



## **BIOD21H3**

### **Advanced Molecular Biology Laboratory (Online)**

### **Winter 2021**

#### **DESIGN OF THE COURSE**

BIOD21 is an advanced molecular biology laboratory course. Due to the Covid pandemic, in 2021 BIOD21H3 will have lecture and online laboratory components. The lectures will provide essential background knowledge for molecular biologists, while the laboratories will describe protocols and show video demonstrations of molecular biology techniques.

The protocols described in this course are those commonly used in modern research laboratories. You will learn how to: i) isolate genomic DNA, generate and characterize knock-out mutants; ii) isolate RNA and characterize gene expression patterns; iii) clone and sequence genes; iv) conduct bioinformatic analysis of DNA and protein sequences. Most importantly, you will learn how to plan and conduct experiments independently, how to interpret and troubleshoot results, and how to present and discuss scientific data.

*Instructor:*

**Professor Sonia Gazzarrini**, [sonia.gazzarrini@utoronto.ca](mailto:sonia.gazzarrini@utoronto.ca)

Office hours: By appointment. Include "BIOD21" in the title and use only @utoronto.ca email. Note: email only for important matters; questions involving detailed answers about lectures and laboratories will be addressed during office hours.

*Laboratory TAs:*

**Deka Mohamed**, [deka.mohamed@mail.utoronto.ca](mailto:deka.mohamed@mail.utoronto.ca)

**Jasmin Patel**, [jas.patel@mail.utoronto.ca](mailto:jas.patel@mail.utoronto.ca)

**Marc Shenouda**, [marc.shenouda@mail.utoronto.ca](mailto:marc.shenouda@mail.utoronto.ca)

Note: TAs will only reply to emails related to the lab material and only during designated office hours. Include "BIOD21" in the subject and use only @utoronto.ca account. For all other inquiries, please contact the course Instructor.

## COURSE REQUIREMENTS

A background in microbiology, genetics, cell and molecular biology is absolutely required for this course.

Exclusion: ([BGYD21H](#))

Prerequisite: [BIOB12H](#) & [BIOC15H](#) & [[BIOC17H](#) or [[IMCB01H](#) & [IMCB02H](#) (for Applied Microbiology students only)]]

Corequisite: [BIOC12H](#) (Note: Although listed as a corequisite, it is recommended that [BIOC12H](#) be taken in advance of [BIOD21H](#).)

## TEXT AND REQUIRED MATERIALS

There is no text or lab manual for this course.

**Laboratory protocols/handouts, lecture notes** and other **course material** (data, including pictures of gels, spectrophotometer absorbances, bioinformatics files, etc.) will be posted on **Quercus**. Please check Quercus for any postings of laboratory/lecture material prior to each lab.

### Reference books

Copies of the books listed below are available at the UTSC library, some of them e.g. Alberts, *et al.* and also Lodish *et al.*, are also available at PubMed Bookshelf. These books contain information relevant to the lecture material and/or laboratory procedures.

### Lecture

- *Molecular Biology of the Cell*. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and J.D. Watson. Garland Publishing, Inc. (any recent edition). **Highly recommended, available on PubMed bookshelf (<https://www.ncbi.nlm.nih.gov/books/>).**
- *Molecular Cell Biology*. Lodish, H., Baltimore, A. Berg, S. L. Zipursky, D., Matsudaira, P., and J. Darnell. Scientific American Books (any recent edition). **Highly recommended, available on PubMed bookshelf.**
- *Cell and Molecular Biology*. Karp, G. J. Wiley & Sons, Inc.

### Laboratory

- *Molecular Cloning: A Laboratory Manual* (Vol. I, II and III), by Sambrook and Russell. Cold Spring Harbor Laboratory Press. 2001. **Highly recommended, copies are on reserve at the library**
- *Laboratory DNA Science*, by Bloom, Freyer, Micklos. The Benjamin/Cummings Publishing Company Inc. **Highly recommended, copies on reserve at the library**
- *Short Protocols in Molecular Biology* by Ausubel, Brent, Kingston, Moore, Seidman, Smith and Struhl. Wiley & Sons, Inc. 1999 (or later)
- *Genome Analysis: A laboratory Manual* (Vol. I, II, III), by Birren, Green, Klapholtz, Myers and Roskams. Cold Spring Harbor Laboratory Press, 1999 (or later)

## COURSE WORK AND GRADING

<b>Final Exam or Take-Home Assignment</b> (covers lecture and lab material)	<b>30%</b>
<b>Laboratories</b>	<b>70%</b>

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### Labs - Grade Breakdown:

<b>A) Electronic Laboratory Notebooks (10 x 2%)</b>	<b>20%</b>
<b>B) Quizzes (4 x 2%)</b>	<b>8%</b>
<b>C) Assignments</b>	<b>42%</b>
Bioinformatics (10%)	
Formal Lab Report (15%)	
Primer Design (5%)	
Oral Presentation (12%)	

#### **A) Electronic Laboratory Notebook**

The electronic Laboratory Notebook (eLN) will include weekly reports of the online labs. They must be submitted weekly and will include:

- i) *Introduction & Rationale*. Describes the experiment and the rationale for doing it.
- ii) *Flow Chart*. Describes how the laboratory procedures is carried out. This will ensure you are prepared for the laboratory and will help you formulate any questions regarding the exercises. **Section i) and ii) must be submitted 2 hours before the start of each lab, and will be checked by the TA.**
- iii) *Data recording*. Organize the data provided to you in figures and/or tables. Data should be properly organized, labeled and have sufficient information that would allow an external reader to understand and reproduce your experiment.
- iv) *Conclusion*. Summarize and interpret your results. **Section iii) and iv) will be completed during the lab and must be uploaded 48h after the lab.**

#### **B) Quizzes**

Multiple choice questions and short answers. They will cover: genomic DNA isolation, T-DNA and PCR, RNA isolation and qPCR, cloning, genome editing.

#### **C) Assignments**

Details about each assignment will be explained during class. **There is a 20% penalty per day for late assignments and 50% penalty for late lab reports.** If you can't complete the lab report on time, please speak to the instructor BEFORE the due date. *Note: plagiarism can have serious academic consequences.*

- 1. Bioinformatics.** Computational analyses of nucleotide and amino acid sequences; primer design and *In-silico* PCR; Gene expression analysis using microarray and RNAseq data; Gateway cloning and guide RNA design. Introduced in Bioinformatics lab and finished outside class.
- 2. Formal lab report 1.** Covers weeks 1 to 5. Due Friday February 26<sup>th</sup>, 2021.
- 3. Primer Design.** Design of gene-specific primers and/or guide RNAs (TBA).
- 4. Oral presentation (on week 12, April 8<sup>th</sup>-9<sup>th</sup>) or Formal lab report 2 (due April 12<sup>th</sup>).** Covers weeks 6 to 11.

### Turnitin.

All written assignments in this course must be submitted electronically by the deadline via Turnitin. If you are unwilling to participate in the system, you must notify your instructor. *“Normally, students will be required to submit their course essays to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University’s use of the Turnitin.com service are described on the Turnitin.com web site”.*

### Missing a laboratory or a test

If you miss a laboratory or are unable to write a test, you must notify your Instructor ([sonia.gazzarrini@utoronto.ca](mailto:sonia.gazzarrini@utoronto.ca)) within 24h and email Jennifer Campbell ([jac.campbell@utoronto.ca](mailto:jac.campbell@utoronto.ca)). You must attach the UTSC Verification of Illness Form or Biological Sciences Self Declaration Form available at this link (<https://www.utsc.utoronto.ca/biosci/missed-term-work>). You will lose 2% of your grade for each missed laboratory (including the first week) without a valid reason. If you miss a laboratory, you may not be able to write assignments/quizzes related to the laboratory and therefore you will lose additional marks. If you miss more than 3 laboratories without a valid documentation you will be dropped from the course.

### Religious accommodation

The University has a commitment concerning accommodation for religious observances. I will make every reasonable effort to avoid scheduling tests, examinations, or other compulsory activities on religious holy days not captured by statutory holidays. According to University Policy, if you anticipate being absent from class or missing a major course activity (like a test, or in-class assignment) due to a religious observance, please let me know as early in the course as possible, and with sufficient notice (at least two to three weeks), so that we can work together to make alternate arrangements.

## LECTURE TOPICS

Lectures will be presented once per week (online synchronous) on Collaborate. Lecture slides will be posted on Quercus prior to each lecture. Lecture topics are listed below and

may change.

### Lecture Topics:

1. **Isolation of genomic DNA and genotype analysis** (PCR and/or PCR-RFLP)
2. **Isolation of RNA and gene expression analysis** (RT-PCR and/or RT-qPCR)
3. **Promoter analysis by histochemical assays** (transcriptional reporters)
4. **Protein localization by confocal microscopy** (translational reporters)
5. **Overview of cloning** (recombinant DNA technology, Gateway and Golden Gate; hosts and vectors and *E. coli* transformation)
6. **DNA sequencing** (sequencing techniques and chromatogram analysis)
7. **Generation of knockout mutants by genome editing** (CRISPR-Cas9 and its applications).

## COURSE MATERIALS AND RECORDING

### Notice of video recording and sharing (download and re-use prohibited)

This course uses the University's learning management system, Quercus, to post information about the course (<https://q.utoronto.ca>). This includes posting readings and other materials required to complete class activities and course assignments, as well as sharing important announcements and updates. Please make it a habit to log in to the site on a regular basis. This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session. Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation, and are protected by copyright. Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor. For questions about recording and use of videos in which you appear please contact your instructor.

## LABORATORIES

### Laboratory schedule and attendance.

Online laboratories (3h) will be held once per week (online synchronous). You will watch video demonstrations of experiments. The TA will go over the methodology and answer any questions you may have. You will then describe and interpret the data provided to you using the electronic Laboratory Notebooks (eLN).

Attendance in laboratories is mandatory. You must arrive well informed and prepared for the laboratory exercises. You will describe each exercise prior to the lab, record the data provided to you, and interpret the results using the eLN. Therefore, simply showing up to the lab will not ensure you any success in this course. The intent of this course is to introduce you to how you would work within a research or industry laboratory.

## **EQUITY DIVERSITY AND INCLUSION**

The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

## **ACCESSABILITY STATEMENT**

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. AccessAbility Services staff (located in Rm AA142, Arts and Administration Building) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations 416-287-7560 or email [ability@utsc.utoronto.ca](mailto:ability@utsc.utoronto.ca). The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course

## **ACADEMIC INTEGRITY STATEMENT**

The University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (<http://www.governingcouncil.utoronto.ca/policies/behaveac.htm>) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences in papers and assignments include using someone else's ideas or words without appropriate acknowledgement, submitting your own work in more than one course without the permission of the instructor, making up sources or facts, obtaining or providing unauthorized assistance on any assignment. On tests and exams cheating includes using or possessing unauthorized aids, looking at someone else's answers during an exam or test, misrepresenting your identity, or falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes.