BIOD21H3 – Advanced Molecular Biology Laboratory
Fall 2018

Instructor: Daman Bawa

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Lab Instructors: Vania Branker

Office Hours: **Wednesdays: 11 AM – 12:30 PM**
Thursdays: 11:30 AM – 2 PM

Office hours will be held in room SW542.

If the hours or the location need to be changed during the semester, you will be notified by an announcement online.

Please be prepared and consult lecture and laboratory materials prior to coming to the office. Appointments outside these hours can be arranged by e-mail.

Course Schedule: Labs are 2 days a week: Wednesday 2 to 5 pm and Thursday 2 to 5 pm. Lectures will be on Wednesdays from 1 – 2 PM and we will also use some of the laboratory time to cover some lecture material. On average there is two hours of lecture/class work and 5 to 6 hours of lab per week.

Textbook: **Introduction to Biotechnology, 3rd Edition by Thieman and Palladino, Pearson Publishing**

This textbook is highly recommended and is available through bookstore.

The best way to reach me outside the office hours is by e-mail. Please use your UTORONTO e-mail account and include your course code in the subject. Emails sent from non-university accounts will not be answered. Please do not use the Quercus built-in email system as I will not be checking that regularly.

BIOD21 is a laboratory/lecture-based course. The emphasis is on the laboratory and lectures complement what is done in the laboratory each week. Assignments, term test and the final exam will be based on background material required for the laboratories and questions that directly relate to what was done in the laboratory as well as applied questions that require the background of the concepts presented in the laboratory.

Attendance in the laboratories is required. Some of the major experiments in the laboratory will begin with a quiz (see schedule at the end)**.** The questions/answers to the quizzes will be covered in the posted laboratory exercises as well as within the lecture on the related material. During lecture, we will also go over specific details related to what you will do in the laboratory that week. Lectures will use some of the laboratory time and there will be, on average, two hours of lecture/class work and 5 to 6 hours of lab per week.

Objectives of this course:

This course is designed as a research course. Although a general schedule is given at the end of the syllabus, the order/type of experiments may need to be modified based on experimental results – as is common in research labs. Any required modifications will be posted online.

This laboratory course provides the students with practical experience in molecular biology techniques that are widely used in the industry, government, clinical, and research laboratories. In addition, this course will provide the background necessary to understand and troubleshoot the techniques used as well as introduce you to related more advanced techniques. Students will gain experience in data analysis and interpretation, with **emphasis on scientific writing, oral presentation and critical thinking**. Application of molecular biology techniques will be a major focus for the course.

At the completion of the course students will have a laboratory skill set that will be useful for future employment in laboratory-based careers. Moreover, the students will gain an appreciation and understanding in how to carry out work in an organized manner with attention to detail and understanding of quality control in experimentation. **Each student is encouraged to ask questions, and participate in class, in laboratories and in office hours. Often times a question can lead to an interesting discussion for all students.**

Lectures:

BIOD21 is a laboratory course. The material covered in the lectures will relate to the laboratory techniques carried out throughout the course. It will include discussion of methodologies, theory behind the methodology and applications for the particular techniques used. Lecture gives you a chance to also ask questions regarding the theory behind the labs you will be conducting. Therefore, come with questions. Lecture material will be posted on the course page by the day of the lecture. Attendance will help to put the laboratory material in context and prepare for the quizzes. The lectures come from a number of sources including primary technique papers, reviews and technical manuals.

The emphasis of the course is the laboratory, the lectures will complement the laboratory experiments and theory.

Laboratories:

- **Attendance in labs is mandatory.** If you miss a lab you must provide a UTSC medical certificate to be excused from the lab and to be able to hand in any assignments related to that lab. The labs are full therefore you will likely not be able to makeup labs. You will lose 5% of your grade for each missed lab. You will not be allowed to hand in any assignment that relates to the missed lab or write the quiz, so the penalty may exceed the 5% stated above. **Missing 3 or more labs regardless of the reasons will lead to the forfeit of ALL laboratory related grades (47%) and failure in the course.**

- Labs run twice a week for a total of 6 hours per week. **There is no makeup for a missed lab.**

- Laboratory exercises will be posted on the course page prior to the date of the scheduled laboratory.

- **It is your responsibility** to come prepared each week to carry out your laboratory. The following preparation will be required:

    - To have completed **an introduction** to each lab (a paragraph) explaining the purpose

    - To have written out your own **flow chart** (this is what you should refer to when doing the lab). Your flowchart should be written such that you should not have to refer back to your lab notes during the lab. Students that insist on using the lab outline rather than their flowchart to carry out their experiment in the lab will have their performance grade significantly impacted.

    - When carrying out experiments you must take complete notes. Therefore, as you do the experiment you will "**log it".** This means writing down in detail what you did, what you observed, times of incubations. You will have **data analysis** (including standard curve construction) **summary / conclusion**, where you analyze the data, do any graphs etc that are required. Your TA will initial this book on a regular basis and collect your books for a final grade.

- To ensure you are prepared for the lab there will also be **quizzes** on some of the lab topics (see schedule) which will test whether you have adequately prepared for the lab. Attending the lectures will help you with the material.

- Equipment in the lab is expensive. You are responsible for your equipment. Accidents can happen but most "accidents" are avoidable with proper preparation and attention to the task at hand.

Absolutely no food, drink, or gum chewing is permitted in the laboratory as it is a violation of biosafety protocols. Students will be required to leave the laboratory if they eat or drink in the laboratory.

For laboratory, the students will require:

1. Lab coat and closed toed shoes (no exceptions, you will be asked to leave the laboratory)
2. Safety glasses
3. A permanent black marker
4. A book for recording your work (your log book). This book can be hard or soft cover, or a binder.

Accessibility:

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 Access*Ability* Services Office as soon as possible. I will work with you and Access*Ability* Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC Access*Ability* Services staff (located in SW302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca.

Academic integrity/plagiarism:

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:

> **In papers and assignments**: 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**: 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. 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. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (refer to: http://academicintegrity.utoronto.ca/).

Use of Turnitin.com:

"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".

The assignments / reports and the research proposal must be submitted to Turnitin (see below). **If you wish to opt out of Turnitin you must send me an email and then submit an electronic copy to me and your lab instructor.**

Grade Breakdown:

- **Midterm: 14%** (short answer, calculations, short essay based on lecture and lab material).
    - **Date: Oct 18, during lab time.**
    - **You must contact me within 48 Hours of missing the midterm and provide me with an appropriate document (e.g. the UTSC medical certificate filled in by your physician) to be able to write the makeup exam**
- **Final exam: 31%** (short answer and short essay based on lecture and lab material). The final exam will be cumulative as it relates to overlapping concepts through the course. **Date: TBA; during final exam period**
- **Quizzes: 2%** (4 X 0.5%)

Quiz 1:	Sep 13	PCR and Restriction Digests
Quiz 2:	Sep 19	Genomic DNA isolation
Quiz 3:	Oct 24	RNA isolation and RT-PCR / RT-qPCR
Quiz 4:	Nov 1	Yeast transformation and protein expression

Quizzes will usually be at the beginning of the practical. If you are late to the practical, you will not be given any extra time to complete your quiz.

- **Lab assignments: 31%**

1. **Gene of Interest Analysis:**	6%	Maximum 4 pages double spaced	**Due: Oct 4**
2. **Formal report 1:**	7.5%		**Due: Oct 31**
3. **Research proposal:**	8%		**Due: Nov 15**
4. **Formal report 2:**	9.5%		**Due: Nov 29**

The content required for each assignment will be explained during the appropriate lecture and laboratory class. The page limit for the assignments does not include figures, tables, legends and reference pages. **All assignments should be written in Times New Roman size 12 font. Late assignments (including research proposal) will be penalized 10% per day. Late assignments will only be accepted up to 7 days past the original deadline, otherwise a mark of zero will be assigned.**

- **Lab performance: 12%**
    - Preparation / flowchart
    - Technical performance
    - Laboratory log/ summary/data analysis
    - **Lab notebooks** will be initialed each week and TAs will keep a record throughout term, the books will be **handed in on Nov 29** for the final grade. If you have not kept up to date each week your marks will reflect your work.

- **Lecture and Lab Participation: 10%.** This will involve one-minute writes, case studies, reflective writing in lab and lecture, summaries/data presentation in lab and concept maps. These exercises will occur randomly and students must complete a minimum of 80% in lecture and all assignments in lab including oral presentations for full credit.

Tentative Lab and Lecture schedule:

The general lab and lecture schedule is given below. **However, this course is designed as a research course and therefore, the order / type of experiment and the topics covered may need to be modified as the semester progresses.** Therefore, this lab schedule should be taken as a general guideline and required modifications will be communicated to the students as necessary.

Dates	Lecture Topics	Laboratory Exercises
Sep 5 / 6	• Brief outline of course • Discuss research proposal • Bacterial growth • Introduction to Bioinformatics and PCR • Outline requirements for picking gene of interest (GOI)	**Wednesday** • Introduction to Bioinformatics • Primer design exercise **Thursday** • Practice pipetting, plating, dilutions • Inoculation of individual colonies into LB/Amp liquid media to get plasmid samples (pB, p90)
Sep 12 / 13	• Continue bioinformatics and PCR • Vectors characteristics • DNA analysis • Restriction endonucleases	**Wednesday** • Plasmid purification • Set up restriction digests • PCR of known gene sequence on yeast genomic DNA (yeast hsp90, hsc90) **Thursday** • Run digests and PCR products on gels • **Quiz 1 – PCR and restriction digests** • **Discussion of GOI and submit GOI primers for ordering**

Sep 19/20	• Basic cloning • Discussion of GOI (if necessary)	**Wednesday** • Yeast genomic DNA isolation • **Quiz 2 – Genomic DNA isolation** **Thursday** • Gel to quantify DNA and check integrity • Evaluate gel results from last week's labs and data discussion • **Due: Concept map of GOI assignment**
Sep 26/27	• Continue basic cloning • cDNA and genomic library theory and practice • Advanced PCR techniques	**Wednesday** • PCR using student primer sequences and genomic DNA **Thursday** • Run PCR products on gel • Purification of PCR products and set up of diagnostic digests • Set up digest for vector
Oct 3 / 4	• Continue Advanced PCR techniques	**Wednesday** • Test vector and PCR product digests on gel and set up ligation • **Brief oral presentation of your research proposal** (2-3 minutes each) **Thursday** • qPCR on yeast genomic DNA to test GOI • *E.coli* transformation with ligated product (may be done later) • **Due: Bioinformatics analysis of GOI**

Modified from Brunt, 2017

Oct 10 / 11	**Reading Week**	
Oct 17/ 18	• DNA sequencing techniques	**Wednesday** • Prepare clones for sequencing • Discuss data for lab report • Go over lab report requirements **Thursday** • **Midterm in class (includes material covered before reading week)**
Oct 24 / 25	• Finish Sequencing techniques (if necessary)	**Wednesday** • RNA isolation from Yeast under control and experimental conditions • Quantify RNA • **Quiz 3 – RNA isolation and RT-PCR / RT-qPCR** **Thursday** • RT-PCR and RT-qPCR on isolated RNA • **Class presentations for lab report 1**
Oct 31 / 1	• Protein expression and function	**Wednesday** • Run gels with PCR products • Bioinformatics analysis on sequence data • **Due: Formal lab report 1** **Thursday** • Finish data analysis and if necessary, transform yeast with expression vector • **Quiz 4 – Yeast transformation and protein expression**

Nov 7 / 8	• Fluorescence microscopy • In-class discussion of GOI protein and its function	**Wednesday** • Set up qPCR / RT-PCR if needed • Go through RNA data analysis **Thursday** • Protein localization using fluorescence microscopy • Go over requirements for lab report 2
Nov 14 /15	• Overview of advanced molecular biology techniques • Finish analyzing RNA and expression data • Data analysis question in-class • **Due: Research proposal**	
Nov 21 / 22	• Finish any lecture material • **Class presentations for lab report 2**	• Lab cleanup
Nov 29	• **Due: Notebooks and lab report 2**	