A. Introduction

The goal of this course is to create a practical "hands-on" laboratory experience for students interested in applied and experimental biology. We are equipping you with the basic bioscience skills required for elaborate experiments and formal scientific reports in future Biology, Applied Life Sciences, and Bioinformatics courses, including an honours thesis project. We hope to inspire you to continue your studies in research fields after graduation. Should you not become a researcher, this course will provide you with the knowledge and qualifications to work in areas such as medicine, private or public laboratories, environmental sciences, forensics, or biotechnology.

B. Syllabus

A detailed course syllabus will be distributed the first day of classes. Students are expected to read it in its entirely, noting any additions or corrections to this lab manual since its date of publication.

THERE ARE LABS THE FIRST WEEK OF CLASSES. The initial lectures and lab techniques in the first two weeks of classes are vital for the remainder of the course!

a. Grade distribution for 2026

See MyCourseLink for components within each of these categories.

- Reports 40%
- Assignments 30%
- Ethics 10%
- Lab books 10%
- Schematics 10%

C. Student behaviour

Students are expected to have reviewed the Lakehead University Code of Conduct at https://www.lakeheadu.ca/students/student-life/student-conduct. A breach of Academic Integrity is a serious offence. The principle of Academic Integrity, particularly of doing one's own work, documenting properly (appropriate paraphrasing and referencing/citation), collaborating appropriately, and avoiding misrepresentation, is a core principle in university study. Students should review the Student Code of Conduct, Academic Integrity, for a full description of academic violations, procedures when Academic Integrity breaches are suspected and sanctions for breaches of Academic Integrity.

Students are expected to:

- Produce their own original work throughout this course;
- Know and use the appropriate citation and punctuation methods for referencing sources of information when quoting, summarizing, and paraphrasing;
- Ask for clarification of expectations as necessary;
- Collaborate appropriately on assigned group and teamwork;
- Acknowledge the contribution of others, including your peers during group work and activities;
- Prevent their work from being used by others (do not post your work on websites, do not provide copies of your work to current or future students, digitally protect and watermark your work);
- Adhere to the principles of Academic Integrity when conducting and reporting research, and;
- Follow the in-class and online quizzes, tests, and examination regulations and protocols (e.g. no communication during exams, no electronic equipment in exam rooms, no duplication of examination materials, comply with written and/or oral instructions from invigilators).

Plagiarism is defined as presenting another persons ideas or phrasings as your own without proper acknowledgement. Examples include (but are not limited to):

- Copying and pasting from the internet without acknowledgement;
- Copying a printed source (peer reviewed paper, textbook, lab manual) without proper acknowledgement;
- Copying from another student (hard-copy, digital, websites), whether past or present, at Lakehead University or from another institution;
- Using direct quotations or large sections of paraphrased material in an assignment without proper acknowledgement, and;
- Submitting the same piece of work in more than one course without the permission of the instructor(s);

Instructors reserve the right to put your lab reports, exams, assignments, and posters through plagiarism checking software (e.g. Grammarly, TurnItIn, quetext). Papers will be compared to internet sources and submissions from previous years.

D. Email communication

Your main avenue for communication with the technician and TA is in-person DURING your lab section or during an office hour. The use of emails should be reserved for emergency circumstances, such as an illness or issues that result in missed course time. Emails for personal reasons (e.g. death in family, SAS accommodations, health, varsity/competitive sports) are acceptable.

Emailing for a copy of lab notes, due dates, and extensions is not acceptable. If you find contradictory information, please discuss in person so it can be corrected and brought to the classes attention during the lab. In-person meetings can be arranged with Zoom an option.

E. Additional tips

Please pay attention during the lectures and pre-lab talks to ensure you understand the expectations for the week. Sometimes last minute changes are required, and these will be posted on MyCourseLink! Chatting on your phone WILL NOT help. We recommend leaving distracting devices in your bags at the back of the room.

Record all due dates and double check them with your group members. If you are not sure of a procedure, expectation, or marking criteria, ask before leaving for the day!

You are encouraged to post course related questions outside of the lab time on the MyCourseLink Discussion boards. These can be viewed by everyone and answered by anyone. The use of discussion boards ensures all students receive the same information.

F. Ethics

A percentage of your grade is allocated to ethics, with the following items under consideration. See MyCourseLink Grades for detailed mark distribution.

a. Participation

This is an applied course and students are expected to attend 6 hr EACH week. You will be graded on attendance, participation, following lab safety protocols, and work space cleanliness. Playing on your cell phone or doing homework for another course while your group does the lab work is NOT recommended and WILL cost you marks! If you have a conflict with another course, or you are not fully prepared to participate this semester, it is recommended that you DO NOT continue and drop the course immediately.

Attendance, participation, and being prepared for this course helps your group be successful when conducting experiments.

b. Group work

Students will be allowed to form their own lab groups (ideally 3, maximum of 4) during the first TWO weeks of the course. The instructor(s) reserve the right to shuffle students to exploit individual strengths and compensate any arising weaknesses or conflicts. Please make note of which

reports and assignments are to be submitted as a group and which are individual efforts. Don't let one person do all the work; participate to your fullest potential on group reports.

Keeping your work bench and cart items organized and stored correctly is KEY to earning top ethics marks. Please avoid on our now infamous "Wall of Shame".

Chapter 13 in the Making Sense textbook does a great job explaining why we need to work in groups in the sciences! Survival skills and techniques for dysfunctional groups are also outlined.

Each week, help your group collaborate to learn the material and master the lab skills. Who knows, you could be a senior student working as a TA in our department. Perhaps you will be a future graduate student mentoring undergrads in a research lab!

c. Be prepared

Did you read the lab manual BEFORE the lab and visualize the procedures? Did you prepare questions if you didn't understand something? Is your group able to finish the labs on time? Coming to the lab prepared is KEY to being successful and finishing the tasks on time. Chat with group members to develop a plan. Decide who will do what BEFORE you arrive! If your group is consistently confused and making the same mistakes each week, you will lose marks; your group may be split up.

Organize yourselves by allocating time to the tasks required for each experiment. For example, it should not take two hours to prepare a 1 M solution of TRIS-HCl buffer simply because you didn't do the bioscience math and don't know what mass to weigh and volume to prepare. Pay attention during the lectures! The theory outlined before each lab will help with any pop-quiz questions that may arise!

d. Use of artificial intelligence

Students are encouraged to use basic tools such as spell and grammar checkers (e.g. Grammarly). Generative AI uses deep-learning models to generate text, images, and other content (e.g. ChatGPT, Jasper, Quillbot, DALL-E, Grok) and will be explored during this course. Each report that allows the use of AI will require a declaration statement and estimation of its use for your submission. AI declarations will be part of your ethics mark.

WARNING: AI TOOLS OFTEN MAKE MISTAKES AND YOU ARE RESPONSIBLE FOR RECOGNIZING AND CORRECTING THEM!

G. Lab skills

Because this is an applied course you are expected to perform techniques in a safe, proficient, and skilled manner. Do not rely on the same group member to do all the pipetting, graphing, data collection, Parafilm use, labeling of test tubes, etc. Rotate the roles of the group members so everyone can practice and develop skills for all the techniques.

You may be asked to demonstrate a skill during a lab; you will be graded on this!

Take turns being the "project leader" for lab experiments; keeping everyone on task is also an important lab skill! Being prepared and finishing the labs on time are both important. Please record in your lab books, your project leader each day!

H. Pre-lab schematics

These are PRE-LAB submissions, so they are due BEFORE the lab starts! If they are placed in the box late, they are subject to an immediate 10% late deductions. This activity is to encourage you to be prepared for our more complex labs! Read the lab introduction a few days prior to each lab details. The first schematic you submit is for a two day lab and you will hand in one for Day 1 and receive feedback so you can improve for Day 2's submission. After reading week, schematics are required for BOTH of the days for that lab. NO SCHEMATIC SHALL EXCEED ONE PAGE, FRONT AND BACK.

Schematics must be HAND-DRAWN. We will provide an example schematic for a lab protocol later in the semester and provide suggestions on how to include this on your posters.

Students MAY use iPad or similar devices to HAND DRAW their schematics. However, you must manually (not digitally) sign your work to attest to the fact it was indeed, your own work. Students are discouraged from sharing their hand drawn or digitally prepared schematics to other students. This activity is meant to ensure YOU know the lab protocol each week and you will not be a detriment to your group.

I. Lab notebooks

Each GROUP of students will be provided with a **hard covered lab notebook**. You will be instructed on how to best keep a lab notebook during Lab 2. The books MUST be left in the lab at all times to facilitate marking. They will be marked at random out of 5 or 10 points. All students in the group will receive the same grade; notoriously absentee students who fail to inform their group or have an insufficient excuse for missing a lab WILL BE penalized with a grade of 0 for that lab book date.

J. Late submissions for lab reports

All late assignments, reports, and posters are subject to a 10% per day late mark deduction. This includes weekends. We WILL NOT accept ANY late reports once students have received their marked feedback. Once you get into a habit of getting behind in your work, it is extremely hard to get caught up. Due dates are distributed throughout the semester to keep you current with the material, keep you on task, and provide timely feedback prior to the next report or assignment. SAS students must have official paperwork for extensions and they MUST include the revised due date.

K. Mini-assignments

To give you some early feedback and keep students and TAs on track, you are expected to submit some simple assignments mini-assignments. Most of these are early in the semester. See Table 1 for assignment labs; there are ten total:

1. A safety sheet check list and answers to safety questions. Hard copy submission only due during Lab 2.
2. Pipetting skills and efficiency in the lab. In-lab assessment during Lab 3.
3. A graphing assignment that include a results section from micropipettes (Lab 3) and excel tutorial (Lab 4).
4. An online review quiz for pipettes (Lab 3), Excel (Lab 4), and solution preparation (i.e. Bioscience math Lab 5).
5. A pH and buffers mini-report that includes content from Labs 5 and 6.
6. An online review quiz on lab report and poster formatting (Lab 9).
7. Your TLC plate calculations and questions due in class (Lab 10).
8. A mini-report on size exclusion chromatography (Lab 11).
9. Your Bradford assay calculations in Excel (Lab 13).
10. A dot blots abstract is due in class (Lab 15).

Please follow the rubric grading scheme for each report to avoid doing extra-work. Assignments in this category are weighted according to the effort of work required. See MyCourseLink for the weighting scheme and due dates.

L. Reports

There are FOUR reports due this semester and they are worth a sizeable amount of your final grade!

a. Classically written lab reports

Valuable information on lab reports can be found in the Making Sense for the Life Sciences textbook. Students are encouraged to read the textbook in its entirety over the first few weeks of class.

All individual written lab reports will be graded on the same generic marking rubric. Therefore, review feedback from each report to help improve your grade on the next submissions. Mini-report early in the semester will help guide you in writing longer lab reports.

For 2026, the TWO required individual formal reports will be:

- Plant pigments: Solvent extraction and spectrophotometry (Lab 7).
- Seed proteins (Labs 13 AND 14).

For due dates, see MyCourseLink.

b. Poster reports

Students are to prepare ONE individual and ONE group report in a poster format. Although posters contain less text and appear "simpler" than a written lab report, do not underestimate the time to complete this work. Start your poster the same week as we start this multi-week experiment and draft it out.

For 2026 the individual poster will be the plant micropropagation experiment Lab 8. For due dates, which includes a draft and final version, see MyCourseLink.

Science is collaborative! For the group poster, each group member receives the same grade. Review each others individual posters completed earlier in the semester to avoid making the same mistakes on the second one. Start a template early!

Working together during the lab and outside the lab is a great way to see how you function in all aspects of a bioscience project. Be patient with each other; explore and realize your individual strengths and weaknesses. Learn from others that may have a different way of doing things.

For 2026, the GROUP POSTER shall be the pDNA experiment (Lab 12). See MyCourseLink for due date.

c. Report due dates

ALWAYS REFER TO MYCOURSELINK FOR DUE DATES!. Late penalties are 10% per day, including weekends. If you see contradictory information in this lab manual and MyCourseLink, please let us know immediately so we can clarify it!

M. Final exam

Students with excellent attendance and participation during this course may be exempt from the exam scheduled in April. The exam format will be a 40 min practical bell-ringer exam followed by a 2 hr written theory exam (long and short answers). You may not use this exam to "get a better grade". The exam, if required, will be worth 50% of your final grade, with your other grades accounting for the remaining 50%.

N. Important information for late course registrants

Students will not be permitted to add this course after the official "add date" as set by Lakehead University. Typically this date is at the end of Week 2. This is a participatory course and missing the first two weeks of school results in a student missing close to 20% of the material covered for a 0.5 FCE course.

Late registrants are responsible for completing ALL assignments or quizzes before the posted due dates and cannot expect extensions or an onerous amount of help from the instructor, technician, and/or TAs. Students will be provided safety training and practical skill assessment at a time suitable to the lab technician.

Late registrants are responsible for obtaining any notes and missed work from other students, and should not assume that all materials covered during the first two weeks has been posted in their entirety on MyCourseLink.

Late registrants may have forgone some of the participation marks for this course. These marks cannot be made up. Late registrants should understand that they have placed themselves in a deficit situation from the start, and they alone are responsible for getting back on an even playing field.

O. Lab schedule

A generic course schedule is outlined in Table 1. Textbook references will be given during the lab or mentioned in this lab manual. The schedule presented here may change due to unforeseen circumstances (fire drills, distilled water outages, pandemics, etc.). Officially, lectures are Thursdays from 2:30 to 3:30 pm and labs are Thursdays 3:30 to 5:30 pm AND Fridays 11:30 to 2:30 pm.

However, our 6 hours will be allocated differently each week for efficiency. Lecture slots will be moved around to accommodate lab protocols and ensure students have some theoretical knowledge of the techniques. Therefore, YOU are expected to be available for the entire 6 h course slot every week!

If you have a direct time conflict with this course and another course, DROP ONE! You will not learn the skills you need without coming each scheduled day. There will NOT be Zoom recordings or virtual labs! You will need to rely on your group members for bioscience techniques missed due to illness.

P. Textbooks

For this class there are two recomended text books, they are useful not only for this class but for many science classes you'll encounter in undergraduate science courses.

1. Making Sense (MS) Ed. 3 - by Margot Northey and Patrik von Aderkas - $57.99 @ LU Bookstore

2. Basic Bioscience Laboratory Techniques (BBLT) Ed. 2 – by Philip L. R. Bonner and Alan J. Hargreaves - $54.95 @ LU Bookstore

Table 1.: Proposed schedule of lab activities for BIOL2910WA

Week	Lab ID	Date	Topics
1	Intro and Lab 1	Thurs Jan 8	Overview of labs; Science!
	Lab 2	Fri Jan 9	Lab safety and equipment
2	Lab 3	Thurs Jan 15	Pipette types and skills
	Lab 4	Fri Jan 16	Excel tutorial and presenting results
3	Lab 5	Thurs Jan 22	Preparation of solutions
	Lab 6	Fri Jan 23	Titration of solutions
4	Lab 7: Day 1	Thurs Jan 29	Plant pigment extracts
	Lab 7: Day 2	Fri Jan 30	Plant pigment spectra and chlorophyll calculations
5	Lab 8: Day 1	Thurs Feb 5	Tissue culturing; prep
	Lab 9	Fri Feb 6	Formal lab reports and posters
6	Lab 8: Day 2	Thurs Feb 12	Tissue culturing; experiments
	Lab 10	Fri Feb 13	Thin layer chromatography
	READING WEEK! No classes Feb 16–20. No assignments or quizzes are due!		
7	Lab 8: Take down	Thurs Feb 26	Tissue culture; take-down
	Lab 11: Day 1	Fri Feb 27	Size exclusion chromatography; prep
8	Lab 11: Day 2	Thurs March 5	Size exclusion chromatography; run
	Lab 12: Day 1	Fri March 6	Plasmid DNA extraction
9	Lab 12: Day 2	Thurs March 12	Horizontal electrophoresis
	Lab 13: Day 1	Fri March 13	Protein extraction from seeds
10	Lab 13: Day 2	Thurs March 19	Protein quantification in extract
	Lab 14: Day 1	Fri March 20	SDS-PAGE preparation
11	Lab 14: Day 2	Thurs March 26	SDS-PAGE run seed proteins
	Lab 15: Day 1	Fri March 27	Immunoassay - Dot blots
12	Lab 15: Day 2	Thurs March 28	Immunoassay - Dot blots
	Lab 16	Tues April 7	Lab tours
	Schematic is due. See lab intro for details since most schematics must cover BOTH days! Report or Poster required. See lab for details and requirements. Assignment is due. See lab for details on due date and requirements.		
	COME WATCH OUR HONOURS THESIS PRESENTATIONS TUESDAY MORNING in CB3013 on April 7th		