, SBL.00402, SBL.00403, SBL.00404, SBL.00326, SBC.07111): these consist of different activities comprising seminars with national and international speakers presenting their research and seminars organized by the different groups in relation to their research activities. Literature study/Journal Club are meetings where researchers and students report and debate recently published articles. See table on page 13.

Research group meetings (SBC.04402, SBL.00401, SBL.00212, SBL.00326; SBC.07111, depending on the orientation of the PhD, see page 13). The meetings are held within smaller groups. PhD students learn how to expose and discuss their current work. Results are discussed in detail in order to provide efficient guidance of the thesis project.