Cycle I: Practical and Experimental Skills

Coordinator: Christoph Handschin

I3: Effective scientific communication: Scientific Writing Course – 21475
(1 day; 1 CP; Spring 2020)

Ch. Handschin
M. V. St-Pierre (PhD, University of Toronto)

Module description:
The scientific writing course is designed to develop and sharpen the English writing skills of students pursuing degrees in the biomedical sciences. The module consists of two parts: a lecture followed by a workshop. The lecture (part A. 0.5 day) emphasizes the concept that effective scientific writing engages the reader and delivers a clear and concise message. The workshop (part B, 0.5 day) emphasizes the practical skills required to achieve clarity of message. The module covers all aspects of the writing process, including syntax, sentence structure, crafting of paragraphs, preparing sections of a hypothesis-testing manuscript, writing of abstracts, identifying scientific questions and elaborating hypotheses. The students are expected to engage verbally in classroom discussion, to participate in group exercises where texts are criticized and rewritten, and to submit personal written work for peer review.

Learning objectives:
The course aim is to encourage novice writers to hone practical skills. The following is expected of students:

1) to become proficient in recognizing and correcting common writing faults related to word choice and syntax.
2) to become proficient in crafting stylistically pleasing sentences and paragraphs.
3) to demonstrate competence in elaborating scientific aims, research questions and hypotheses.
4) to master the skills of writing abstracts for scientific meetings.
5) to participate in a peer-review process wherein the texts of fellow participants are critiqued.

The courses are limited to a maximum of 15 participants.

I4: Introduction into fluorescence and live cell imaging (IMCF Course) – 34605
(4 days; 2 CP; Spring 2020)

O. Biehlmaier, N. Ehrenfeuchter, W. Heusermann, A. Loynton-Ferrand

Imaging procedures are becoming increasingly important in all fields of biological research. This course will provide an introduction to fluorescence microscopy and live cell imaging and will be composed of lectures and associated hands-on sessions. The lecture series covers basics of light and fluorescence microscopy and gives an overview on image processing. Practical work using wide-field and confocal microscopes will be a major part of this course (50%). The participants will set-up experiments on state-of-the-art microscopes and analyze the resulting imaging data. The aim of this course is to provide students with the basic concepts underlying modern microscopy techniques. The validation of the course will consist in a written exam.

Please note that this course DOES overlap with the current IMCF Blockkurs!

I5: Proteomics course on protein interaction analysis by affinity purification – mass spectrometry (PCF Course) – 34604
(3 days; 1 CP; Spring 2020)

T. Bock, A. Schmidt

3-day practical course on affinity purification - mass spectrometry (AP-MS) based investigation of protein-protein interactions and posttranslational modifications. This course focuses on the protein interaction analysis of protein phosphatase complexes, which have been linked to the regulation of a number of fundamental biological processes (e.g. cell growth, apoptosis and more) and are involved in cellular transformation during tumorgenesis.

Day 1: Sample preparation
Seminar: Introduction to AP-MS workflows, advantages/disadvantages of different protein affinity tags/enrichment strategies

Hands-on training: Affinity purification of one target protein per student (each student can bring one additional protein of interest for purification via affinity resins), protein digestion over night

Day 2: Mass spectrometric analysis
Seminar: Introduction to mass spectrometry (MS) and its applications in molecular biology

Hands-on training: Solid-phase extraction of peptides, mass spectrometric measurement

Day 3: Data analysis
Seminar: Introduction to MS-data analysis, principles of protein identification

I6: A Practical Introduction to Biophysical Methods (BF Course) – 34603
(4 days; 2 CP)

X. L. Blatter, **T. Sharpe**

This course will provide a practical and theoretical introduction of a range of biophysical methods that can be used to characterize the stability, size, structure and interactions of biomolecules. Students will gain hands-on experience of eight different techniques in experiments to characterize ligand-binding affinity, thermodynamic stability, secondary structure content, oligomeric state and size of proteins in solution. The course will also show how the techniques can complement one another, and we will discuss which techniques might be suitable for students' own projects.

At the end of the course, students will be required to write a short proposal (2-4 pages) for the application of at least one of the techniques covered in the course to their own research project. The proposal should demonstrate a theoretical understanding of the technique, consideration of the sample requirements and experimental protocol, and ideas about the potential meaning of the results within the context of their project.

Day 1:
Titrations for binding assays, fluorescence intensity, microscale thermophoresis (protein-ligand interactions)

Day 2:
Isothermal Titration Calorimetry (protein-ligand interactions), Analytical Ultracentrifugation (oligomeric state)

Day 3:
Circular Dichroism Spectroscopy and Thermal-Shift Assay (structure and stability)

Day 4:
Static and Dynamic Light Scattering, Analytical Ultracentrifugation (size and oligomeric state)

I8: Python Programming for Structural Biology – 45249
(3 days; 1 CP; Fall 2019)

T. Maier, A. Mazur, M. Podvinec

Day 1:
Analysis of structural and biophysical data with Python. Numerical Python modules: NumPy, SciPy, Pandas. Data visualization: Matplotlib

Day 2:
Working with protein structures and sequences: Biopython, OpenStructure and PyMOL

Day 3:
Practical session, ideally with application to participants' research projects

The course will cover the essentials of practical Python programming for structural biology. It is designed for PhD and MSc students who already have basic knowledge in Python programming and would like to learn how to enhance their skills to solve realistic cases in the field of structural biology. The focus will be put on acquiring practical knowledge about Python modules relevant to structural biology, numerical analysis and visualization. The course days consist of an introductory presentation on the basic concepts and best practices, followed by practical exercises, during which participants can apply the acquired skills.

Course data will be announced coming soon!

I9: Advanced Python Programming for Structural Biology - 55622
(2 hrs/week, 2 CP, Fall 2019)

T. Maier, A. Mazur, M. Podvinec

The course will cover the essentials of practical Python programming for structural biology. It is intended for PhD and MSc students with basic knowledge in Python programming, who would like to enhance their skills by solving realistic cases in the field of structural biology. The course will present programming concepts and approaches to address problems from the fields of structural biology and biophysics and introduce useful code libraries to tackle these questions. The course will consist of short presentations, practical exercises and seminars. Throughout the course, active student participation and solving homework assignments will be required.

I10: Applied Statistics Using R – 49935
(3 days; 1 CP; Spring 2020)

Th. Fabbro

3-day course on applied statistics using the open-source software environment R for statistics and graphics (www.r-project.org). Apart from being a powerful software environment for statistical analyses, you can easily produce tables and publication quality graphics with R. Using one software for statistics and graphics reduces the danger of inconsistencies. The course combines lectures and practical exercises using R. Participants should therefore bring their own laptops if possible. Detailed instructions for software installation will be provided after registration.
Of course, we will not be able to explore the full capabilities of R in three days. After this course, however, participants should be able to continue working independently with R. The course includes an Exam on day 3.

Day 1: Introduction to R
Course participants will be guided through their first R session or refresh their R programming skills. We will focus on the basics of the R programming language and on working with data.

Day 2: Tables, Graphics and reproducible reports
Course participants will produce tables and graphics using R and learn how the use of markdown (http://rmarkdown.rstudio.com/) allows to directly embed R code and R output in text documents (keyword: reproducible research).

Day 3: Data analysis
Course participants will refresh their knowledge about basic statistical tests and linear models (including ANOVA and linear regression) and learn how to apply them in R. An outlook on more complex statistical models will be given at the end of the day.

Recommended lectures without credit points

Research Integrity
(1 day)

D. Shaw

Course topics:
Data acquisition, management, sharing, ownership, manipulation
Plagiarism, honest and dishonest mistakes
Authorship responsibilities
Advisor-student relationships
Behavior in scientific collaborations
Conflicts of interest

This course is mandatory for PhD Students who have started within Fall Semester 2016 or later.