University of Zurich[UZH] | ETH zürich | University of Basel

Zurich-Basel Plant Science Center

Guide to the
PSC PhD Program in Plant Sciences 2018

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1 Why a PSC PhD Program in Plant Sciences?

Welcome to the PSC PhD Program in Plant Sciences. The Zurich-Basel Plant Science Center (PSC) offers training in techniques at the forefront of plant sciences and a qualification framework for building up transferable skills and competencies for a successful career in academia and beyond. This guidebook should help you plan your PhD studies and tailor your training to your needs. The guide outlines what professional skills we expect you to develop during your PhD studies (Section 3). In the training overview and course catalog, we present the wide range of workshops designed to help you attain these skills (Section 4).

As a PhD student, you make research your absolute priority. However, you are also expected to develop into an independent researcher, able to publish, present and communicate your work to a variety of audiences, including the public. You need to be able to write successful grant proposals. You must learn to be aware of your responsibilities as a researcher. You need skills to collaborate with other researchers and to build up your own scientific network.

You will need assistance in developing all these challenging skills. Your supervisor and the wide range of courses offered by the PSC PhD Program in Plant Sciences will support you. PSC workshops provide an introduction to conceptual and technical approaches in research and also up-to-date knowledge from new research fronts in plant sciences. Our workshops aim to enhance your interdisciplinary research competence in the field of plant sciences and we offer training in the development of transferable skills following the competence matrix laid out in Section 3.

What if you plan to leave the academic world after your PhD studies? Our workshops provide training in a range of transferable skills that will prove valuable outside of academia as well. Completion of a structured PhD program is expected by many potential future employers, both inside and outside academia.

To be awarded the PSC PhD Program Certification, you must complete 12 credit units (ECTS) during your 3-year PhD study period (Section 2).

An excellent way to develop many of the skills outlined above is by participating in the organization of our bi-annual international PSC PhD symposium (next in 2016). Together with a group of 5 – 6 PSC PhD students you could have the opportunity to form the scientific organization committee of an interdisciplinary symposium. Your task would be to ensure a high-quality scientific program with invited speakers from all over the world.

Within the PSC PhD Program in Plant Sciences, you are embedded in a lively and international community of over 700 researchers.

2 Admissions, Registration and Regulations

2.1 Admission to the PSC PhD Program

The PhD Program is open to you if your research group/supervisor is member of the PSC (overview of member groups: www.plantsciences.uzh.ch/aboutus/people.html).
All PSC PhD students must be enrolled at the University of Zurich, ETH Zurich or the University of Basel. The candidate is conditionally accepted to the PhD Program after requirements are fulfilled. Final acceptance depends on the formal admission requirements of the University of Zurich, ETH Zurich or University of Basel.

To ensure equal treatment of Track I (recruitment via LSZGS) and Track II (direct application to PI) candidates, and in accordance with the rules of the LSZGS, group leaders are required (as of January 2013) to organize a formal admission interview with their future PhD students if recruited via Track II. The interview should be conducted in presence of at least one other PI or faculty member, and the supervisor should fill out an interview protocol to be submitted to the program office. Please contact your supervisor if you are a Track II student.

2.2 Registration for the PSC PhD Program

All necessary documents can be downloaded at our webpage:
www.plantsciences.uzh.ch/teaching/phdplantscience/procedures.html (see point 'Requirements for Completion').

Register for the PSC PhD Program in Plant Sciences by filling in the registration form provided on our webpage. We will then send you a welcome package with all necessary documents.

UZH MNF: All PhD students must register for a structured PhD program. We must sign the "Acceptance confirmation Structured Doctoral Program" letter that is part of your matriculation documents (for information about the matriculation see:
http://www.uzh.ch/studies/application/doktoratphd.html).

We can only sign the form after admission interviews have been conducted, and after we have received the signed interview protocol and the signed registration form. Registration is necessary within 3 months of beginning your PhD.

Furthermore, PhD students must register to the UZH Faculty of Science by using the following link: Registration Doctoral Studies http://www.mnf.uzh.ch/en/studium/phd/anmeldung.html. For more information on the Graduate Schools and Doctoral Studies at the Faculty of Science (MNF), please visit the following website http://www.mnf.uzh.ch/en/studium.html.

ETHZ D-USYS and **ETHZ D-BIOL**: The registration with a structured PhD program is recommended, but not mandatory for PhD candidates.

University of Basel, Philosophisch-Naturwissenschaftliche Fakultät: Enrollment in a structured PhD program is recommended, but not mandatory for PhD candidates.

2.3 Institution-specific regulations during PhD studies

You must carry out your PhD studies in accordance with the regulations of either the University of Zurich, the ETH Zurich or the University of Basel, depending on the academic affiliation of the host laboratory where the research work is carried out (= home institution). Please refer to Doctoral regulations of your home institution and of your home department/faculty.

Here we present a brief summary of some of the relevant regulations at the three partner institutions:

University of Zurich, MNF:

- **Teaching requirements:** With their PhD supervisor, PhD candidates must complete the "Planning teaching hours" form from the Department (Fachbereich) of Biology for the fulfillment of a minimum of 100 teaching hours. A template is provided in our welcome package.
- **Thesis Committee:** The PSC PhD student and the supervisor select the thesis committee 6 months after the beginning of the project. The committee has at least three members, including the supervisor. Two members of the committee (including the chairperson) are from the MNF with "Promotionsrecht" (Professors with the right to award doctorates). The thesis committee composition **must be communicated to the program office** as part of the Doctoral Agreement.
- The first committee meeting should be held 6 – 12 months after the beginning of the PhD. Subsequent meetings are held every 12 months. If at the yearly meeting the thesis committee finds that the progress of the PhD candidate is not sufficient, it can request that the Dean of Studies disqualify the candidate. At least three members of the thesis committee (including thesis supervisor) have to be present. Participation of external members can also be arranged by using Skype etc. It is the responsibility of the PhD student to set up the thesis committee, arrange the yearly thesis committee meetings, and document the activities. The signed thesis committee meeting protocol is to be sent back to the program office within 4 weeks after the meeting took place. A template is provided in our welcome package.
- For details see: http://www.mnf.uzh.ch/en/studium/reglemente.html#4

ETH Zurich, D-USYS and D-BIOL:

- **Research Plan:** A written research proposal, including the research plan, is to be defined 12 months after registration. The research plan needs verification through the representative of the doctoral board and the thesis committee (D-BIOL). Should a thesis be carried out outside the ETH domain, it should be specified in the research plan. Doctoral students who are requested to take qualifying exams may only submit their research plan once they have completed those exams.
- **Thesis Committee:** The PSC PhD student and the supervisor select the thesis committee 6 months after the beginning of the project. For D-BIOL: The committee has min. three members: the official thesis supervisor (professor at the Department), the immediate supervisor (if applicable), two additional professors or senior scientist of which one is independent from the institute of the official supervisor. For D-USYS - composition of committee: Direct supervisor plus at least one co-examiner who is not from own research group.
  The thesis committee composition must be communicated to the program office in the Doctoral Agreement. The first committee meeting should be held 6 – 12 months after the beginning of the PhD. Subsequent meetings are held every 12 months. It is the responsibility of the PhD student to set up the thesis committee, arrange the yearly thesis committee meetings, and

document the activities. At least three members (D-Biol) or two members (D-USYS) of the thesis committee (including thesis supervisor) have to be present. Participation of external members can also be arranged by using Skype etc. The signed thesis committee meeting protocol is to be sent back to the program office within 4 weeks after the due date of the thesis committee meeting. A template is provided in the welcome packet.

D-BIOL: https://www.biol.ethz.ch/en/doctoral-studies.html
D-USYS: https://www.usys.ethz.ch/en/doctorate.html

University of Basel, Philosophisch-Naturwissenschaftliche Fakultät:

- **Thesis Committee:** It is strongly recommended to set up a thesis committee including one external (non-faculty) member. Within the thesis committee one faculty member has to be nominated as chairperson. Regular meetings of the thesis committee and PhD candidate as well as regular feedbacks are recommended. The thesis committee composition must be communicated to the program office in the Doctoral Agreement. The first committee meeting should be held 6 – 12 months after the beginning of the PhD. Subsequent meetings are held every 12 months.
- For details see (German only): www.unibas.ch/doc/doc_download.cfm?uuid=D030CCF29704A8CB76F49E238D348C47&vobj_id=2016

2.4 Admission to Courses

We accept PhD students from LSZGS programs into our courses, provided that the supervisor is a member of the PSC and that spaces are available. PSC students registered in the PSC PhD Programs (i.e. Plant Sciences or Science & Policy) have enrollment priority. For PhD students registered in LSZGS programs, all courses of the PSC PhD Program in Plant Sciences are fully recognized.

PhD students select their individual course work in agreement with their PhD supervisor or their PhD thesis committee.

2.5 PSC PhD Certification

Upon successful completion of the PSC PhD Program in Plant Sciences, the Zurich-Basel Plant Science Center will award a program certification based on the following criteria:

- 12 credits (ECTS) acquired during doctoral term from lectures, courses and workshops. 1 ECTS is equal to either a lecture of 1 hour per week during one semester or a full two- to three-day workshop including home-work or preparatory work (=30 learning hours).
- 6 ECTS from courses that are either organized or accredited by the PhD Program in Plant Sciences. We fully accredit the following courses: courses organized by the Zurich-Basel Plant Center (www.plantsciences.uzh.ch/teaching/phdplantscience/courses.html) or the Life Science Zurich Graduate School (www.lifescience-graduateschool.ch/index.php?id=11), and courses offered through the Universities in the area of transferable skills.
- 6 ECTS may be acquired in courses outside of our own program, for example from the PhD Programs associated within the Swiss Plant Science Web

(www.swissplantscienceweb.ch/education/phd-programs/) or other national and international PhD courses.
- Active participation in the colloquium "Challenges in Plant Sciences" (2 ECTS) during one semester is the mandatory part for the PSC PhD Certification in Plant Sciences. You are advised to participate in the colloquium at the beginning of your PhD studies. If you have already participated in the colloquium during your Master's studies you have finished the mandatory parts. You can then choose your 12 ECTS freely from other courses organized or accredited by the PSC.
- We strongly recommend that you acquire 4 ECTS in the area of transferable skills through courses organized/accredited by the PSC.
- It is possible to obtain credit points through the organization of the PSC PhD symposium (3 ECTS).
- Participation and presentation of your PhD work at international conferences may be awarded 1 ECTS.

The PSC issues a program certification after all requirements have been fulfilled and the Doctoral Degree Certificate of your home university has been awarded. Required submissions (uploaded to DissGo):
- A copy of course participation documents
- A list of all completed courses (at least 12 ECTS), signed by the PhD supervising professor
- A copy of your Doctoral Degree Certificate (send by Email or mail to the PSC office)

Exam Registration and Doctoral Examination: The final degree is conferred by your home institution

UZH MNF: For your registration for the examination (http://www.mnf.uzh.ch/en/studium/phd/checkliste-fuer-doktorierende.html, 'Registration for the PhD Defense') you will need to include 'List of credit points' together with all copies of certifications of course participation. This document needs to be signed by the responsible faculty member.

ETH D-USYS and **ETH D-BIOL**: For your registration at the doctoral administration (www.ethz.ch/content/associates/students/en/doctorate.html) you will need to include "Course participation certificate for doctoral students" together with all copies of certification of participation for courses. This document needs to be signed by the department office. A template of this document is provided in the welcome package
The doctoral student must hand in the form Registration for the Doctoral Examination and a bound examination copy to the Doctoral Administration ETH at least 12 working days before the exam.

2.6 Confidentiality

It is an important goal that the participants of the PhD program exchange their scientific results between different institutes and the host institutions. Any such results shall be kept strictly confidential by all participants of the program and shall not be disclosed to persons outside of the program as long as the results are not published by the author/originator of the results. No participant of the PhD program shall use any scientific result to the detriment of one of the host institution. In particular, no participant shall impair a host institution's right to seek protection for intellectual property contained in such results by way of a premature publication or other premature

disclosure of results.

3 Training Curriculum and Course Catalog

3.1 Curriculum

Note: For all students that have started their PhD after February 2016 it is mandatory to visit the LSZGS introduction event "Introductory Lecture to Good Scientific Practice and Scientific Integrity" (2 hours, no ECTS). Within the event you will sign the declaration of "Good scientific practice" that is will become part of your DissGo documents. All PhD students that have or will visit a course on "Research Integrity" or "Ethics" in their PhD program don't need to visit the introduction.

Tailor coursework to your needs within the PSC PhD Program in Plant Sciences by combining courses from the following domains (but note mandatory colloquium):

Module	ECTS
Mandatory Module: Colloquium "Challenges in Plant Sciences" **[corresponding: 3.3.1]**	2
Mandatory Elective Modules: • Technical Courses in all areas of Plant Sciences: Intensive workshops on skills, methods and techniques used in plant science research **[corresponding: 3.3.2]** • Statistical Methods **[corresponding: 3.3.3]** • Transferable Skill Courses organized by PSC or Life Science Zurich Graduate School (Communicating and Disseminating Science / Professional Conduct in Research / Research Management / Professional and Career Development / Finance, funding and resources) **[corresponding: 3.3.4]** • Workshops from the specialized PSC PhD Program in Science and Policy **[corresponding: 3.3.6]**	4 - 10
Elective Module: Remainder of 12 ECTS may be chosen from*: • Participation in international scientific symposium with own scientific contribution (oral or poster presentation) (max. 1 ECTS) • Organization of PSC PhD Symposium (max. 3 ECTS) **[corresponding: 3.3.5]** • Other scientific or transferable skill courses	max. 6

* with approval from principal investigator or thesis committee

The **mandatory** colloquium "Challenges in Plant Sciences" should be taken in the first half of the PhD studies (offered each autumn term). We strongly recommend that you complete additional coursework in the first half of your PhD:

- Scientific Writing I (offered each autumn term)
- Scientific Presentation Practice (offered each spring term)
- Responsible Conduct in Research" (offered each spring term)

- Courses in Statistical Methods.

PSC Summer Schools: Our summer schools allow students to engage in cutting-edge plant science topics and to meet the experts from all over the world. The summer schools address the biggest challenges currently facing science and society. Example topics from recent years:

2016 PSC Summer School: Agriculture and Society
2015 IDP BRIDGES Summer School: Shaping our Future
2014 PSC Summer School: Green Revolution Reloaded - Emerging Technologies for Sustainable Crop Production
2013 Science & Policy Summer School: Governing the Transition to a Bio-based Economy
2013 SPSW Summer School 2013: Plant Volatiles: from lab bench to application
2012 SPSW and SystemsX.ch Summer School: Modeling Development in Plant Sciences
2011 SPSW Summer School 2011: Terrestrial Ecosystem Dynamics in a Changing World
2011 PSC-ETNA Summer School: Food Security – How can Science and Policy Contribute?
2010 SPSW Summer School: the global food crisis - how can plant sciences contribute?

3.2 Research and Transferrable Skills Developed in the PhD Program

All courses of the Zurich-Basel Plant Science Center have been developed to advance the acquisition of research and transferable skills that will serve you both in and outside of academia. Below is a list of skills we expect you to acquire during your PhD program.

Cited and adapted from Joint Skills Statement (2001):
http://www3.imperial.ac.uk/graduateschools/transferableskillstraining/jointskillsstatement

Research Skills and Techniques – you will develop:

1. The ability to recognize and validate research problems and to formulate and test hypotheses.
2. Original, independent and critical thinking and the ability to develop theoretical concepts.
3. Knowledge of recent advances within your field and in related areas.
4. An understanding of relevant research methodologies and techniques and their appropriate application within your research field.
5. The ability to critically analyze and evaluate your findings and those of others.
6. An ability to summarize, document, report and reflect on your research progress.

Understanding the Research Environment and the Scientific Community – you will develop:

1. A broad understanding of the context, at national and international levels, in which your research takes place.
2. Awareness of issues relating to the rights of other researchers, of research subjects, and of others who may be affected by your research, e.g. confidentiality, ethical issues, attribution, copyright, malpractice, ownership of data and the requirements of the Data Protection Act.
3. Appreciation of standards of good research practice in your institution and/or discipline.
4. An understanding of the relevant health and safety issues and responsible working practices.
5. An understanding of funding processes and evaluation of research.
6. The ability to justify the principles and experimental techniques used in your own research.
7. An understanding of the process of academic or commercial exploitation of research results.

Research Management – you will be able to:

1. Apply effective project management through the setting of research goals, intermediate milestones and prioritization of activities.
2. Design and execute systems for acquisition and collation of information through the effective use of appropriate resources and equipment.
3. Identify and access appropriate bibliographical resources, archives, and other sources of relevant information. Use information technology appropriately for database management, recording and presenting information.

Personal Effectiveness – you will develop:

1. A willingness and ability to learn and acquire knowledge.
2. An ability to be creative, innovative and original in your approach to research.
3. Flexibility and open-mindedness.
4. Self-awareness and the ability to identify own training needs.
5. Self-discipline, motivation, and thoroughness.
6. An ability to recognise boundaries and draw upon/use sources of support as appropriate.
7. Show initiative, work independently and be self-reliant.

Communication Skills – you will learn how to:

1. Write clearly and in a style appropriate for the purpose, e.g. progress reports, published papers, and PhD thesis.
2. Construct coherent arguments and articulate ideas clearly to a range of audiences, formally and informally through a variety of techniques.
3. Constructively defend research outcomes at seminars and in examinations.
4. Contribute to promoting the public understanding of your research field.
5. Effectively support the learning of others when involved in teaching, mentoring or demonstrating activities.

Networking and Teamwork – you will:

1. Develop and maintain co-operative networks and working relationships with supervisors, colleagues and peers, within the institution and the wider research community.
2. Be able to understand your behaviour and its impact on others when working in and contributing to the success of formal and informal teams.
3. Listen, give and receive feedback and respond perceptively to others.

Career Management – you will develop:

1. An appreciation for the need for and show commitment to continued professional development.
2. Ownership for and manage your career progression, set realistic and achievable career goals, identify and develop ways to improve your employability.
3. Demonstrated insight into the transferable nature of research skills to other work environments and the range of career opportunities within and outside academia.
4. An ability to present your skills, personal attributes and experiences through effective CVs, applications and interviews.

Course Catalog 2018 for PhD Program in Plant Sciences

The PSC PhD Program in Plant Science organizes many courses in plant sciences and transferable skills in cooperation with: Life Science Zurich Graduate School, Swiss Plant Science Web, University of Zurich, University of Basel, ETH Zurich

Current Course Listings viewable at:
http://www.plantsciences.uzh.ch/en/teaching/phdplantscience/courses.html

3.2.1 Technical Courses in Plant Sciences: Mandatory Course

Colloquium 'Challenges in Plant Sciences' (2 ECTS / 60 learning hours), PSC professors (Each Autumn Semester)	
The colloquium "Challenges in Plant Sciences" is a core event of the Plant Science Center's PhD program and the MSc module. The colloquium introduces participants to the broad spectrum of disciplines in plant sciences. The topics offer integrated knowledge about plant sciences, from the molecular level to the ecosystem level, and from basic to applied science while making use of the synergies between the different research groups of the PSC. The course offers a unique chance to approach interdisciplinary topics as challenges in the field of plant sciences. During the kick-off meeting, lecturers give talks on various topics as a general introduction to their research fields. Subsequently, each student group prepares a presentation chosen from a variety of topics and based on literature provided by the lecturers. Students gain knowledge and practice discussing and presenting research results.	
Remark:	Mandatory part of the PhD Program in Plant Sciences

3.2.2 Technical Courses Plant Sciences: Other Courses

Advanced course on 3D microscopy imaging of plant tissues and image processing (1 ECTS, 3 days), Dr. Célia Baroux and Prof. Joop Vermeer, University of Zurich; Dr. Alexis Maizel, Center for Organism Science, University of Heidelberg (2018)
Resolving the subcellular localization of a fluorescent compound in intact plant tissues or whole organs is a challenging task. Specific problems are posed by the high refractive nature of fresh tissues, sample thickness and stress-induced autofluorescence in dissected tissues. Together with classical problems of photobleaching and phototoxicity, these plants-specific issues make high-resolution and time-lapse imaging of fluorescent reporter proteins (or counterstaining) dye very challenging. *The aim of this course is to obtain both an overview and a specific practice. First, this course will give an overview of available microscopy imaging solutions depending on applications. We will specifically practice confocal laser scanning microscopy imaging of Arabidopsis tissues using different mounting and clearing agents; the aim is to learn customizing the acquisition parameters towards maximum possible resolution within specific constraints of speed, viability, bleaching and signal diffraction levels in fresh vs. fixed tissues.* *The course also offers a brief introduction to high-resolution two-photon microscopy for deep tissue imaging. Second, we will learn exploiting the benefits of 3D imaging at the qualitative and quantitative level. We will practice 3D volume rendering, preparation of attractive image material for publication, image segmentation and extraction of quantitative information for statistical analyses.*
Advice and ethics of editing digital images (1 ECTS, 3 days), Dr. Bernd Pulverer, European Molecular Biology Organization (EMBO) Chief editor (2018, every two years)
This course aims to focus on a key step in the scientific process: the rendering of scientific data in a form that

can be shared with colleagues – usually in the form of a published research paper, a preprint or a scientific talk. This step is critical as it is all too easy to misrepresent research findings in the rush to publish and given the pressures to publish 'high impact' research papers. The course aims to complement other training at the PSC PhD program and therefore focuses on image based data and digital processing of such data for publication.
Topics covered will include:

1) *Best practice and responsible conduct when acquiring and processing image based data. How to assemble a compelling paper that nevertheless represents the scientific findings in an accurate, unbiased manner.*
2) *Reproducibility: critical evaluation of the 'reproducibility crisis' and how to render papers more reproducible. New policies and mechanisms that enhance reproducibility.*
3) *The most frequent digital image aberrations observed in the literature and how to prevent them.*
4) *What to do if you find image aberrations in unpublished work and published work (including your own data, data from your lab and other labs).*
5) *How to peer review image based data and screening mechanisms at journals for digital image aberrations.*

How journals deal with image aberrations – emerging best practice.

Alpine Plant Ecology – International Summer School (3 ECTS, half-day preparatory meeting in Basel, 5 full days field course + preparation in e-learning course / 90 learning hours), Prof. Christian Körner and PD Jürg Stöcklin, University of Basel (Every Spring Semester)

It's a comprehensive graduate course on alpine plant life in the Swiss central Alps, jointly organized by the University of Basel and ETH, and the Zurich-Basel Plant Science Center (PSC) for graduate students with basic plant science training. The course covers microclimatology, vegetation ecology, reproduction biology, aspects of biodiversity, soil science, ecophysiology and ecosystem ecology. Morning and evening lectures, field excursions and team-work on small projects will make this week, in a truly alpine environment, a life time experience. The ALPFOR research station is surrounded by a great variety of typical alpine vegetation, including glacier forfields.

Analysis and Diversity of Plant Non-structural Carbohydrates (1 ECTS, 2 full days / 24 learning hours), Dr. Sebastian Streb, Prof. Samuel Zeeman, ETH Zurich (2013, next: not scheduled yet)

The aim of this course is to provide (i) some hands-on experience in methods commonly used to analyze plant carbohydrates and (ii) some insight into the diversity of carbohydrates found in the plant kingdom. To this end, you will be acquainted with HPLC-PAD, TLC, colorimetry, radio-HPLC, $^{14}CO_2$ pulse-chase, autoradiography, and phloem sap analysis.

Chlorophyll Fluorescence - Practical Applications and Analysis (1 ECTS, 2 full days / 24 learning hours), PD Dr Jörg Leipner and Dr. Eduardo Pérez Torres, ETH Zurich (2017, Every two Years)

The overall aim of the course is to get an insight into the practical applications of non-invasive photosynthesis analyses in basic and applied plant biology as well as into the underlying theory of the analysis techniques.
At the end of the course, the students can identify scientific questions in which the analysis of photosynthesis will give a surplus in knowledge gain. Furthermore, the students will be able to develop and use appropriate chlorophyll fluorescence analyses in order to elucidate such scientific questions. Finally, they can interpret data generated by chlorophyll fluorescence analysis and draw the correct conclusions.
This course wants to give an introduction into wide-spread methods of photosynthesis research that are useful for many (applied) plant scientists; out of scope are techniques that are reserved for experts in basic photosynthesis research.

Concepts in Evolutionary Biology (BIO 395), (1 ECTS, 2 days) Prof. Barbara König, Prof. Lukas Keller, Prof. Michael Krützen, Prof. Marcelo Sanchez, Prof. Kentaro Shimizu, Dr. Anne Carole Roulin, Dr. Anna K. Lindholm Krützen, University of Zurich

Concepts in evolutionary biology are often used ambiguously, partly because the same terms may have different

usage in other fields in biology. The course is designed for graduate students with interdisciplinary projects encompassing evolutionary biology and other disciplines, and provides lectures and simple calculation exercises in population and quantitative genetics.

Conservation Field Course in Scotland (3 ECTS, one week / 90 learning hours)**,** Prof. Jaboury Ghazoul, ETH Zurich (2019, Every two Years)

The course offers an opportunity to Swiss-based students to apply their knowledge and challenge their preconceptions to novel socio-environmental situations. The course specifically encourages students to explore and evaluate alternative management approaches that seek to integrate local economic needs with conservation priorities. An understanding of changing human perspectives to conservation (and associated land management approaches) will be gained. Using this understanding students will consider future challenges to conservation and land management, and develop solutions to resolve them.

The course will allow students to learn about ecology, conservation and management issues in a unique landscape. Daily excursions will focus on specific important issues relating to conservation management in the area. Excursions will be led by local experts representing science, management and policy, each of whom will explore with the students the complexities of the chosen topics. Topics will encompass species, habitats and landscapes from economic, ecological and cultural perspectives across various spatial and temporal scales.

Students will be encouraged to explore selected topics in more detail, examples being (1) trade-offs between deer, that are important to the local economy, and the regeneration of Caledonian pine forests, (2) the implications of changing land use and land-tenure systems, (3) the management of tourism on sensitive upland habitats, (4) securing a balance between renewable energy generation (e.g. wind farms, forestry) and landscape beauty, (5) predicted effects of climate change on plant communities, and (6) the impact of invasive species on natural plant communities.

In the evenings, group presentations and discussions based on the accumulated knowledge will aim to develop feasible solutions to current conservation challenges.

Current challenges in Plant Breeding (in ETH VVZ: 751-3603-00L, 2 ECTS / 60h work), Prof. Bruno Studer and Dr. Andreas Hund ETH Zurich; Dr. Simon Krattinger and Dr. Thomas Wicker, University of Zurich (Every Autumn Semester)

The seminar "Current challenges in plant breeding" aims to bring together national and international experts in plant breeding to discuss current activities, latest achievements and future prospective of a selected topic/area in plant breeding. The topic this year will be: "Potential and limitations of genomic selection in plants".

The educational objectives for the participants of the PhD Program in Plant Sciences cover both thematic competences and soft skills:

Thematic competences: Deepening of scientific knowledge in plant breeding, Critical evaluation of current challenges and new concepts in plant breeding, Promotion of collaboration with practical plant breeders

Soft skills: Independent literature research to get familiar with the selected topic, Critical evaluation and consolidation of the acquired knowledge in an interdisciplinary team, Establishment of a scientific presentation in an interdisciplinary team, Presentation and discussion of the teamwork outcome, Establishing contacts and strengthening the network to national and international plant breeders and scientist.

Genetic Diversity: Techniques (1 ECTS, 2 half days + preparatory work/homework / 30 learning hours) Dr. Aria M. Minder, ETH Zurich (Every Autumn Semester)

This course provides training for advanced students (master, doctoral or post-doctoral level) in how to measure and collect genetic diversity data from populations, experiments, field and laboratory. Different DNA/RNA extraction, genotyping and gene expression techniques will be addressed. After an introduction (one afternoon), students will have 3 weeks to work in groups of two through different protocols according to their timetable. At the end the whole group meets for another afternoon to present the techniques/results and to discuss the advantages and disadvantages of the different techniques. Examples are: RNA/DNA extraction, SNP genotyping, pyrosequencing, real-time qPCR.

Genetic Diversity: Analysis (1 ECTS, 4 days / 30 learning hours), Dr. Stefan Zoller, Genetic Diversity Center, ETH Zurich (Every Spring Semester)
The course provides basic training for advanced students (e.g. master, doctoral or post-doctoral level) in genetic data analysis with special focus on massive-parallel sequencing data (e.g. NGS data). The course is divided into different modules covering the following topics: Introduction into Linux OS and the usage of the command-line interface, Phylogenetics, Reproducible Science, Regular Expressions, R for Biology, Next Generation Sequencing (NGS) data analysis: Quality Control and Filtering/Trimming, Genome and Transcriptome Assembly and Annotation, RNAseq Design and Analysis, Metagenomics / Metatranscriptomics / Amplicon Sequencing, SNP-Calling, RAD Sequencing. Students will work with real data examples or can bring their own data. Exercises are a central part of the course.
Introduction to Functional Genomics (1 ECTS, 3 full days / 30 learning hours), Dr. Ralph Schlapbach, Dr. Endre Laczko, Dr. Hubert Rehrauer, Functional Genomics Center Zurich (2019, Every two Years)
The aim of the course is to enable participants to design and interpret functional genomics experiments and critically evaluate available technical options. Demonstrations of available technologies at the FGCZ will be included. In the postgenomic era emphasis of research shifts from merely accumulating sequence data towards the identification of functional significance of gene products. The goal of functional genomics is to understand the relationship between genome sequence and phenotype. An important aspect here is the measurement of molecular activities with the high-throughput 'omics' technologies transcriptomics, proteomics and metabolomics. The course comprises a theoretical introduction to mass spectrometry, the key technology for protein and metabolite analyses, and to transcriptional profiling. The diverse set of available technologies and most recent developments will be presented, including bioinformatic approaches to analyse the data and comprehend large amounts of data.
Introduction to genome-wide association studies (GWAS) (1 ECTS, 2 days / 24 learning hours), Lead Prof. Ueli Grossniklaus, University of Zurich (Next: 2018)
The development of high-throughput sequencing and genotyping technologies has revolutionised genetic research. The possibility to compare millions of DNA polymorphisms between multiple individuals allowed the development of genome-wide association studies (GWAS) over the last years. GWAS identify statistical associations between genetic variants and a trait of interest at a genome-wide level. Given their power and sensitivity, GWAS quickly are now a standard approach to investigate the genetic architecture of multiple traits in different species. This course will provide an introduction to GWAS for graduate students. It will cover the genetic and statistical background on which GWAS are based and will have a strong practical component with computer exercises and the use of real data. At the end of the course the students will be able to interpret GWAS studies and to carry out their now analyses. They will also gain from learning basic concepts of population genetics, genomics and quantitative genetics.
Introduction to Light Microscopy and Image Processing (1 ECTS, 3 full days / 24 learning hours) Dr. Gábor Csúc, ETH Zurich (2017, Every Two Years)
Light microscopy is a frequently used tool in plant sciences. Still, many are not aware of all the factors that are necessary for a good quality, reproducible microscopy images. The aim of the course is to give the students a practice-oriented introduction to the basics of light microscopy, including also a short introduction to image processing. This 3 days course gives a basic introduction into light microscopy. During the mornings lectures will summarize the necessary theory and the afternoon session will concentrate on practical, hand-on exercises. The following subjects will be dealt with transmission microscopy (phase contrast, DIC), fluorescence microscopy (including confocal imaging), basics of image processing
Microbiomics (1 ECTS), Dr. Matthew Horton, in development, (2018, Every Two Years)
Next-Generation Sequencing 1: Introductory Course - Assembly, annotation and transcriptomes BIO 610 (1 ECTS, 3 days / 30 learning hours)**,** Prof. Kentaro Shimizu, Prof. Jun Sese, Dr. Rie Inatsugi,

Dr. Masaomi Hatakeyama, Dr. Tony Kuo, Dr. Jianqiang Sun, Dr. Heidi Lischer (Every Spring Semester)

Course content: *Handling of the huge data produced by next generation sequencers (NGS) requires us experimental knowledge and computational skills. The aim of this course is to familiarize the participants with experimental methods and data analysis about NGS. Topics will include: fundamental analysis of the sequence data, UNIX tools, and RNA-seq analysis.*

Learning outcomes

- Understand concepts of NGS technologies
- Understand basic operation of UNIX operating system
- Design a research experiment and the data analysis involving biologically relevant issues affecting populations of plants or animals
- Map NGS data onto a reference genome and estimate gene expression level
- Understand differential gene expression and polymorphism analysis using NGS data
- Understand algorithms of De novo assembly and alignment of NGS data
- Understand basic bioinformatics of large datasets for practical use in genetic analyses

Next-Generation Sequencing 2: Advanced Course - Transcriptomes, Variant Calling and Biological Interpretation BIO 634 (1 ECTS, 2 days / 30 learning hours), Dr. Stefan Wyder, Dr. Heidi Lischer, Prof. Kentaro Shimizu (Every Spring Semester)

Fast advances in Next-Generation Sequencing (NGS) technologies are opening fascinating opportunities in life science research. The analysis of the large amounts of data produced requires knowledge of NGS methods as well as practical skills in computing. The aim of this course is to introduce students to the design and analysis principles of widely used NGS applications at an advanced level, based on the course "Next-Generation Sequencing 1 – Introductory Course: Assembly, Mapping, and Variant Calling". The focus of this advanced course lies in transcriptome analysis and biological interpretation of gene lists. This course also provides hands-on computer training on the Linux/Unix command line and shell scripting.

Pathways and Fluxes: Exploring the Plant Metabolic Network (1 ECTS, 2 full days / 24 learning hours), Prof. R. George Ratcliffe, Dr Nicholas J. Kruger, Department of Plant Sciences, University of Oxford, UK (2017, every three years)

The fluxes that flow through the plant metabolic network sustain life and are directly linked to the agronomically important parameters of crop yield and composition. Flux is the only direct measure of metabolic activity, and so measurements of metabolic flux allow the definition of metabolic phenotypes that are closely related to biological function. An understanding of these phenotypes and the flux distributions that define them is therefore essential for analysis of the behavior and regulation of the plant metabolic network. This course provides a theoretical and practical introduction to the methods available for measuring, inferring or predicting fluxes and considers how this knowledge informs our understanding of the function of the plant metabolic network. The course will describe the methods used for the prediction and measurement of fluxes in the plant metabolic network. It will provide an assessment of the applicability of these methods and a discussion of the significance of the results that have been obtained. This will include an analysis of the contribution of these methods to our understanding of the network as well as a discussion of the relevance of the methods to plant metabolic engineering. The lectures will be complemented by computing sessions that will introduce some of the modelling software used to analyse fluxes, providing an opportunity to explore the complex (and often counter-intuitive) behavior of metabolic networks.

Basic Plant Disease Diagnostics (1 ECTS, 3 full days / 30 learning hours), Dr. Ueli Merz and Dr. Monika Maurhofer Bringolf, ETH Zurich (2018)

Identification based on host, symptoms and micro-morphology, completed with life cycles and related control measures of the most important fungal diseases and their causal pathogens of selected annual and perennial crops. A half-day excursion will be integrated to allow applied training of symptom recognition on the field

level. The students will learn and train preparation skills for microscopy, acquire basic knowledge of selected diseases (Identification, Biology of pathogen, Epidemiology) and understand the corresponding integrated control measures practiced in Swiss agriculture.

Population Genetics and Genomics of Adaptation (1 ECTS, 3 days), Prof. Dr. Karl Schmid and Dr. Fabian Freund, University of Hohenheim (2019, Every two Years)

The rapid increase in the amount of phenotypic and genomic information from natural populations, common garden experiments and mapping populations allows to dissect patterns and processes of plant adaptation. This development is matched by new statistical approaches and software tools to analyse genomic and phenotypic data. The course provides a hands-on introduction to the study of plant adaptation with a focus on population genetics concepts and tools. We will cover demographic analysis with coalescent simulations and Approximate Bayesian Computation (ABC), model selection and validation, identification of genomic regions involved in local adaptation using tests of selection or correlations with environmental parameters.

Protein-coding Evolution and Detecting Natural Selection (1 ECTS, 2 days) Dr. Maria Anisimova, ZHAW (2018, Every three Years)

Course Description: *Molecular data provide rich information about the biological forces shaping biodiversity. Molecular phylogenies are now routinely used to test a variety of biological hypotheses, with applications ranging from medicine and epidemiology to agriculture and ecology. Natural selection is one of the major forces shaping the genomic diversity, often responsible for adaptations to new pathogens and environments. This course will provide an introduction to modelling the molecular evolution, phylogeny inference and statistical hypothesis testing in phylogenetics. These techniques became a must in most genomic analyses.*
Course Program: *Models of sequence substitution, Infering phylogenies in a nutshell, Detecting positive selection at the protein coding level*

Phylogenomics (1 ECTS), Prof. Yvonne Willi, University of Basel, in development, 2019

QTL Analysis in Arabidopsis (1 ECTS, 2 full days / 24 learning hours), Prof Ueli Grossniklaus, University of Zurich, Prof. Tom Juenger, University of Texas at Austin (2017, Every two Years)

This course is an introduction to current methods used in the study of polygenetic variation in plants. In particular, we'll explore the use of quantitative genetic experiments, quantitative trait locus (QTL) analyses, and linkage disequilibrium (LD) mapping as tools for dissecting the genetic details of continuous variation. The course will concentrate on providing students with the basic statistical and conceptual foundation for understanding continuous variation as well as an introduction to various mapping methods and current challenges in QTL cloning. Finally, we will collect phenotypic data on an Arabidopsis thaliana experimental population and conduct basic mapping analyses in a hands-on lab setting.

RNA Sequencing – A practical course for Plant Scientists (1 ECTS, 3 full days / 24 working hours), Dr. Lucy Poveda, Dr. Weihong Qi and others, Functional Genomics Center Zurich (Every Autumn Semester)

Next-generation sequencing (NGS) technologies have revolutionized many fields in biology. The Functional Genomics Center Zurich (FGCZ) offers a four-day course with hands-on practicals. The aim is to help scientists interested in NGS technologies, particularly applied to RNA sequencing, to gain a better understanding of the techniques available and their applications. The practical consists of a library preparation starting from polyA enriched RNA, followed by a sequencing run on a bench top sequencer. An introduction to the analyses of the resulting data and some exercises will be offered too. The lectures cover existing and upcoming NGS technologies, their applications and the principles of downstream data analysis. By the end of the course participants should be able to make informed decisions about which technology and workflow to apply to solve specific research questions.
Course Program
Library Prep: PolyA RNA-seq library generation: principles and types
Sequencing: Detailed description of available sequencing technologies platforms, Hands-on laboratory work:

preparing and performing sequencing runs *Data analysis: Run QC: Criteria for run performance and quality of data, Preprocessing of the raw data, Mapping the data to a reference, Mapping quality control for RNA-seq data, Transcripts expression quantification and tests for differential expression, Set-based analysis (e.g., pathways, GO-categories) IT and awareness of the data storage and its size*
Sustainable Plant Systems (in ETH VVZ 551-0209-00) (2 ECTS), Dr. G. Singh Bhullar, FIBL; Prof. Marcel van der Heijden Agroscope; Dr. Frank Liebisch and Dr. Melanie Paschke, ETH Zurich (Every Autumn Semester)
Future demand in agricultural output is supposed to match the needs of 9-billion people with less input of resources. We will discuss current plant science research in the context of sustainability on the production side. *A special focus will be on research on agro-ecological systems and farming system research. Can we transform our agricultural practices and move behind existing paradigms to develop innovative and sustainable agriculture production systems? Where does current research indicate on directions for transformation of current practice and how can we assess and analyze them though research?* *The seminar is set up as a blended-learning seminar, i.e. a combination of face-to-face meetings and self-organized learning with provided online learning material. The seminar comprises two workshop afternoons and an intensive, well-structured self-study/ group work phase in between the workshops. Students can earn 2 ECTS for successful completion of the seminar.* *Key objectives for the seminar are that (1) participants will be able to discuss issues of sustainability in the context of current plant science research topics (2) participants will be able to phrase their own visions for sustainability in plant sciences, their group work topic and their own MSc or PhD project.*
Transdisciplinary Seminar on Research for Sustainable Development (in ETH Vorlesungsverzeichnis: 701-0015-00L) (2 ECTS / 60 learning hours), C. E. Pohl, M. Stauffacher, B. Truffer, ETH Zentrum (Every Autumn Semester)
The participants understand the specific challenges of inter- and transdisciplinary research in general and in the context of sustainable development in particular. They know methods and concepts to address these challenges and apply them to their research projects. The seminar covers the following topics: Theories and concepts of inter- and transdisciplinary research, The specific challenges of inter- and transdisciplinary research, Involving stakeholders, Collaborating disciplines, Exploration of tools and methods, Analysing participants' projects to improve inter- and transdisciplinary elements.
Visual analytics of large-scale biological data (1 ECTS, 3 days), PD Dr. Kay Nieselt, Center for Bioinformatics Tübingen, Integrative Transcriptomics, University of Tübingen (2018, every two years)
In this course, we will focus on omics data (mainly genomics and transcriptomics data) and combined data such as GWAS and eQTL. The course is a mixture of theoretical lectures and interactive, practical sessions. The hands-on training will introduce the most commonly applied tools in the field as well as some maybe less commonly but nonetheless very useful ones. Dependent on the participants' programming abilities we will use GUI-based tools as well as R/Bioconductor and other scripting languages. *Learning Outcomes: Understand the process of visual analytics, Know the basics and do's and don'ts of visualization, Learn how to visualize large-scale genome data, Learn how to visualize transcriptional regulation and abundance, Understand the challenge of GWAS and eQTL data visualization and learn new approaches to address these challenges.*

3.2.3 Statistical Methods Courses

Experimental design and statistics are core skills of the PSC PhD Program in Plant Sciences. The PSC offers statistics courses at different levels.

Basic Courses

Advanced Data Management and Manipulation using R (1 ECTS, 2 full days / 24 learning hours), Dr. Jan Wunder, WSL (2018, Every two years)
The analysis of large data sets ("big data") is becoming increasingly important in science and elsewhere. In this course, you will learn how to use R to manage and manipulate large data sets, i.e. to sort, merge, subset, aggregate and reshape data, including outlier detection and gap filling algorithms. For advanced data manipulation, we are going to use novel developments such as plyr/dplyr ("A Grammar of Data Manipulation"), the pipe operator (%>%) for simpler R-coding and data.table for the fast aggregation of large data sets. Furthermore, we will have a closer look at R-data base connections, MySQL queries and the creation of new data bases from R. Depending on the course progress, there will be scope for individuals to work on small projects and / or their own data sets.
Bioinformatics and genome analyses (1 ECTS, 3 full days / 30 learning hours) TBD
Computational Biology (1 ECTS), Prof. Christian von Mering, Prof. Andreas Wagner, Prof. Kentaro Shimizu, University of Zurich (Every Autumn Semester)
The Molecular Life Science course BIO 673 focuses on Computational Biology. In this course, we will study the theoretical and practical aspects of sequence alignment, phylogeny reconstruction, genome-wide association of phenotypes and genotypes, and more. In doing so, we will also learn how to generally manipulate data and launch software from the command line, including some simple scripting (programming) exercises.
Introduction to Data Analysis using R (1 ECTS, 3 full days / 30 learning hours), Dr. Stefanie von Felten, oikostat GmbH (2018, every two years)
This course provides an introduction to statistics ideal for MSc and PhD students in ecology or related fields. Of course, molecular biologists with an interest in statistics are welcome to join as well. Topics treated in this course include: important probability distributions, classical statistical tests (t-test, chi-square-test, U-test), the theory of hypothesis testing (examples: randomisation test and t-test, analysis of variance ANOVA, linear regression (simple and multiple), analysis of covariance ANCOVA, outlook, e.g. GLMs, MEMs... *The course will consist of both lectures and computer practicals using the free software package R for statistics and graphics. Participants can bring their own PC or Mac laptops with the latest version of R downloaded from http://stat.ethz.ch/CRAN/ (a small number of computers will be available for those without laptops). The course will be limited to 20 people to allow one-to-one supervision during the computer practical exercises.* *Prerequisites: Knowledge of the R (or S-Plus) language would be ideal, but is not essential.*
Introduction to R (1 ECTS, 3 full days and homework / 30 learning hours)**,** Dr. Jan Wunder, WSL (Every Spring Semester)
This basic introduction to R focuses on the technical aspects of data organisation, handling, analysis and presentation using the wide-spread command line program R. This course is not an introduction to statistics, but lays the foundation to efficiently use statistical applications of R, which are introduced in other courses. No previous experience with programming languages is required. The course addresses students who would like to become familiar with a powerful, single and freely available alternative to spreadsheet programmes (excel), other, less flexible commercial statistical packages (SPSS, Jump, Minitab etc.) and graphics software for presenting data (excel, Sigmaplot etc.). *Topics covered include the proper organisation of the workspace, reading and writing data files, using R as a calculator, using logic operators, manipulating data frames, summarising and aggregating data, programming 'ifelse' statements, loops, short routines, handling time fields in data frames, drawing and customising graphs.* *Depending on the course progress, there will be scope for individuals to work on small projects and / or their*

own data sets.
Scientific Visualisation Using R (1 ECTS, 2 full days / 24 learning hours), Dr. Jan Wunder, WSL (Every Autumn Semester)
Visualisations can decide about the success of scientific lectures, poster presentations or journal articles. In this course you will get a brief introduction into general design principles for data visualisations, learn about the Do's and Don'ts of visual presentations, understand how much information can be presented in a figure and get guidelines for visual communication. Based on this theoretical framework and a (very) brief introduction into R we will spend most of the course time to learn how to use R as a powerful graphical software to create a wide range of customised graphics that include - but are not limited to - traditional scatterplots, barcharts, stripcharts, boxplots, spineplots, mosaic plots and interactive graphics as well as grid-based geographic maps and state-of-the-art multipanel conditioning plots (and many more). *You will learn about the two pillars of the R graphics systems, i.e. Traditional and Grid graphics. The course focuses on the latter system and more recent developments such as ggplot2 and other advanced libraries based on the "The grammar of graphics"-concept. Depending on the course progress, there will be scope for students to work on small projects and / or their own data sets.*
Statistics for Ecologists (1 ECTS), Dr. Sabine Güsewell (ETH Zurich) (Every Year)
This class provides students with an overview of techniques for data analysis used in modern ecological research, as well as practical experience in running these analyses with R and interpreting the results. Topics include linear models, generalized linear models, mixed models, model selection and randomization methods. *Students will be able to:* *- describe the aims and principles of important techniques for the analysis of ecological data* *- choose appropriate techniques for given problems and types of data* *- evaluate assumptions and limitations* *- implement the analyses in R* *- represent the relevant results in graphs, tables and text* *- interpret and evaluate the results in ecological terms* *Course Content:* *- Linear models for experimental and observational studies* *- Model selection* *- Introduction to likelihood inference and Bayesian statistics* *- Analysis of counts and proportions (generalised linear models)* *- Models for non-linear relationships* *- Grouping and correlation structures (mixed models)* *- Randomisation methods*
Statistical Methods in Molecular Biology (1 ECTS, 3 full days /30 hours workload)**,** TBD
The understanding of statistical principles is of central importance in modern life sciences. This course will provide an introduction in statistical methodology and will cover a number of statistical techniques that are important for practical data analysis in biology. Concepts include descriptive statistics, distributions, sampling
Tutorial on Plant Modelling (1 ECTS), Dr. Pierre Barbier de Reuille, University of Bern (2019, every two years)
This course aims to provide the basis for understanding computer modelling applied to plant sciences. Students will get a feel for what it takes to create a computational model, learn to be critical about modelling issues and be better placed to decide which modelling techniques to apply to their own needs. ***Course Program:*** *This 2 days course mixes presentations, discussions and hands-on approaches. In particular, you will see what it takes to create a model, from the idea to the final implementation.*

3.3.4 Transferable Skills Courses

Communicating science

Dealing with the Publication Process (1 ECTS, 2 full days / 30 learning hours)**,** Dr. Philipp Mayer (science-textflow, http://www.science-textflow.ch/), Prof. Dr. Christian Fuhrer and Dr. Melanie Paschke (University of Zurich) (Every Spring Semester)
Description: *In this 2-day workshop PhD students will learn specifically to deal with the whole publication process: from choosing journals strategically, to submission, to publication. The course can be visited in parallel or after Scientific Writing I, Scientific Writing II.* ***Objectives:*** *Understand the publishing process and develop individual publishing strategies*
Scientific Communication Practice (1 ECTS, 2 full days / 30 learning hours), Dr. Jacopo Pasotti |Communication Skills| (also part of Plant Science & Policy) (2017, Every Two Years)
Scientists are under pressure to communicate with the public about their research. This pressure comes from funding bodies such as the EU, the SNF, the taxpayers, recruiting agencies and policy makers. Improved public and media communication is essential if the public is to better understand who scientists are and what they do. Also, communicating is a source of personal satisfaction. For scientists, it's worth learning the basics of communication early in their careers. This course provides a guide to effective science communication, in theory and practice.
Scientific Presentation Practice (1 ECTS, 2 full days / 30 learning hours), Dr. Barbara Hellermann, ETH Zurich (Every Spring Semester)
Effective oral communication is an important skill in scientific and academic endeavors. In fact, success in both the academic and the professional arenas may well depend upon your ability to communicate orally with a variety of audiences. It goes without saying that you need to create presentations that are well constructed, logical and interesting, but achieving this goal can take a fair amount of preparation and practice, especially when you are working in a second language. *This course will provide you with the opportunity to prepare a presentation and practice your presenting skills in English. Particular attention will be paid to the following points: Identifying your MAP (Message, Audience and Purpose), Creating rapport with your audience, Achieving logical structure, Using appropriate visuals, Improving your delivery in English* *The skills that you practice during this course should prove helpful when you are faced with tasks such as making public presentations, presenting lab reports, giving technical briefings or training sessions, presenting at conferences, attending job interviews, and speaking at seminars.*
Scientific Writing I (1 ECTS, 2 full days / 30 learning hours), Dr. Patrick Turko, University of Hospital Zurich (Every Autumn Semester)
This course is a foundation course in scientific writing skills. It offers writers practice in expressing themselves precisely, concisely and, above all, clearly when writing English for scientific purposes. Particular attention is paid to Organisation, Flow and Style. Participants will receive feedback on their writing and will have the opportunity to edit and improve texts written in English. The course serves as preparation for a second course, "Scientific Practice 2: Writing Up Research in English", which accompanies scientific writers as they produce the individual chapters of a research article in English.
Scientific Writing II (1 ECTS, 2 full days / 30 learning hours), Dr. Jacopo Marino, Paul Scherrer Institute (Every Spring Semester)
This course is tailored for PhD students working in life sciences, who wish to improve their writing skills in English. The course emphasizes the importance of simplicity, clarity, and brevity to communicate science in an effective manner. During the course, participants will develop a critical approach towards the recognition of elements that make written communication weaker or stronger. Participants will improve their self-confidence

towards the writing of scientific manuscripts and the communication of science as a whole. *The course covers the following topics: 1) Grammar and syntax. Where to position different types of words (nouns, adverbs, etc.) within a sentence. The importance of punctuation, and its use in scientific writing to avoid ambiguity. Breaking up long sentences. The use of active and passive voices. Removing redundancy. How to connect sentences. ; 2) Avoid ambiguity and vagueness. The use of "which, who, that". The use of "a, one, the". Latin words and numbers.; 3) The structure of a paragraph. Where to put new and old information. Breaking up long paragraphs. Readability tests and the use of spell checkers.; 4) Sections of a scientific manuscript. The importance of figures to draw a story-line. The title. The abstract. How Hollywood movie industry can help scientists writing better abstracts. How to structure the introduction, methods, results, and discussion. Hedging and criticism.*
Visualizing your research (1 ECTS, 2 course days including working on own visualisations in between, 30 learning hours), Marina Bräm Graphic designer, Scientific Visualization (NZZ Sonntag), Tom Reed, Illustrator and author (Freelance), Juanita Schläpfer, Science Communicator and artist (PSC) (2014, 2015, next: not scheduled yet)
Improve your visual communication skills with guidance from practicing professionals in the fields of info-graphics, illustration, art and science communication. This two-day workshop will provide both practical and theoretical input, on how and why to engage with your audience, use of visual metaphors and creating your own hand drawn illustrations. You will develop you own visualization project and get detailed feedback in small groups. The workshop is aimed at doctoral students but if there are sufficient places available post-docs and other researchers are welcome. Please note that the course focuses on visual communication concept design rather than software skills.

Responsible Conduct in Research

Responsible Conduct in Research (1 ECTS, two half-days of attendance + self-study and team work in between / 30 hours of work; offered in spring semester), Prof. Nina Buchmann, ETH Zurich, Dr. Melanie Paschke, Zurich-Basel Plant Science Center (Every Spring Semester)
When studying at a University, Master's and PhD students are joining the scientific community and, therefore, have to learn the codes of professional and responsible conduct in research. In this course, we provide information about specific rules, regulations and guidelines for research integrity and responsible conduct as well as a tool kit for moral reasoning. The course will rise awareness for potential conflicts of interest and will discuss real life examples, e.g., about questions of authorship and giving credits, data treatment and interpretation, communication and responsibility in the public. Students will discuss case studies with a typical conflict potential or a dilemma. They will work together in teams, discuss the codes of conduct and values established in science, and apply them to their case studies. The teams have to agree on actions to be taken for each case and present a consensus view.
Research with biological material from abroad – International regulations and good research practice (CBD ABS, IT FAO & CITES) (1 ECTS / 24 hours of work), Susette Biber-Klemm (SCNAT & University of Basel), Marco D'Alessandro (Federal Office for Environment), Mathias Lörtscher (Federal Veterinary Office), Sylvia Martínez (University of Basel & Zurich-Basel Plant Science Center), François Pythoud (Federal Office for Agriculture) (2017, Every Two Years)
Utilization of non-human biological material that comes from abroad is more than just a matter of competence in research techniques and methods. Scientists must be aware of legal and procedural requirements in order to correctly access biological material and to respect existing international and national regulations on plant genetic resources. Researchers need to be familiar with the Nagoya Protocol and terms such as Prior Informed Consent, Mutually Agreed Terms, Benefit-Sharing and Due Diligence in research. *The overall goal of this course is to inform young scientists about the relevant international treaties and*

existing international and Swiss regulations that affect research projects with genetic resources and to illustrate which steps to undertake.
Training will focus on the

- *Nagoya Protocol on Access to Genetic Resources and Benefit Sharing (ABS) and the Convention on Biological Diversity (CBD),*
- *International Treaty on Plant Genetic Resources for Food and Agriculture (IT FAO),*
- *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).*

The course will provide solid knowledge on 1) Correct and legitimate access to genetic resources and benefit-sharing for academic research, 2) The Multlateral System of the plant treaty, 3) Requirements for importing material under CITES in general, and specifically for plant genetic resources, 4) Swiss regulations, 5) Available support and counseling services for scientists in Switzerland.
Students work in groups, actively analyse each other research projects with genetic resources (biological material) and discuss exemplified case studies.

Research Management

Project Management for Research (1 ECTS, in total 2 full days / 30 learning hours), Dr. Andrea Degen, eurelations AG (2017, Every Two Years)

Every project has high scientific and organisational demands. Not only your project work but also other activities, such as organising workshops and meetings, require good planning and management and are the focus of this course. With the help of internationally standardised project management and its tools, the project internal communication as well as the monitoring of results can be simplified. And the experience has shown: project management boosts the performance of researchers and is at the same time a promising basis for the successful collaboration between industry and academia.
This course should motivate researchers to develop further their personal leadership qualities and to initiate and coordinate in the near future their own projects. At the end of the course the participants will be able to:
Use the key elements of professional Project Management (IPMA standards) in terms of the application and implementation of research projects.
Contents: Analysis of research environment, definition of projects, stakeholder management, Project objectives, how to deal with moving targets, Project structuring (time, content), Project planning (activities, quality, costs, data), Project organisation (roles of participants, competences, tasks and responsibilities), Financial administration, Project monitoring and steering, Risk management, Project leadership, Social Media for the improvement of communication and the dissemination of results

Writing a Post-doctoral Grant (1 ECTS, 2 full days / 30 learning hours), Dr. Andrea Degen, eurelations AG, Dr. Melanie Paschke (Every Autumn Semester)

Objectives: To train involved PhD-students/future Post-docs to write grant/fellowship applications to proceed in their scientific careers and get informed and updated about most common research funding organisations (national & international, public & private).
Prior Knowledge: Ideally, you plan a grant application in due term (not later than one year after this course) or you are already involved in grant writing. We expect that you have already good to excellent knowledge in scientific writing and project management for research (e.g. by visiting the specific courses in our PhD Program in Plant Sciences).
Content: Funding opportunities for PhD-students/future Post-docs to plan their further career, Know more about the mission of funding organisations and align the application, Plan and structure a grant application, Learn about some basic techniques of grant writing (not identical to scientific writing), Learn how to calculate the finances of a grant application, Learn about basics of IPR (intellectual property rights) and international

scientific networking *Methods: Theoretical introduction and practical exercises in groups, Database research on the internet* *Feedback on technical aspects of the grants you are currently working on*

Patenting (please register at Life Science Zurich Graduate School: http://www.lifescience-graduateschool.uzh.ch/en/courses/tsc.html)

Patenting in the Life Sciences (1 ECTS, 2 full days /30 learning hours), Prof. H. Müller, University of Basel et al. (organized by Life Science Zurich Graduate School. Please check course catalogue at: (Next courses in 2018)
What is a patent? How is it obtained? What are the implications of Life Science patents for – my career perspectives? – academic research? – society?

Career Development (please register at Life Science Zurich Graduate School: http://www.lifescience-graduateschool.uzh.ch/en/courses/tsc.html)

Career Cornerstones - Active Career Building in Academia and Business (1 ECTS, 2 full days / 24 learning hours), Dr. Monika Clausen, Dr. Monika Clausen & Netzwerkpartner GmbH (organized by Life Science Zurich Graduate School.
Self-marketing Skills – Improve your International Presence (1 ECTS, 2 full days / 24 learning hours), Dr. Monika Clausen, Dr. Monika Clausen & Netzwerkpartner GmbH (organized by Life Science Zurich Graduate School.
Competency Awareness – the Foundation of a Confident Self-Presentation (1 ECTS, 2 full days / 24 learning hours), Dr. Monika Clausen, Dr. Monika Clausen & Netzwerkpartner GmbH (organized by Life Science Zurich Graduate School.
The Successful Start of a Business Career (1 ECTS, 2 full days / 24 learning hours), Dr. Monika Clausen, Dr. Monika Clausen & Netzwerkpartner GmbH (organized by Life Science Zurich Graduate School.

3.3.5 Events Organized by PhD Students

PSC PhD Symposium (3 ECTS) (next: 2018)

PSC PhD Students
Note: organized every two years – next time 2018
Together with a group of 5 – 6 PSC PhD students, you will be responsible for the organisation of an international and interdisciplinary PSC symposium. As a member of the scientific and organisation committee, you will fulfil the following tasks:

- Development of a symposium topic
- Invitation of speakers from around the world to contribute to a high-quality scientific program
- Organization of symposium logistics
- Fundraising and finances

3.3.6 Workshops from the PSC PhD Program in Science and Policy

You may also attend courses from our specialized PSC PhD Program in Science and Policy. Details on these courses may be found at:

http://www.plantscience.ethz.ch/education/science_policy/

Workshop titles:

- Evidence-based Policy-making (2 ECTS)
- Stakeholder Engagement (2 ECTS)
- Communicating Science (2 ECTS)
- Building Political Support (2 ECTS)
- Contributing to a Policy Action (2 ECTS)
- Understanding Policy Evaluation (2 ECTS)

3.3 Other Courses through the Universities

Excellent English language skills are one of the requirements for successful completion the PSC PhD Program in Plant Sciences. Additional training can be obtained through:

- Language Skills for PhD students of University of Zurich and ETH Zurich http://www.sprachenzentrum.uzh.ch

The PSC organizes some of its transferable skill courses in cooperation with the Life Science Zurich Graduate School. All skills courses are accredited within the PSC qualification framework. Please regularly check the website of LSZGS to be able to enrol in these and other transferable skill courses.

- Details and Registration for LSZGS courses: http://www.lifescience-graduateschool.ch/graduate-courses/transferable-skill-courses.html

Transferable Skill Courses, University of Basel:
http://www.unibas.ch/index.cfm?uuid=42422556D176E06E3F2D939BBA35EFF5&&IRACER_AUTOLINK&&

Transferable Skill Courses, University of Zurich, Graduate Campus:
http://www.ueberfachliche-kompetenzen.uzh.ch/index.html

Courses of the Didactica Program of UZH: some of the courses offered by "Hochschuldidaktik UZH" can be finished with ECTS (active participation and individual assessment necessary). We accredit these courses in the PSC PhD Programs. Online registration: http://www.hochschuldidaktik.ch

Previous courses (not offered any more)

Innate Immunity in Plants (1 ECTS, 3 full days / 30 learning hours)**,** Prof. Thomas Boller, University of Basel

The aim of this course is to present an introduction to and overview of theory and experimental approaches to investigate "innate immunity" in plants. Recent work has shown that innate immunity in plants and animals are based on similar basic principles. In particular, both plants and animals recognize so-called "pathogen-associated molecular patterns" (PAMPs). These PAMPs elicit a defense response including formation of reactive oxygen species and induction of a multitude of genes.

Radio-Isotopes in Plant Nutrition (3 ECTS / 90 hours workload during one semester), Prof. Emmanuel Frossard, ETH Zurich

Radio-isotopes are extensively used at the soil/plant or ecosystem level to quantify the fluxes of elements (phosphorus (P), heavy metals, radionuclides) within a given system and to assess the importance of processes controlling these fluxes (e.g. exchange reactions between the soil solution and the soil solid phase, element turnover through the microbial biomass, organic matter mineralization etc.).

The course will first present the principles, the basic assumptions and the theoretical framework that underlay the work with radioisotopes. It will present how the introduction of an isotope into a system can be done so as to get information on the structure of the system (e.g. number and size of compartments). Secondly, case studies on isotopic dilution and tracer work will be presented for instance on the isotopic exchange kinetics method to determine nutrients or pollutants availability. The case studies will be adapted to the ongoing research of the group of plant nutrition and will thus give an insight into our current research. In addition, published studies will be analyzed and presented by the students. Finally, the advantages and disadvantages of work with radioisotopes will be analyzed and discussed critically.

Transport Processes in Plants (1 ECTS, 2 full days / 24 learning hours), Prof. Enrico Martinoia, University of Zurich

Life exists due to barriers established between the environment and the cell. Biological membranes establish these barriers. The lipid bilayer does not allow hydrophilic molecules such as ions and sugars to cross the membrane. On the other side, proteins embedded in the lipid bilayer are responsible for the selective uptake of constituents into the cell. Within eukaryotic cells compartmentation allows that different processes can occur at the same time in a cell. In this course we will show some techniques, how fluxes between the outside and within the cell can be measured. We will perform classical flux analysis using radiolabelled compounds with yeasts and protoplast and use the patch clamp technique to demonstrate ion currents across the vacuolar membrane.

Stable Isotope Ecology of Terrestrial Ecosystems (2 ECTS, one week/5 days / 60 learning hours) Prof. Nina Buchmann, Dr. Rolf Siegwolf, ETHZ

This course provides an overview about the applicability of stable isotopes (carbon 13C, nitrogen 15N, oxygen 18O and water 2H) to process-oriented ecological research. Topics focus on stable isotopes as

indicators for the origin of pools and fluxes, partitioning of composite fluxes as well as to trace and integrate processes. In addition, students carry out a small project during lab sessions. Learning Objective: Students will be familiar with be familiar with basic and advanced applications of stable isotopes in studies on plants, soils, water and trace gases, know the relevant approaches, concepts and recent results in stable isotope ecology, know how to combine classical and modern techniques to solve ecophysiological or ecological problems, learn to design, carry out and interpret a small IsoProject, practice to search and analyze literature as well as to give an oral presentation. Content: The analyses of stable isotopes often provide insights into ecophysiological and ecological processes that otherwise would not be available with classical methods only. Stable isotopes proved useful to determine origin of pools and fluxes in ecosystems, to partition composite fluxes and to integrate processes spatially and temporally.

Online Publishing, Communicating and Creating a Web Presence: How to Make your Research Visible (1 ECTS, 2 full days and 24 learning hours), Dr. Melanie Paschke, PSC

Online publishing and communicating has become an important channel for scientist to make their research visible, connect with other scientists, and open science to the interested public. Several technologies have popped up in recent years that can support scientists in their publication, communication and self-marketing purposes: open-access journals, research blogs and portfolios, research wikis and professional online networks.

In this two-day workshop, you will learn:

- about these technologies and how to use them.
- how to improve your visibility and creating a web presence using e.g. research portfolios or online research networks.

Topics discussed will include:

- Publication strategies as part of your web presence (online open-access journals vs. traditional journals)
- Using bibliometric measurements (e.g. impact factor, citation indexes) for online publications
- Using weblogs and wikis in your daily work
- Writing for a research blog
- Creating personal research portfolio (hands-on training)

Using professional online research networks

Role of Agriculture in our society in 2020 (1 ECTS, 30 learning hours), Luc Henry, Syngenta Basel, Switzerland

Currently, there is a remarkable gap between public perception and understanding of world agriculture and its role in our society. This places enormous stress and tension not only on governments and agribusinesses, but also on individuals as consumers. This gap, unfortunately, is widening and future opinion leaders have a major role to play in filling this gap.

The objective of this course therefore is to provide students with the opportunity to explore the topic of world agriculture (including production and consumption, the technologies used and being developed, the impact on the environment, the food security challenge, the carbon footprint of agriculture, the biofuels, etc), and to put in place a framework to understand and foresee the potential required changes over the next years. The purpose of the course, by its very nature, is not to provide a single, “correct” perspective about agriculture. Instead, it aims at making students aware of possible

scenarios, the consequences of the different scenarios, and help them to shape their own vision of agriculture in 2020.

Molecular Biology and Genomics of Plant-Pathogen Interactions (1 ECTS, 2 full days / 24 learning hours), Prof. Beat Keller, University of Zurich

Genetic resistance is the most economical and environmentally friendly option for controlling plant diseases in agricultural ecosystems. Plant breeders have expended considerable effort to incorporate resistance genes into the major crops over the past 100 years. Pathogens have evolved to overcome many of these resistance genes, leading to a cycle of boom-and-bust with significant economic and societal consequences. This course will explore the molecular basis of disease resistance with an emphasis on agricultural crops. Topics will include: mechanisms of resistance; major gene resistance and quantitative resistance; genetic and biochemical models of gene-for-gene interactions; resistance gene structure and evolution; effector molecules in pathogens, boom-and-bust cycles and durable resistance; resistance gene deployment and management strategies; approaches for genetic engineering of resistance; identification and mapping of major resistance genes and quantitative (QTL) resistance; bioinformatics of plant pathogen genomes ("Pathogenomics").

Niche Modeling (1 ECTS, 2 days) Prof. Antoine Guisan (U Lausanne), Prof. Niklaus E. Zimmermann (WSL, ETHZ), Prof. Yvonne Willi (U Basel)

The course will be based on a mix of lectures and practicals. The lectures will cover the preparation of data (species data and environmental predictors) for modelling, an introduction to basic and more advanced SDM fitting (e.g. GLM/GAM, CART, and their bagging/boosting versions) and evaluation methods, and how to derive projections to the same or different study areas, or to different time steps, such as future climates. The use of ensemble of models to assess uncertainty will also be covered. Practicals will allow the students to get trained in all these aspects. Due to the limited number of days (2), only an overview of these different aspects will be given and short practicals conducted. Depending on the course progress, there may be scope for individuals to work on their own data sets, so participants are encouraged to prepare their datasets as [species x sites] and [environment x sites] matrices before the course.

Applications of Stable Isotopes in Plant Sciences (Workshop) (1ECTS, 60 learning hours), Prof. Nina Buchmann, Prof. Emmanuel Frossard, Prof. Johan Six, Dr. Roland Werner, Dr. Matthias Barthel, Dr. Charlotte Decock (ETH Zurich) and Prof. Ansgar Kahmen (University of Basel). Scientists at both field sites (DOK trial: Dr. Paul Mäder, Dr. Andreas Fliessbach (FiBl), Juliane Hirte (Agroscope); Hofstetten crane: Ansgar Kahmen)

Lectures: Introduction to stable isotopes, tracer vs. natural abundance applications, instrumentation. Overview lectures on stable carbon, nitrogen, oxygen and hydrogen isotope applications in agricultural and forest ecosystem sciences. Field visit: Students will get to know stable isotope applications in agricultural (DOK trial) and forest (Hofstetten crane site) ecosystems, interact with those who had carried out different stable isotope studies at the sites. Students know the basics about stable isotope applications to study plant and soil related research questions. Students are able to decide on tracer vs. natural abundance designs for a given research objective. Students understand the main mechanisms and processes imprinting on the stable isotope composition of the material of interest (e.g., plants, soils, gases).

Chlorophyll Fluorescence - Principles and Applications (1 ECTS, 3 full days / 24 hours of work), Dr. Diana Santelia, University of Zurich, Dr. Klara Panzarova, Photon Systems Instruments (2015)

Chlorophyll fluorescence analysis is one of the most powerful and widely used techniques by plant physiologists and ecophysiologists. Chlorophyll fluorescence is used for rapid non-invasive measurement of photosystem II activity. PSII activity is very sensitive to range of biotic and abiotic factors and therefore chlorophyll fluorescence technique is used as rapid indicator of photosynthetic performance of plants in different developmental stages and/or in response to changing environment. The course will consist of lectures related to the theoretical background of this technique and practicals where different measuring protocols will be used to illustrate the types of information that fluorescence can provide. We will use both imaging and non-imaging tools for analysis of chlorophyll fluorescence kinetics. The analysed samples will be from cyanobacteria, algae and plants.

Metabarcoding and DNA Barcoding (1 ECTS, 3 days / 30 learning hours), Prof. Alex Widmer, ETH Institut für Integrative Biologie, Dr. Stefan Zoller and Dr. Jean-Claude Walser, Genetic Diversity Center, ETH Zurich (2013)

The goal of DNA barcoding is the identification of species through the analysis of nucleotide variation in short, standardized gene regions. These gene regions are typically amplified by PCR from samples of unknown origin and are then sequenced individually using standard Sanger sequencing technology. DNA metabarcoding is an extension that aims at identifying multiple species from a single, often complex and possibly degraded, environmental sample. A target gene region from all species represented in the sample is then amplified by PCR and sequenced using a high throughput nucleotide sequencing approach. DNA barcoding is widely used by ecologists and conservation biologists to identify species. Examples include the analysis of wood samples from logged trees or the validation of field identifications of vegetative plant parts. DNA metabarcoding is mainly used by ecologists and evolutionary biologists interested in biodiversity assessment, for example from water or soil samples, or the analysis of animal diet, gut bacteria composition and parasite diversity.

Linear Models in R (2 ECTS, Prof. Andrew Hector, University of Zurich)
Introduction to Anova and Regression (2 ECTS, Prof. Andrew Hector, University of Zurich)
Statistics: Special Topics (2 ECTS, Prof. Andrew Hector, University of Zurich)
Multiple Regression using Information Criteria and Multimodel Averaging (2.5 ECTS, Prof. Andrew Hector, University of Zurich)
Modelling of Plant Growth (2 ECTS, Prof. Andrew Hector, University of Zurich)
Contemporary applied statistic for Ecology (2 ECTS, Prof. Andrew Hector, University of Zurich)