



## BIOC23H3 – Practical Approaches to Biochemistry Summer 2018

**Instructor:** Daman Bawa

**Office:** Portable 104 – Room 110 (not used for office hours)

**E-mail:** [bawa@utsc.utoronto.ca](mailto:bawa@utsc.utoronto.ca)

**Lab Instructors:** Catherine Deane, Alaura Androschuk

**Office Hours:** TBA

**Office hours will be held in the library in room AC254.**

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.

**Lecture:** Thursday 8:00 -10:00 AM  
Room MW140

**Textbook:** Biochemistry Laboratory Modern Theory and Techniques, 2<sup>nd</sup> Edition by Rodney Boyer. Pearson Publishing.

This textbook is highly recommended and is available through bookstore. This book provides practice questions, theoretical information and other helpful resources that are applicable not in this course but other laboratory courses as well.

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.

---



**BIOC23 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. Each of the major experiments in the laboratory will begin with a quiz.** 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. Attendance in lecture is highly recommended to assist you in the laboratory component.

## **Objectives of this course:**

This laboratory course provides the students with practical experience in biochemical 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 biochemical techniques to biological studies will be a major focus.

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:**

BIOC23 is a laboratory course. The material covered in the two-hour lecture 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.

**Video recording of the lectures is not permitted.**

**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 proper documentation 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 once a week for a total of 4 hours per lab. **There is no makeup for a missed lab.**
- Laboratory exercises will be posted on the course page a week 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 each lab topic** (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 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 SW302) 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/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: 15%** (multiple choice, short answer, calculations, short essay based on lecture and lab material). **Date: June 28, in class.**
  - **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: 32%** (multiple choice, short answer, calculations, 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**
- **Lab assignments: 24%**
  1. **Mitochondria Isolation:** 2.5%    Maximum 2 pages double spaced    **Due: May 24**
  2. **Formal report 1 - IgG:** 7.5%    Maximum 5 pages double spaced    **Due: July 5**
  3. **Formal report 2 - GST:** 9.5%    Maximum 5 pages double spaced    **Due: July 26**
  4. **Enzyme kinetics - AP:** 4.5%    Maximum 2 pages double spaced    **Due: Aug 2**

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.**

- **Research proposal: 6%** (Maximum 4 pages – double spaced, size 12 Times New Roman font. Other details to be provided in lecture.)

- **Concept map** for research proposal **due on June 28.**
- **Research proposal** **due on July 19**

- **Quizzes: 6%** (6 X 1.0%)

|                |         |  |
|----------------|---------|--|
| <b>Quiz 1:</b> | May 10  | Differential centrifugation / mitochondria isolation |
| <b>Quiz 2:</b> | May 27  | Ion exchange and thin layer chromatography           |
| <b>Quiz 3:</b> | May 24  | Gel permeation chromatography                        |
| <b>Quiz 4:</b> | May 31  | IgG isolation  |
| <b>Quiz 5:</b> | June 14 | GST purification / Western blotting                  |
| <b>Quiz 6:</b> | July 19 | Alkaline phosphatase                                 |

Quizzes will 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 performance: 10%**

- 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 Aug 2 for the final grade. **If you have not kept up to date each week your marks will reflect your work.**

- **Lecture and Lab Participation: 7%.** 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.

- Lecture component: 3%
- Lab component: 4%

## Lecture schedule:

More than one topic may be covered in one week and some of the other topics will be covered over more than one lectures. Lecture notes for the course will include enough detail for a stand-alone review of the topic and the textbook will provide excellent background and sample problems. Much of the lecture material will be done using examples, therefore, some of the material will not be covered in the detail that is provided in the notes. **We will take a problem-based learning approach to some of the lectures. Therefore, it is imperative that students come prepared for the lecture by reading the lecture notes (and textbook, if applicable) before coming to the class. All lab procedures will be reviewed in the lecture.**

**Topic 1:** pH and buffers. This topic will not be covered in class but lecture notes will be posted and the material will be testable on the exams.

**Topic 2:** Cell fractionation, protein isolation and purification

**Topic 3:** Chromatography

**Topic 4:** Protein quantification and gel electrophoresis

**Topic 5:** Immunochemistry / Western analysis

**Topic 6:** Enzyme kinetics

**Topic 7:** Mass spectrophotometry and information science – use in protein identification and related protein technologies

**Topic 8:** Use of isotopes in biochemical studies

## Lab schedule:

The labs will run according to the following schedule. If any changes need to be made due to unforeseen circumstances, it will be posted online.

| Date    | Lab Week | Lab Exercise  |
|---------|----------|---|
| May 10  | 1        | <b>Experiment 1:</b> Isolation of mitochondria using differential centrifugation. <b>(Quiz 1)</b> <ul style="list-style-type: none"><li>○ Data discussion before you leave the laboratory</li></ul>   |
| May 17  | 2        | <b>Experiment 2:</b> Ion exchange chromatography <b>(Quiz 2)</b> <ul style="list-style-type: none"><li>○ In-class reflective practice and class discussion</li></ul>  |
| May 24  | 3        | <b>Finish experiment 2</b> (Thin layer chromatography) and <b>start Experiment 3:</b> Gel permeation chromatography <b>(Quiz 3)</b> <ul style="list-style-type: none"><li>○ In-class reflective practice</li><li>○ <b>Differential Centrifugation assignment due</b></li></ul>    |
| May 31  | 4        | <b>Experiment 4 Part I:</b> IgG isolation – Salting out via ammonium sulfate and set up dialysis <b>(Quiz 4)</b> <ul style="list-style-type: none"><li>○ Write a figure legend for Thin Layer Chromatography plate per bench and do group critique and class discussion</li></ul> |
| June 7  | 5        | <b>Experiment 4 Part II:</b> IgG Isolation – DEAE Sephadex ion exchange and protein quantification. <ul style="list-style-type: none"><li>○ Finish protein quantification table and determine volume to load on the gel</li></ul>   |
| June 14 | 6        | <b>Experiment 4 Part III:</b> IgG Isolation – SDS gel electrophoresis and staining with coomassie blue<br><br>Experiment 5 Part I: Purification of GST fusion protein from <i>E. coli</i> – Isolation and affinity chromatography <b>(Quiz 5)</b>                                 |



**June 18**

**Reading Week**

June 28

7

**Experiment 5 Part II:** Purification of GST fusion protein from *E. coli* – Gel electrophoresis and western transfer

- Discussion of data from IgG lab (experiment 4) by each bench, classroom discussion, one-minute write to summarize the data, sample figure legend and critique

July 5

8

**Experiment 5 Part III:** Purification of GST fusion protein from *E. coli* – Immunoblot with anti-GST antibody and detection

- Discussion of concept map for research proposal with your TA if you have questions.

- **IgG formal lab report due**

July 12

9

**Group presentations on Experiment 5** – Full analysis of GST purification data.

July 19

10

**Experiment 6:** Enzyme kinetics – Alkaline phosphatase (**Quiz 6**)

- **Research proposal due in lab.**

July 26

11

Experiment 6: Data analysis and class discussion

- **GST formal lab report due**

Aug 2

12

No lab.

**Alkaline phosphatase assignment and lab notebooks due – time to be arranged by your TA.**