**BIOL 486 / BIOL 524 / BIOL 680G High Throughput Instrumentation**

**Winter 2021**

**COURSE OUTLINE**

## 1. General information

**Course Code:** BIOL 486, BIOL 524, BIOL 680

**Class:** Tuesdays 14:45h – 17:30h, Online

**Instructor:** Prof. Laurent Potvin-Trottier (laurent.potvin@concordia.ca)

**Office hours:** Email instructor for appointment between 13:30h – 14:30h on Tuesdays

## 2. Course description

This course will introduce a broad range of topics on high throughput approaches in biology and biotechnology. Technologies covered in the course will include next-generation sequencing (NGS), microarrays, NGS-based techniques with a focus on transcriptomics (RNA-seq, single-cell RNA-seq), mass spectrometry (mass spec) proteomics, automated liquid handling, microfluidics, and flow cytometry. Class time will be divided into a lecture component introducing the different high-throughput technologies at a basic conceptual level and an application component in which guest speakers will come discuss applications of the technologies. Evaluation will include two in-class exams, written assignments, and oral presentations. For presentations, students will be asked to present articles on research involving high-throughput approaches in biology and to critically evaluate the work. Students are encouraged to develop critical skills in reading, commenting and presenting primary scientific literature. The course emphasizes the students' initiative, collaboration and active learning. Students are encouraged and expected to develop the capacity to provide constructive feedback to each other and to actively participate to the course through discussions, content and various educational experiences.

**Course Description from the Concordia Calendar:**
This course provides an in-depth look at high-throughput instruments used in biotechnology and genomics. Students are exposed to technologies such as massively parallel sequencing, high-throughput genotyping, construction of DNA microarrays, proteomics, robotics platform, mass spectrometry, fluorescence-activated cell sorting, chemical screening, microfluidics, surface plasmon resonance, protein microarrays.

## 3. Learning Objectives

At the end of the course, students should be able to:

- Understand the general principles of the techniques introduced in the class, including their limitations
- Identify the appropriate techniques to answer important biological questions
- Read, understand and critically evaluate scientific papers involving the high-throughput techniques introduced in the class

## 4. Schedule

****SPECIAL COVID-19 TEACHING****

The Winter 2021 semester will be entirely online. Changes have been made to adapt the course to this reality, but some changes to the course format might be introduced throughout the semester to ensure the best learning experience.

**Lectures (Zoom and pre-recorded)**

In order to reduce the length of the live Zoom time, some lectures will be pre-recorded and available on Yuja. Other lectures will be live on Zoom, and students are encouraged to participate and ask questions during the lecture by "raising their hand".

**Journal club (Zoom)**

There are journal clubs on each topic of the course. These journal club will be led by a team of two students, who will present and discuss critically the paper. Everyone in the class will read the paper beforehand, and it will be more a discussion than a presentation. Students will be evaluated in the participation in the journal clubs when they are not leading the discussion.

**Oral presentation (Zoom)**

Student in team of two will present a paper related to the technologies covered in the class. This will be a more typical presentation with slides.

**Participation**

This is a small class designed to be interactive and provide active-learning opportunities. Therefore, attendance to journal clubs and oral presentation during the scheduled lecture time will be typically **mandatory.** Contact the instructor immediately if you have constraints that prevents you from attending the scheduled class time.

**Exams**

The two exams will be on COLE without auto-proctoring during the scheduled class time. You will have access to all the materials from the class. The questions will be in a similar style than the problem sets. Students will be encouraged to log into the Zoom lecture room with their cameras on to ask questions to the instructor.

**TENTATIVE CLASS SCHEDULE**

| | Date | Assignment | Content |
|---|---|---|---|
| 1 | Jan 19th | Select date/topics for journal club (Jan 22nd) | • Course introduction **(live)**<br>• Lecture introducing next-gen DNA sequencing (NGS) **(live)** |
| 2 | Jan 26th | • Read journal club paper<br>• Select topics for oral presentation | • Demo of NGS instrument and presentation on applications<br>• Journal club: applications of NGS<br>• Lecture introducing NGS-based techniques, focusing on transcriptomics **(pre-recorded)** |
| 3 | Feb 2nd | • Pset 1 out<br>• Read journal club paper | • Demo of NGS-based technique and presentation on applications<br>• Journal club: NGS-based techniques<br>• Lecture introducing MS proteomics **(pre-recorded)** |
| 4 | Feb 9th | Pset 1 due (Feb 11th) | Student presentations on papers on research involving high-throughput technologies |
| 5 | Feb 16th | • Read journal club paper | • Demo of mass spectrometer and presentation on applications<br>• Journal club: applications of MS proteomics |
| 6 | Feb 23rd | | Test 1 covering NGS, NGS-based techniques, and MS proteomics |
| Mid-term break | | | |
| 7 | Mar 9th | | Lecture introducing high-throughput screening and liquid-handling automation **(live)** |
| 8 | Mar 16th | • Read journal club paper | • Demo of liquid-handling robotics and presentation on applications<br>• Journal club: applications of HTS and liquid-handling automation<br>• Lecture introducing microfluidics **(pre-recorded)** |
| 9 | Mar 23rd | • Pset 2 out<br>• Read journal club paper | • Demo of microfluidics instrument and presentation on applications<br>• Journal club: applications of microfluidics<br>• Lecture introducing flow cytometry **(pre-recorded)** |
| 10 | Mar 30th | • Pset 2 due (April 2nd)<br>• Read journal club paper | • Demo of flow cytometer and presentation on applications<br>• Journal club: applications of flow cytometry |
| 11 | Apr 6th | | Student presentations on papers on research involving high-throughput technologies |
| 12 | Apr 13th | | Test 2 covering all topics |
| 13 | Apr 20th | | Site visit to Genome Quebec Innovation Centre(?) |

## 5. Behaviour

Section 5, 6 and 7 are an excerpt from Concordia's course outline guidelines.

All individuals participating in courses are expected to be professional and constructive throughout the course, including in their communications.

Concordia students are subject to the Code of Rights and Responsibilities which applies both when students are physically and virtually engaged in any University activity, including classes, seminars, meetings, etc. Students engaged in University activities must respect this Code when engaging with any members of the Concordia community, including faculty, staff, and students, whether such interactions are verbal or in writing, face to face or online/virtual. Failing to comply with the Code may result in charges and sanctions, as outlined in the Code.

## 6. IP

Content belonging to instructors shared in online courses, including, but not limited to, online lectures, course notes, and video recordings of classes remain the intellectual property of the faculty member. It may not be distributed, published or broadcast, in whole or in part, without the express permission of the faculty member. Students are also forbidden to use their own means of recording any elements of an online class or lecture without express permission of the instructor. Any unauthorized sharing of course content may constitute a breach of the Academic Code of Conduct and/or the Code of Rights and Responsibilities. As specified in the Policy on Intellectual Property, the University does not claim any ownership of or interest in in any student IP. All university members retain copyright over their work.

## 7. Extraordinary circumstances

In the event of extraordinary circumstances and pursuant to the Academic Regulations, the University may modify the delivery, content, structure, forum, location and/or evaluation scheme. In the event of such extraordinary circumstances, students will be informed of the changes.

## 8. Course materials

There is no required text for the course, but the following book is recommended:

- Lesk, Arthur M. *Introduction to genomics*. 3rd edition. Oxford University Press, 2017. ISBN: 9780198754831

The book covers the first half of the course and recommended readings will be given from the book. General background information can be obtained from any up-to-date molecular biology textbook (e.g. Molecular Biology of the Cell, Alberts, and Molecular Biology of the Gene, Watson) or various online sources. Documents will be posted online or sent by email on a regular basis. Part of the course interaction will occur through the Moodle online course (document uploads, discussions and answer to questions on forums). As such, students are expected to check their email messages and log on to the course Moodle website on a regular

basis. Since access to PubMed and scientific journals is critical, it is recommended for students who plan to work on their assignments off campus to get their Concordia Library PIN in order to log on to CLUES.

## 9. Grading

| Contribution to grade | Activity | Description | Format |
|---|---|---|---|
| **20%** | **1st exam** | Covering next-gen sequencing, NGS-based approaches, mass spec proteomics | In-class, multiple choice, short answer, long answer |
| **20%** | **Oral presentation** (group of 2) | Presentation on one of the general HT approaches, focusing on applications as well as basic concepts/principles | 20 minutes (powerpoint, keynote, etc.) |
| **15% (2x7.5%)** | **Assignments** | Two problem sets to prepare for the exams | Multiple choice, short and long answer |
| **25%** | **2nd exam** | Covering all of the HT technologies discussed in class | In-class, multiple choice, short answer, long answer |
| **20%** | **Journal club** | Presentation of the assigned article and participation in the discussion | Chalk talk, round-table discussion |

**Marking scheme:** A+ 90-100, A 85-89, A- 80-84, B+ 77-79, B 74-76, B- 70-73, C+ 67-69, C 64-66, C- 60-63, D+ 57-59, D 54-56, D- 50-53, F < 50

## 10. Ethical behaviour

The following statements are taken from The Academic Integrity Website (concordia.ca/students/academic-integrity) :

**Plagiarism**:

The most common offense under the Academic Code of Conduct is plagiarism, which the Code defines as "the presentation of the work of another person as one's own or without proper acknowledgement." This includes material copied word for word from books, journals, Internet

sites, professor's course notes, etc. It refers to material that is paraphrased but closely resembles the original source. It also includes for example the work of a fellow student, an answer on a quiz, data for a lab report, a paper or assignment completed by another student. It might be a paper purchased from any source. Plagiarism does not refer to words alone –it can refer to copying images, graphs, tables and ideas. "Presentation" is not limited to written work. It includes oral presentations, computer assignment and artistic works. Finally, if you translate the work of another person into any other language and do not cite the source, this is also plagiarism.

In Simple Words:

**DO NOT COPY, PARAPHRASE OR TRANSLATE ANYTHING FROM ANYWHERE WITHOUT SAYING WHERE YOU OBTAINED IT!**

## 11. Use of third-party software and websites

We will be using Slack to facilitate interaction in the class. There is no requirement for you to use this software, and the only personal information that you have to provide to join the channel is your name and email.

**LIST OF STUDENT SERVICES:**

1. Biology Graduate Program Assistant: Kelly Pingel
2. Counselling and Psychological Services: concordia.ca/students/counselling-life-skills
3. Concordia Library Citation and Style Guides: library.concordia.ca/help/howto/citations
4. Student Success Centre: concordia.ca/students/success
5. Health Services: concordia.ca/students/health
6. Financial Aid and Awards: concordia.ca/offices/faao
7. HOJO (Off Campus Housing and Job Bank): csu.qc.ca/hojo
8. Academic Integrity: concordia.ca/students/academic-integrity
9. Access Centre for Students with Disabilities: concordia.ca/offices/acsd
10. CSU Advocacy Centre: csu.qc.ca/advocacy
11. Dean of Students Office: concordia.ca/offices/dean-students
12. International Students Office: concordia.ca/students/international
13. Student Hub: concordia.ca/students