2015-2016 CSB Graduate Modules

Students enroll in CSB 1020H for Fall (F) 2015, Winter (S) 2016, or Summer 2016*, depending on the session the specific module is offered. This course code is used for all quarter-credit (0.25 FCE) CSB modules.
***Summer courses/modules cannot be requested on ROSI until March 14, 2016.**

Please note that each quarter-credit module has a unique teaching section, and that code must be entered when requesting a specific module on ROSI.

If you want to request two modules in the same session (e.g. Winter 2016), you will need to contact the CSB Graduate Office to arrange for enrolment in a second module.

For students in graduate programs outside of CSB, any single quarter credit module may not help complete any of your graduate program requirements.

Module: The Biology of Signal Transduction
CSB 1020H/F, Teaching Section LEC 0120
Coordinators*: Professor A. Lange*
Offered: Fall 2015 session (organizational meeting on Monday Sept. 14th, followed by 5-6 meetings)
Weight: One module (0.25 FCE)
Time: Mondays, either 10 am – 12 pm or 2 pm to 4 pm
Location: UTM campus, Room TBA
Enrolment: Limited to 6 students

Description:
This seminar-based module focuses on the intercellular communication and signal transduction events that mediate fundamental biological events in animals, e.g. role of cyclic AMP, cyclic GMP, NO, IP_3 in mediating physiological processes leading to homeostasis. Each student will prepare and present two seminars of their choice, preapproved by the instructors. All students must read all the papers and will be expected to participate in the discussion. Students will also be assigned the task of being a critical reviewer of two of the seminars, i.e. they must prepare 2-3 critical questions/per paper in advance and they will be asked to lead the discussion. A final critique paper will be expected as the final component of the course.

Evaluation:

2 Seminars (25-30 minutes; 15 minutes for discussion)	50%
2-3 Critical Questions Submitted for two papers	10%
Contributing to the Discussion	10%
Final Critique/Report (to be discussed)	30%

Prerequisites: None

Module: Self/Non-self-Recognition in Plants
CSB 1020H/F, Teaching Section LEC 0106
Coordinators: *Professors D. Goring and K. Yoshioka*
Offered: Fall 2015 session, for six weeks starting Thursday November 5th until December 10th.
Weight: One module (0.25 FCE)
Time: Thursdays 1 pm - 3 pm
Location: St. George campus, Earth Sciences Centre, Room 3056
Enrolment: Limited to 9 students

Schedule/Seminar topics: 2 hours/week
Week 1: Introductory lecture and reading assignments.
Weeks 2-5: Student presentations and discussion (2 presentations/week)
Week 6: Summary Discussion

Description:
The molecular and cellular basis of self/non-self-recognition has been well-studied in the animal research field, but it is a more recent emerging topic in plant research. The molecular mechanisms of plant self/non-self-recognition is starting to be revealed in two different aspects: self-incompatibility (recognition and rejection of self-pollen) and immunity (plant resistance against micro-organisms). In this seminar course, students will investigate the current knowledge of self/non-self-recognition of plants. The course will provide a forum for an interactive discussion between the instructors and students and will be based on a selection of current high impact primary research papers.

Evaluation:
Each student will present a PowerPoint style presentation based on an assigned topic using a selection of primary research papers. A written summary on the same topic in the format of a *Science Perspective* will also be due at the end of the module. Students are expected to read all papers and participate in all discussions. However for each presentation, two students will be assigned the task of asking questions and leading the discussion.

50% Presentation (one presentation per student on a primary research paper)
25% Leading discussions/Participating in discussions
25% Written Summary in the format of a *Science Perspective*

Pre-requisites for module: undergraduate courses in molecular and cell biology
Reading materials: TBA
Website: There will be a Blackboard site for this module

Course: Computational Genomics and Bioinformatics
Course Code: CSB 1472H/S, Teaching Section LEC 0101
Coordinator: *Professor N. Provart*
Offered: Winter 2016 session
Weight: Half credit (0.5 FCE)
Time: Wednesdays 10 am – 1 pm
Location: St. George campus, Ramsay Wright Building, Room 432
Enrolment: Limited to 10 graduate students (minimum 8 reserved for CSB grads)

*CSB1472H/S is a half-credit course that takes place during the full Winter session. It is the equivalent of two modules. Graduate students should NOT request the course using the undergraduate course code CSB472H1S, because it would not count toward graduate credit.

Description:
Recent technological advances have driven a revolution in genomics research that has had a direct impact on both fundamental research as well as direct application in nearly biological disciplines. These advances have made the generation of genomic data relatively straightforward and inexpensive; nevertheless, the data are meaningless if they cannot be properly analyzes. Computational genomics and bioinformatics are the tools we use to extract biological information from complex genomic data.

CSB1472 will teach you the fundamentals of analyzing genomic data. This course emphasizes understanding how core bioinformatic analyses work, the strengths and weaknesses of related methods, and the important parameters embedded in these analyses. CSB1472 is not an applied methods course, nor a course to for developing new bioinformatic tools, but rather a course designed to provide you with a basic understanding of the principles underlying genome analyses. We will examine the fundamentals of sequence alignment, phylogenetic analyses, genome annotation, gene prediction, and gene expression data analysis. Theoretical, applied, and statistical issues will be addressed.

The material is presented as an inverted course. Lectures are pre-recorded and available prior to class. Class time is devoted to review of the lecture material, discussion of the primary literature related to the course material, and hands-on analysis laboratories.

Graduate students evaluation is based on: contribution to the literature discussion; an NSERC-style grant proposal; and contribution to the grant review panel.

Recommended text: Zvelebil & Baum 2008 Understanding Bioinformatics. Garland Science, New York.

Course: Methods in Genomics and Proteomics
Course Code: CSB 1025H/S, Teaching Section LEC 0101
Coordinator: *Dr. Pauline Wang*
Offered: Winter 2016 session
Weight: Half credit (0.50 FCE)
Time: Thursdays 12-4 pm
Location: St. George campus, Earth Sciences Centre Room 4076 & Ramsay Wright 109.
Enrolment: Limited to 2 graduate students

Students who are interested in taking this course should contact Dr. Pauline Wang at pauline.wang@utoronto.ca. The course requires instructor approval, after it is requested on ROSI.

*CSB 1025H/S is a half-credit course that takes place during the full Winter session. It is the equivalent of two modules. This course is also offered to undergraduate students as CSB 474H1S. Graduate students should NOT request this course as CSB474H1S on ROSI, because it would not count toward graduate credit.

Description:
Genomics and proteomics have revolutionized biological research. It is now theoretically possible to fully characterize the structure, organization, regulation and interaction of all genes, proteins and small bioactive molecules in an organism. CSB 1025H/S is an intensive and rigorous laboratory course that will teach students how to produce and analyze data that are central to the fields of genomics and proteomics. The course is divided into three modules, the first of which focuses on genomics, the second on transcriptomics, and the third on proteomics. Each module begins with at least two wet labs where students generate data and end with computer labs where students analyze

the data. In this way students will learn how to conduct an experiment from beginning to end. Techniques taught include DNA and RNA extraction, shotgun library construction, PCR, DNA sequencing, expression profiling using microarrays, 2D-gel proteome analysis, mass spectrometry and associated bioinformatics analyses such as sequence analysis and assembly, and statistical analysis of microarray and mass spectrometry data. This is an advanced laboratory and computer-based course, and assumes a strong background in molecular genetics and some prior laboratory experience.

Required Text: No required textbook. Information will be provided through lectures presented in the first wet lab and first computer lab of each module.

Evaluation: Three quizzes (15%), three lab reports (60%), lab performance (25%). Graduate students have an additional grant proposal (20%).

Prerequisite: BIO 260H1/HMB 265H1 (Genetics), BIO 255Y1/CSB 330H1/350H1 or by permission of the instructor. Recommended Preparation: BCH 311H1/CSB 349H1/MGY 311Y1

Module: A Practical Course in Statistical Modeling and Machine Learning for Biological Analysis
Coordinators: *Professors Quaid Morris & Alan Moses*
Offered: Winter 2016 session, starting February 24th through the end of March
Weight: One module (0.25 FCE)
Time: Wednesdays at 10 am
Location: St. George campus, exact location TBA
Enrolment: Limited 24 students (12 from Molecular Genetics and 12 from Cell & Systems Biology)
Pre-requisite: Programming experience (or willingness to learn R programming outside of class), a course in statistics

This course will introduce graduate students in molecular biology and life sciences to major concepts statistical analysis and machine learning applied to large biological datasets. We will cover algorithms for clustering, learning binary classifiers, regression, and testing for enrichment of gene/protein features within experimentally-defined gene lists. The class will be organized around four problem sets, each covering one of these four topics. These problem sets will require programming in the R statistical language, students without programming experience are advised to take "A practical course in programming for biologists". Classes and problem sets will focus on the practical aspects of applying these algorithms to data -- in most cases students will be employing pre-existing versions of these algorithms rather than re-implementing them. However, some theoretical concepts will be discussed in class.

Evaluation: Students will be graded based on four problem sets.

Module: Topics in Cell and Developmental Biology: The making and function of cellular protrusions.
CSB 1020H/S, Teaching Section LEC 0104
Coordinator: *Professor D. Godt*
Offered: Winter 2016 session.
Weight: One module (0.25 FCE)
Time: TBA
Location: St. George campus, Ramsay Wright Building, room TBA
Enrolment: Limited to 8 students

Description:
Cellular protrusions permit a multitude of interactions between cells and their environment. They allow us to hear and see, help in nutrient absorption and secretion, allow cells to move, function in signaling, and are involved in host-parasite interactions. This seminar-based module focuses on the molecular mechanisms that control the formation and function of cellular protrusions, such as filopodia, microvilli, stereocilia, and others. Graduate students will present and discuss primary research articles, will guide group discussions, and write a paper.

Grading:
30% Presentations (a short and long presentation)
20% Leading a discussion
20% Participation in discussions
30% Written report

Module: Plant Metabolism Research and its Experimental Design
CSB 1020H/S, Teaching Section LEC 0119
Coordinator*: Professor E. Nambara*
Offered: Winter 2016 Session
Weight: One module (0.25 FCE)
Time: Exact dates TBA; middle of the Winter session
Location: St. George campus, Earth Sciences Centre, Room TBA
Enrolment: Limited to 6 students

Description:
Students will study the principle and methodology of phytochemical experiments. This course is a forum for an interactive discussion between the instructor and students. We will discuss the proper methods for extraction, purification and detection of various natural products in the experimental designs.

Participation, 12%
Discussion in class, 24%
Presentation, 32%
Report, 32%

Prerequisites: None
Reading Materials: TBA

Module: Protein homeostasis in plant development and stress response
CSB 1020H/S, Teaching Section LEC 0121
Coordinators*: Professors S. Gazzarrini and R. Zhao*
Offered: Winter 2016 session (6 weeks, 2h/week)
Weight: One module (0.25 FCE)
Time: TBA
Location: UTSC campus, Room TBA
Enrolment: Limited to 8 students

Description: This seminar-based course focuses on the mechanism and role of protein folding, trafficking and degradation in plant development and stress response. Two introductory lectures will be given by the instructors, and then each student will prepare and present one seminar of their choice, preapproved by the instructors. All students must read the papers, submit 2-3 critical questions/per paper in advance and participate in the discussion. A final written

paper will be due at the end of the course.

Evaluation:

Seminar	40%
2-3 Critical Questions	15%
Contribution to the Discussion	15%
Final Report	30%

Module: Cell Biology of Gastrulation
CSB 1020H/F (Summer 2016), Teaching Section LEC 0107
Coordinators*: Professors A. Bruce & R. Winklbauer*
Offered: Summer 2016* session, to begin late April or early May 2016 for six weeks (plus an organizational meeting).
Weight: One module (0.25 FCE)
Time: TBA, but likely Wednesdays 5-7 pm
Location: St. George campus, Ramsay Wright Building, room TBA
Enrolment: Limited to 8 students

Description:
Gastrulation in different animals, including invertebrates and vertebrates, is used to illustrate biological processes and to discuss basic concepts in animal development. This course will explore cell behaviours that occur during migration, tissue rearrangement and spreading as well as tissue separation. In addition to discussing these cell behaviours in the context of gastrulation, we will explore other contexts in which these same or similar behaviours also occur.

Evaluation:
40% seminar (1 presentation per student on a primary research paper)
30% final presentation (group project)
10% write-up of final presentation (one per group)
20% participation in discussion

Pre-requisites for module: Some background in developmental biology as well as a strong interest in the topic.

*Summer courses cannot be requested on the Student Web Service until March 14, 2016.

Module: Integrative Physiology of Stress
CSB 1020H/F (Summer 2016), Teaching Section LEC 0101
Coordinators: *Professors L. Buck and D. Lovejoy*
Offered: Summer 2016*, for six weeks between April and May.
Weight: One module (0.25 FCE)
Time: TBA
Location: St George Campus, Ramsay Wright Building, room TBA
Enrolment: limited to 8 students

Description:
This is a seminar based course in which students will investigate the impact of environmental and pathological stress on an animal's ability to maintain homeostasis. Physiological concepts common to aspects of neurophysiology, neuroendocrinology, cellular and systemic signalling mechanisms, and mechanisms of aging will be explored in the context of major stressors.

The course will provide a forum for an interactive discussion between the instructors and students and will be based on a selection of current high impact primary research papers.

Schedule:
2h/week; 6 weeks
Week 1:Introductory lecture and reading assignments.
Weeks 2-5: Students presentations and discussion (2 talks/week)
Week 6: Summary Discussion
Evaluation: Students will each present a PowerPoint style presentation based on a selection of primary research papers. Presentation dates and papers will be assigned; students are expected to read all papers and participate in all discussions. However, for each presentation 2 students will be assigned the task of asking questions and leading discussion. Students will be required to write a “news and views” paper on their presentation topic or another of their choosing.

Seminar: 2 x 20-30 min, and 60 min for discussion of both papers. 40%
Participation in Discussion: 2 students assigned as major questioners/talk 20%
News & Views paper 40%

*Summer courses cannot be requested on the Student Web Service until March 14, 2016.

Other courses that may be of interest to Cell and Systems Biology graduate students, instructed by CSB Graduate Faculty

CHM 1448H/S - Modelling of Biochemical Systems
Coordinator: *Professor D. McMillen*
Offered: Winter 2016 session
Weight: Half credit (0.50 FCE)
Time: TBA
Location: UTM campus, building and room TBA
*Offered through the Department of Chemistry

An introduction to mathematical modelling of complex biological systems. The primary focus will be on sets of chemical reactions arising in biological contexts (for example, in gene regulation). Such sets of coupled reactions give rise to mathematical models that display nonlinear and stochastic behaviour. The course will provide a survey and practical introduction to the mathematical techniques used in modelling, simulating, and analyzing such systems, including nonlinear dynamics as well as Monte Carlo and other simulation techniques for stochastic systems. Although examples will be drawn mainly from biochemical systems, the techniques discussed will be applicable to many systems in physics, chemistry, and biology. The course will be presented in a self-contained and pragmatic manner aimed at providing an applied introduction to these mathematical techniques to a potentially interdisciplinary audience.

* Special note to CSB students: The course includes a large independent-project component, and we can tailor that to each student's level of mathematical background. One standard approach is to get you to investigate an existing model of some biological system you work with in your lab, or to formulate a very simple model if nobody's done it before. The work can focus more on computational simulations (we'll get you to learn how to do this) than on mathematical analysis, if that's more your speed. Don't be scared off by the very mathy description of the CHM version of the course, is what I'm saying: if you are interested, you can get in touch with Prof. David McMillen (david.mcmillen@utoronto.ca) to discuss your background and what you might be able to work on during the course.

BME 1462H/S – Biological Image Analysis
Coordinator: *Professor R. Fernandez-Gonzalez*
Offered: Winter 2016 session
Weight: Half credit (0.50 FCE)
Time: TBA
Location: St. George campus, building and room TBA
*Offered through the Institute of Biomaterials and Biomedical Engineering

Image analysis has become a central tool in modern biology. While the human eye can analyze images, its assessments are often qualitative. Computers provide quantitative, unbiased measurements, and enable the automation of the analysis, leading to a larger number of processed samples and a greater power of downstream statistical tests. In this course, we will discuss the main steps in the analysis of digital images, with an emphasis on different modalities of microscopy data, including confocal, TIRF and super-resolution. Topics will include image display, filtering, segmentation, mathematical morphology and measurements. Lectures will be complemented with examples from the current literature. Students will also have the opportunity to develop solutions to the analysis of images from their own research in a final project.