

# **BIOD21H3**

## **Advanced Molecular Biology Laboratory**

### **Fall 2019**

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

BIOD21 is a laboratory and lecture course. The lectures provide essential background knowledge for molecular biologists, while the laboratory provides hands-on experience in many molecular biology techniques.

The protocols used in this course are those commonly used in a research lab. In this course you will: isolate RNA and characterize gene expression patterns; isolate genomic DNA, generate and characterize knock-out mutants; clone and sequence genes. Most importantly, you will learn how to plan and conduct experiments independently, how to interpret and troubleshoot results, present and discuss scientific data.

- This course is offered by:

**Professor Sonia Gazzarrini**

Office hours: Mondays 11-12 or by appointment.

Office room: SY222 (SRB-Science Research Building)

e-mail: [gazzarrini@utsc.utoronto.ca](mailto:gazzarrini@utsc.utoronto.ca)

**Note:** email only for important matters; questions involving detailed answers about lectures and laboratories will be addressed during office hours.

- Laboratory TAs

**Eliana Vonapartis**

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- Laboratory Technician

**Anatoli Tchigvintsev**

## 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 outlines', 'Lecture notes' and other 'Course material' (pictures of gels, bioinformatics files, etc.) will be posted on Quercus. Please check Quercus for any postings of laboratory/lecture material prior to each lab.

Students also require:

a) a lab coat (no exceptions)

b) at least one permanent marker with a fine tip (Black). The best choice is a Sanford "Sharpie" fine point or extra fine point. Alternatively, a Staedtler lumocolor permanent marker (fine point). The Sanford markers are usually cheaper and can be bought at any business supply store. I would suggest you buy yourself two markers (a fine point and extra fine point)

c) a book for recording your work (your laboratory log book). This book can be hard covered and bound, or a binder with paper added.

## REFERENCE BOOKS

Copies of the books below are in the [UTSC library](#), certain of them e.g. Alberts, *et al.* and also Lodish *et al.*, are also available at [PubMed Bookshelf](#). These 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; on PubMed bookshelf)**

*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; on PubMed bookshelf)**

*Cell and Molecular Biology*. Karp, G. J. Wiley & Sons, Inc.

## Laboratory

*Laboratory DNA Science*, by Mark V. Bloom, Greg A. Freyer, David A. Micklos. The Benjamin/Cummings Publishing Company Inc.

**(highly recommended; copies are on reserve in the library)**

*Molecular Cloning: A Laboratory Manual*, Vol. I, II and III,  
by Sambrook, J. and D.W. Russell. Cold Spring Harbor Laboratory Press. 2001.

**(highly recommended; copies are on reserve in the library)**

*Short Protocols in Molecular Biology*. by Ausubel F., Brent B., Kingston R.E., Moore D.D., Seidman J.G., Smith J.A. and Struhl K.E. Wiley & Sons, Inc. 1999 (or later)

*Genome Analysis: A laboratory Manual*, Vol. I, II and III,  
by Birren B., Green E.D., Klapholtz S., Myers R.M., and Roskams J.  
Cold Spring Harbor Laboratory Press, 1999 (or later)

## **GRADE BREAKDOWN**

<b>Final Exam</b>	<b>40%</b>
Covers <b>lecture and lab</b> material	
<b>Laboratory</b>	<b>60%</b>

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### ***Laboratory Grade Breakdown***

<b>A) Lab performance</b>	<b>10%</b>
preparation:	3%
technical performance:	3%
laboratory log:	4%
<b>B) Quizzes (2 x 5%)</b>	<b>10%</b>
<b>C) Assignments</b>	<b>40%</b>
bioinformatics (5%)	
formal lab report 1 (15%)	
formal lab report 2 or oral presentation (15%)	
primer design (5%)	

## LOG BOOKS

Your log books will be looked at throughout the course. You may be asked to hand in calculations or graphs for certain labs which will be graded as Pass/Fail and will contribute to laboratory /log data analysis grade. The log books will be collected **the last day of class** for the final evaluation.

## QUIZZES

Multiple choice question and short answers

## LAB ASSIGNMENTS

The content required for each assignment will be explained during class. **Assignments will be considered late if they are not handed in at the beginning of the lab on the due date (2% penalty per day). Late lab reports will NOT be accepted (you will lose the entire mark: 15%).** If you can't complete the lab report on time you will have to 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 provided to you. Introduced in Bioinformatics lab and finished outside class.
- 2. Formal lab report 1:** Covers weeks 1 to 6.
- 3. Formal lab report 2 (or oral presentation):** Covers weeks 7 to 11.
- 4. Primer Design:** Design of gene-specific primers (in class).

**IMPORTANT NOTE:** All written assignments in this course must be submitted electronically via Turnitin.com, as well as submitted as a hard copy by the deadline. If you are unwilling to participate in the system, you must tell your instructor.

## TURNITIN

*“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”.*

## LECTURES

Lectures will be once per week and are not designed to be only explanations of specific laboratory exercises. Lecture notes will be posted on Quercus prior to each lecture.

Lecture topics include, but are not limited to:

1. **Isolation of genomic DNA and genotype analysis**
2. **Isolation of RNA and gene expression analysis**
3. **PCR**
4. **Sequencing**
5. **Recombinant DNA technology.** Overview of cloning: hosts, vectors, restriction and modification enzymes.
6. **Recombinant DNA analysis.** Isolation of plasmid DNA. Restriction digest and restriction mapping. Gel electrophoresis.
7. **Cloning strategies and vectors**
8. **Genome editing**

## LABORATORIES

**A) Laboratory schedule and attendance.** Laboratories meet 2 days a week: Wednesday and Thursday, 2 to 5 pm. You will be carrying out a laboratory exercise every Wednesday and Thursday.

**Attendance in laboratories is mandatory.** It is your responsibility to carry out the experiments correctly and within the time frame of the laboratory schedule. You will be graded on how you work in the laboratory, whether you are prepared and how well you keep a log of your experiments, detailing exactly what you did and what you observed. In research you **MUST** have excellent notes on your daily work, as **REPRODUCIBLE DATA** is an absolute must. Therefore, simply showing up to the lab will not ensure you any success in this course. You must arrive well informed and prepared to carry out the laboratory exercises. Since each week builds on the previous week of work, you will often be preparing the materials you need for subsequent experiments. The intent of this course is to introduce you to how you would work within a research or industry laboratory.

**Missing a laboratory is like missing a term test.** If you miss a laboratory you must provide the [UTSC Verification of Illness Form](#) within 2 days of the missed laboratory to Jennifer Campbell ([jacampbell@utsc.utoronto.ca](mailto:jacampbell@utsc.utoronto.ca); room SW421D) Course Coordinator in Biological Sciences. Please ensure your physician has indicated a clear start date, end date and visit date(s) on the form. Notes that are missing dates or have dates that do not correspond to the laboratory missed will not be accepted. You will lose 3% of your grade for each missed laboratory (including the first week) without a valid medical certificate. If you miss a laboratory, you will not be able to write assignments/quizzes/lab report related to the laboratory and therefore you will lose additional marks. If you miss more than 3 laboratories without a valid documentation (medical certificate) you will be dropped from the course

**B) Log books** will be organized with the following format:

Introduction & flow chart. **Prior to the lab, every student should write an Introduction (paragraph)** in the log book that describes in general the goals/purpose for the day (include date; pages should be numbered). This introduction will be **followed by a flow chart/outline that will diagrammatically describe how the laboratory procedures** within the exercises will be carried out. Include all relevant information (for example incubation times, volumes to use). If two experiments are ongoing then indicate within this flow chart when you might be carrying out certain steps of the various exercises. You should be able to use the flow chart/outline to carry out the experiment without constant referral to your handouts. This will ensure you are prepared for the laboratory and will help you formulate any questions before starting your work. This preparation is required and **will be checked each day by the TA.** It will be recorded whether the preparation was done and to what level (unacceptable / acceptable / good / excellent). The TA will initial various pages. At the end of the year you will be assigned a final grade for your preparation, lab performance and record keeping (see mark breakdown).

Methods/procedure. **Follow the handouts, and during the course of the experiment write down on your log book each step in detail** (use past tense). Indicate volumes used, time of incubation (write the actual times). Describe exactly what you did and what you observed. If a step was carried out by your partner and not you indicate that in your log book.

Results. Your data/results should be properly labeled (use Figure numbers; label each lane of a gel; etc.) and have sufficient information so that an external reader can understand your results.

Discussion. Summarize and interpret your results.

For example: Thursday Sept 23:

- 1) An isolated white colony from plate number 1, containing *E. coli* strain D21-1, was aseptically transferred to a 5 ml aliquot of sterile LB containing 100 µg/ml of ampicillin. This tube was assigned the number 1.
- 2) The culture was incubated at 37°C with constant shaking in a water bath shaker. The cultures were grown overnight and placed at 4°C the next morning by the TA.

Wed Sept 29:

- 1) Culture tube #1 was removed from the 4°C fridge. The cells had sedimented to the bottom of the tube. The pellet was resuspended by gently tapping the tube. The cell pellet dispersed and the culture was turbid.
- 2) One ml of *E. coli* strain D21-3 was aseptically removed from the 5 ml overnight culture and placed in a 1.5 ml microfuge tube. The remaining culture was put back into the fridge to keep as a source of culture if needed.
- 3) Sample was centrifuged at 1000xg for 5 min at RT (room temperature). A small cream coloured pellet was observed at the bottom of the tube. The supernatant was clear.
- 4) The media was poured off and excess media drained from the tube by inverting the tube on a paper towel for 1 min.
- 5) 100 µl of solution 1 was added to the cell pellet and the pellet was resuspended by agitation using a vortex at speed 6. The sample was left on ice for 5 min.

#### Another example

- 1) John prepared the DNA samples for *Eco* RI digestion, for specific details see John's log book. I prepared the samples for Hind III digestion. See table below.

#### **C) Laboratory Material.**

The exercises will be carried out in pairs. **Each pair will be provided with:**

- 1) Sterile pipet tips for micropipettes; a box (blue) for a large volume pipettor (100 µl-1000 µl) and a box for small to mid-range micropipettes (1µl to 200 µl)
- 2) a can (lined with tinfoil) containing sterile 1.5 ml microcentrifuge tubes
- 3) a bag of disposable gloves for each student (the size given to you will be determined in the first week). There will be enough gloves to last you the entire course. If you however use more than three pairs a day, you will run out. If this happens you will be required to buy any extra gloves you require. This will introduce you to the cost of research. A box of 50 pairs of gloves (you have been given 36 pairs) costs between \$8.50 and \$12.00 depending on the supplier and the size of the order. Therefore, you can see that in gloves alone this course spends over \$200 dollars. Extra gloves will cost 50¢ a pair.
- 4) racks for tubes.
- 5) sectioned box for microcentrifuge tube storage (2 boxes each pair).
- 6) you will be given a variety of solutions that you will keep in your locker, fridge or freezer over the course of the labs.

**Per pair of students** you will be provided with a set of micropipettes. These will be numbered with your group number and placed in zip lock bag. You are responsible for properly using and storing your micropipettes. You will be responsible for returning the empty pipet tip boxes and picking up a new box. Responsible use of your supplies and equipment is critical to obtaining good results in a research setting. **Misuse of equipment is very costly and will not be tolerated.**

The University of Toronto is dedicated to fostering an academic community in which the learning and scholarship of every member may flourish, with vigilant protection for individual human rights, and a resolute commitment to the principles of equal opportunity, equity and justice.

### **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. I will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff (located in S302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or [ability@utsc.utoronto.ca](mailto:ability@utsc.utoronto.ca).

### **ACADEMIC INTEGRITY STATEMENT**

Please consult: <http://www.utoronto.ca/academicintegrity/resourcesforstudents.html>. Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, 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 include, but are not limited to: *On tests and exams*: Using or possessing unauthorized aids, looking at someone else's answers during an exam or test., misrepresenting your identity. *In academic work*: Falsifying institutional documents or grades, copying someone else's answers or data when preparing lab reports or papers, falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes. All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. There are other offences covered under the Code, but these are the most common. Please respect these rules and the values that they protect.