2019-2020 CSB Graduate Modules

Students enroll in CSB 1020H or CSB1021H for Fall (F) 2019, Winter (S) 2020, or Summer 2020*, depending on the session the specific module is offered. These two course codes apply to all quarter-credit (0.25 FCE) CSB modules.
***Summer courses/modules can not be requested on ACORN until March 16, 2020.**

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

If you want to request two modules in the same session (e.g. Fall 2019), you may 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.

Seminar and lab-based modules offered 2019-2020

Modules: Plant Physiology – Energy Metabolism (Part I) – course code CSB1020H/F, Teaching Section LEC 0138, and Plant Physiology – Plant Environment Interactions (Part II) – course code CSB1021H/F, LEC 0138
Coordinator: *Professor Ingo Ensminger*
Offered: Fall 2019
Weight: Each module is 0.25 FCE
Time: Thursdays 11.00 – 13.00 (L), Mondays or Tuesdays 13.00 – 16.00 (Wetlabs)
Location: UTM, Room TBD (L), Wetlabs DV4071
Enrollment: 4 grad students per module

Duration:
Each module for six weeks from September - October (Part I) and October – November (Part II). BIO312H5F is a half credit course that takes place during the Fall session. For graduate students it is split into two parts, each worth one module. Graduate students should NOT request the course using the undergraduate course code BIO312H5S, because it would not count toward graduate credit.

Description
This course will teach you the principal physiological processes in plants and their response to environmental factors and global change. The course will emphasize plant interactions with rising atmospheric CO_2 and climate warming, and examine their effects on photosynthesis and plant metabolism.
The material is presented in lectures (2 hours per week). Wet labs are designed to provide an understanding the principals of ecophysiological measurments such as photosynthetic gas exchange, chlorophyll fluorescence, or measurements of plant water status.

Graduate student evaluation for each module is based on one exam (30%), 2 laboratory reports (each 15%), online lab quizzes (10%), participation and performance during labs (10%), research proposal (20%).

Reading materials:, Taiz, Zeiger, Møller and Murphy (2015) Plant Physiology and Development, Sixth Edition

Module: Mass spectrometry for biological systems
CSB1021H/F, Teaching Section LEC 0137
Coordinator: *Professor Michael Phillips*
Offered: Fall 2019 session for 6 weeks running September 23rd to December 2nd, 2019
Weight: One module (0.25 FCE)
Time: 1-3 pm
Location: Mississauga campus, Davis building, room TBA.
Enrollment: limited to 8 students

Description:
This is a seminar based course that covers the theory and application of mass spectrometry in biological research. Initial lectures by the instructor will cover ionization and detection of small molecules using quadrupole, ion trap, and time-of-flight mass spectrometers. Students will give an oral presentation on a specific application of mass spectrometry. Group discussion and practical training will introduce modern data analysis pipelines for metabolomics data sets.
Students will be assigned readings from the literature, and Martin Smith's textbook "Understanding Mass Spectra" is highly recommended to accompany course lectures.

Schedule:
2h/week; 6 weeks (meets every other week from Sept. 23rd to Dec. 2nd, 2019)
Week 1-2: Introductory lectures and reading assignments
Weeks 3-5: Students presentations and discussion (2 talks/week)
Week 6: Summary Discussion

Evaluation:
Students will deliver an oral presentation based on a recent publication. A list will be provided, and presentation dates and papers will be assigned the first day of class. Students are expected to read all papers and participate in all discussions. Students will be assigned a research proposal term paper on a mass spectrometry related topic different from the one they presented.

Seminar: 20 min + 60 min for discussion of the paper	40%
Participation in Discussion: Students must participate in discussion of oral presentation	20%
Research proposal term paper	40%

Module: Self/Non-self-Recognition in Plants
CSB 1020H/F, Teaching Section LEC 0106
Coordinators: *Professors Daphne Goring and Keiko Yoshioka*
Offered: Fall 2019 session, for six weeks from Wednesday October 16th to December 4th (no class on October 23rd and Nov. 6th).
Weight: One module (0.25 FCE)
Time: Wednesdays 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 2-6: Student presentations and discussion (Two presentations/week. One in week six)
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: Quercus

Course: Foundational Discoveries in Genome Biology and Bioinformatics
Course Code: CSB 1482H/F, Teaching Section LEC 0101
Coordinator: *Professor Alan Moses*
Offered: Fall 2019 session
Weight: Half credit (0.5 FCE)
Time: Tuesdays 11 am – 1 pm
Location: St. George campus, Earth Sciences Centre, Room 3087
Enrolment: Limited to 12 graduate students (minimum 9 reserved for CSB grads)

*CSB 1482H/F is a half-credit course that takes place during the full Fall session. It is the equivalent of two modules. This course is also offered to undergraduate students as CSB 471H1F. Graduate students should NOT request this course as CSB471H1F on ACORN because it would not count toward graduate credit.

Description:
This course will focus on close reading and detailed discussion of landmark papers in genome biology and bioinformatics. Focus will be on the context of the paper, technological developments exploited (or reported) and impact on the field. Topics include: comparative, population and functional genomics, single cell genomic technologies, genome browsers, alignment and clustering algorithms. Evaluation will be focused on class discussion and presentations.

Evaluation:
Class participation (30%)
In-class presentation (35%)
Written report (35%)

Pre-requisites: Instructor approval

Module: Theoretical and Applied Topics in Data Visualization for Genome Biology
CSB 1020H/F, Teaching Section LEC 0133
Coordinators: *Professor Nicholas Provart and Dr. Jamie Waese*
Offered: Fall 2019 session, beginning Wed. October 30th for a total of six meetings.
Weight: One module (0.25 FCE)
Time: Wednesdays from 9 am -12 pm (tentative)
Location: St. George campus, Earth Sciences Centre, Room TBA
Enrolment: Limited to 10 students

Description:
The past decade has seen a vast increase in the amount of data available to biologists, driven by the dramatic decrease in cost and concomitant rise in throughput of various next-generation sequencing technologies. While access to data is no longer limiting, manipulating and interpreting those data has become a bottleneck. One important aspect of interpreting data is data visualization. This graduate course module will provide a theoretical perspective on data visualization for biological applications, along with a hands-on component to provide practical training for students. The format of the course will be six 2-hour modules, each consisting of a short theory lecture of around 40 minutes followed by a discussion of 2-3 assigned papers/online resources per week, with students taking turns to present the papers/resources. The last 30-45 minutes of each module will encompass a hands-on session where students will use various data visualization packages (such as Tableau, D3, Plotly, ggplot, etc.) to explore biological data sets.

Evaluation:
20% - Contribution to discussion
20% - Presentation of assigned paper or online data resource (15-minutes)
60% - Project

The project will be to tell a story with data. You may use any technique you like (e.g., poster, interactive tool, video, etc.). It should combine data analysis, data visualization and a narrative to contextualize the findings. It should be accessible and engaging to anyone with an interest in biology.

Pre-requisites for module: Familiarity with molecular biology
Reading materials: TBA
Website: TBA

Course: Computational Genomics and Bioinformatics
Course Code: CSB 1472H/S, Teaching Section LEC 0101
Coordinator: *Professor Nicholas Provart*
Offered: Winter 2020 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 7 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 analyzed. 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.

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 2020 session
Weight: Half credit (0.50 FCE)
Time: Tuesdays 12-4 pm
Location: St. George campus, Earth Sciences Centre Room 4076 & Ramsay Wright 109.
Enrolment: Limited to 2 or 3 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 ACORN.

*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 ACORN, 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: Neuroscience of Behavioural State Control
CSB 1020H/S, Teaching Section LEC 0123
Coordinator*: Professor John Peever*
Offered: Winter 2020 session.
Weight: One module (0.25 FCE)
Time: Winter session, dates and times TBA.
Location: St. George campus, Ramsay Wright Building, Room TBA
Enrolment: Limited to 6 students

Description:
This course will examine the latest advances in how the nervous system controls behavioural states such as sleep, arousal, daily rhythms, breathing and movement. It will consider leading hypotheses on the function of the cell systems, organ systems and at the whole organism level that lead to appropriate and pathological control of such behaviours.

Evaluation:
Students will present 2 seminars, one from each section of the course. They will write a brief synopsis of the presentation. Students will also participate in discussion. Seminars and discussion will focus on issues raised in a selection of primary research papers. Written assignment: students will write a “News and Views” style review article on a current “hot topic” within the field. The subject chosen will accommodate the specific research interests of each student but must be different from those discussed in seminars.

Seminar = 20% (x2 = 40% total)
Synopsis = 10% (x2 = 20%)
Discussion = 10% (x2 = 20% total)
News and Views = 20%

Prerequisites: None
Reading Materials: to be determined by the specific interests of the participating students.

Module: Leaving the Epithelium: Molecular and Cellular Mechanisms of Animal Tissue Diversification and Homeostasis
CSB 1021H/S (Winter 2020), Teaching Section LEC 0136
Coordinator: *Professor Ulrich Tepass*
Offered: Winter 2020 session, from February to March 2020 for six weeks (plus an organizational meeting).
Weight: One module (0.25 FCE)
Time: Tuesdays 4-7 pm
Location: St. George campus, Ramsay Wright Building, room RW601
Enrolment: Limited to 8 students

Description: This course will discuss cellular and molecular mechanisms of a phenomenon of central importance to the development and homeostasis of the animal body. The epithelium is the defining building block of animals and their organs. A number of processes allow cells to leave an epithelial sheet to control cell number/density of epithelia, remove diseased or injured cells, or create new non-epithelial cell types such as neurons or muscle cells. These processes are referred to as delamination, ingression, or extrusion and employ divers mechanisms for exiting epithelial layers.

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 and cell biology, and a strong interest in the topic.

Module: Topics in Cell and Developmental Biology: Genetic strategies in the analysis of animal development
CSB 1020H/S, Teaching Section LEC 0104
Coordinator: *Professor Dorothea Godt*
Offered: Spring 2020 session. The module starts at the end of February 2020 with an informal meeting to discuss the course, which is followed by 6 weeks of seminars (March to April).
Weight: One module (0.25 FCE)
Time: TBA
Location: St. George campus, Ramsay Wright Building, room 601
Enrolment: Limited to 8 students

Description:
Strategies to manipulate genes and gene activity and to detect and measure changes in gene expression have become exceedingly sophisticated and are no longer restricted to a few model organisms. In this reading course, we will discuss recent articles focusing on how genetic analysis contributes to revealing mechanistic insight into developmental processes, such as cell differentiation, stem cell activity, cell polarity, and tissue morphogenesis.

Graduate students will present and discuss primary research articles, will guide group discussions, and write a paper.

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

Module: Cell Biology of Gastrulation
CSB 1020H/S (Summer 2020*), Teaching Section LEC 0107
Coordinators*: Professors Ashley Bruce & Rudi Winklbauer*
Offered: Summer 2020* session, between May and July 2020 for six weeks (plus an organizational meeting in May).
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 ACORN until March 16, 2020.

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

LMP2120H - Molecular Clinical Microbiology & Infectious Diseases
Course Coordinators**:** *Drs. Roberto Melano and Nahuel Fittipaldi*
Email: roberto.melano@oahpp.ca or Nahuel.Fittipaldi@oahpp.ca
Weight: 0.5 FCE

Course Objective:
With particular emphasis on new laboratory techniques, the goal of this course is to provide students with the scientific basis for how these techniques help us understand the epidemiology of infectious diseases, their current impact on human medicine and their role in the detection and characterization of etiologic agents causing diseases.
The goals of this course are to:

1) Educate on genomic/proteomic applications for the diagnosis, control, and management of infectious diseases.
2) To provide knowledge of both practical and theoretical aspects of the specialist area of medical microbiology and the necessary skills to undertake individual and collaborative research in this field.
3) Focus on new methods including next-generation sequencing, high resolution proteomics, and bioinformatics.

Curriculum:
Molecular Clinical Microbiology & Infectious Diseases is a course that provides an introduction to medical bacteriology, virology, mycology and parasitology. The course consists of lectures from specialists in each topic, and discussions on selected papers. Students should be familiarized with concepts pertaining to basic molecular biology principles and techniques for understanding various contemporary areas of research in clinical microbiology and their applications. This programme covers these areas, together with training in research skills.
Prerequisite:
A background in infectious diseases, microbiology and molecular biology is expected.

Evaluation and Guidelines:

1) 35% of the mark will be based on a student presentation of a current research paper

2) 35% will be based on a take-home research proposal (maximum 5 pages in length) including the following sections: (I) Background & Rationale, (II) Hypothesis & Significance, and (III) Research Design & Methods, that will involve critical and creative thinking (report will be due 60 days after assignment)
3) 20% will be based on two written critiques of scientific papers discussed in lectures
4) 10% of the mark will be based on participation

(Note: Late submissions will incur a penalty of a 5% reduction in marks for each day late.)

Course Format and Guidelines:
Each class will be structured as follows (3h sessions per week, 2 lectures):

1. Professor 1: Introductory lecture (40 min + up to 5 min question period)
2. One student will present a pre-assigned paper (20 min). This will be followed by questions from a student in the audience assigned to write a critique on the paper in advance (these critiques should be collected by the professor before the start of each class). The professor will lead a general discussion on the topic.
3. Coffee break 5 to 10 min.
4. Professor 2 : Introductory lecture (40 min + up to 5 min question period).
5. As described in 2 (above), the second student will present a pre-assigned paper (20 min) followed by questions from a student in the audience assigned to write a critique on the paper in advance (these critiques should be collected by the professor before the start of each class). The professor will lead a general discussion on the topic.

Additional Guidelines:
For PowerPoint presentations, students are expected to start with a background to the field, describe the methods used, and carefully analyze data (from specific experiments to overall meaning of findings/major advances). Whenever possible, presenters should identify limitations, suggest additional required experiments, and highlight/propose future directions. Students are also expected to prepare high quality slides to ensure effective communication of material to faculty and peers. For the written critiques, students are expected to follow a similar overall structure to present a critical analysis of the paper. For the take-home research proposal, students will be assigned one specific topic and will prepare a 5 page report according to provided guidelines.