

Biochemistry 3LA3 course syllabus

1 YOUR MISSION

Hello everyone and WELCOME to Biochemistry 3LA3 😊😊😊😊😊😊😊😊

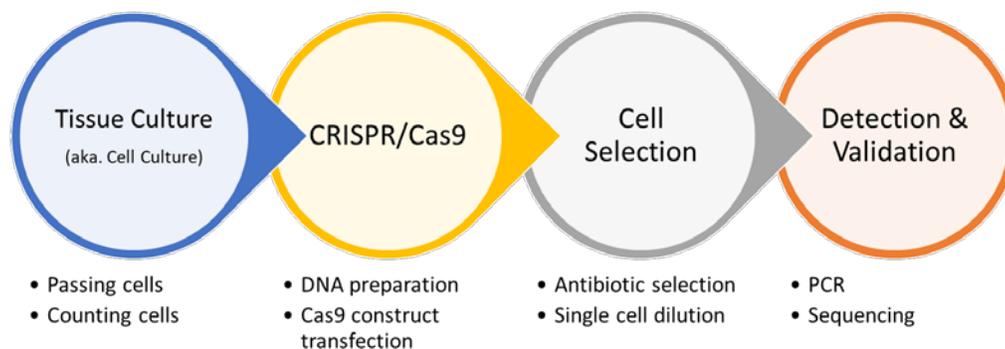
We designed this course to immerse you in several advanced biochemistry techniques that have huge biomedical implications in the research field. You will embark on an amazing adventure through the world of mammalian cell culture and CRISPR/Cas9 technology. You will then discover antibody applications: from purifying immunoglobulins, to Western blotting, and ELISA techniques. Your adventure would not be complete without a journey into the wonderful world of quantitative PCR and its applications to a plethora of research fields: including food science.

The course itself is designed to provide an experiential learning opportunity into the world of research. As such, we have also implemented team-based learning and reflection skills as strong components threaded throughout the course. You will be assigned to a lab pair and a research team and, as a team, you will rotate through the different laboratory techniques.

The class time is mostly repurposed for preparatory lab work, or reflection, or assessments. To help you through this process we have designed team-based rotation schedules which will guide you through the course setup.

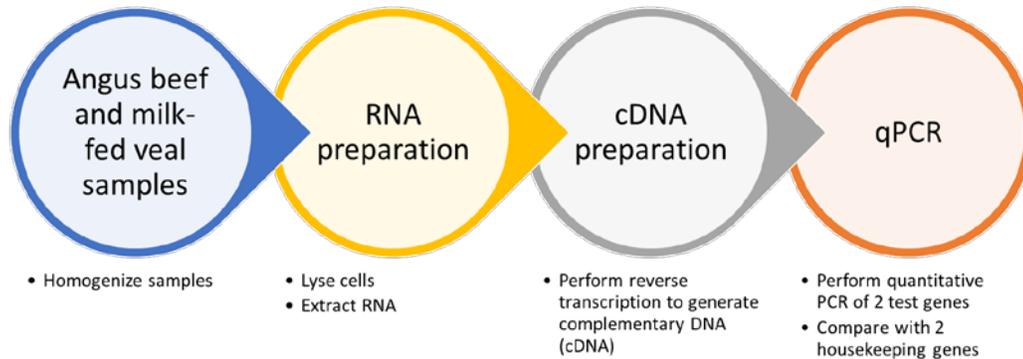
Each student will rotate through three techniques modules:

😊 **CRISPR module** – in this module you will work with your team to understand how to manipulate mammalian cell culture. You will be using a mouse liver cell line to grow mammalian cells, passage cells, and transfect exogenous vectors into these cells. More specifically, you will be knocking out a gene - glucose-6-phosphate dehydrogenase (*G6pd*) – from the genome of this cell line. You will employ CRISPR/Cas9 technology in order to knock out this gene. This module will also take you through the process of selecting for successful gene knockouts by showcasing the use of single cell dilutions for this selection process. Finally, you will isolate genomic DNA and test for the presence/absence of your *G6pd* gene using PCR.

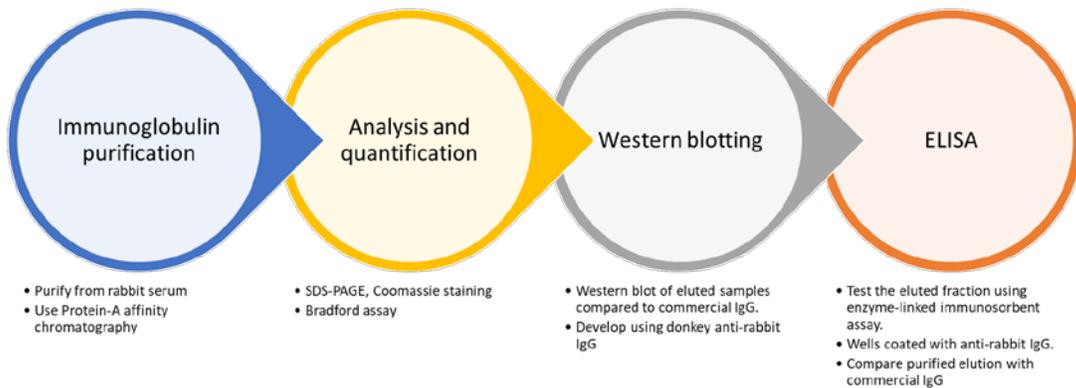


😊 **qPCR module** – in this module you will work with your team to determine the gene expression profile of two different cuts of meat: a sample of Angus beef (typically 32-36 weeks of age) and a sample of

milk-fed veal (3-16 weeks of age). This module uses research techniques in the field of food science. In particular, you will be utilizing qPCR to analyze gene expression levels of two genes: muscle myosin protein (MYH7) and tropomyosin protein (TPM3). The gene expression of these two muscle proteins can be correlated with the tenderness of the meat. In this module you will homogenize the two beef samples, extract RNA, conduct reverse transcription to generate complementary-DNA (cDNA), and you will perform quantitative-PCR on the generated cDNA looking specifically at the gene expression of the two aforementioned proteins. As a team, you will then discuss your results in the context of beef tenderness and age of beef prior to slaughter.



☺ **Antibodies module** – in this module you will work with your team to isolate immunoglobulins (aka. Antibodies) from rabbit serum. You will be using the automated AKTA start system with a Protein-A conjugated affinity chromatography column. Once purified and quantified, you will use your purified samples to conduct an enzyme-linked immunosorbent assay (ELISA). The ELISA is a powerful diagnostic technique as it can be used to determine if patients have antibodies to many infectious diseases.



We developed this course structure with the hopes of:

- ☺ Engaging you in advanced biochemistry techniques and their biomedical applications
- ☺ Providing an immersive lab environment conducive to collaboration, technical skill development, and knowledge translation
- ☺ Developing your technical communication skills

Your individual perspective

We would like all of you to take a moment and think about the following:

- 😊 What are **my** course expectations?
- 😊 What are **my** course goals?
- 😊 What are **my** future goals?
- 😊 What are **my** learning beliefs?

We would like all of you to really think about these and share them during the lab time whenever appropriate.

2 COURSE MECHANICS

Dr. Felicia Vulcu (vulcuf@mcmaster.ca)

Office → HSC-4H43 (please enter through 4H45: as you get off the 4th floor purple area elevators, turn right and head for the glass door in front of you).

Course Instructors My door is always open should you have questions, or you just want to pop in and talk. If I'm not in my office, no worries, you can email me, and we'll set up a meeting time 😊

Dr. Caitlin Mullarkey (mullarkc@mcmaster.ca)

Office → MDCL 3300/G

Undergraduate Coordinator **Vivian Leong** (leongv@mcmaster.ca)
Office → HSC-1H6

Laboratory Assistant **Taylor Gauthier** (biochemistryadvisor@mcmaster.ca)
Office → HSC-4H45



In **OUR** course

- **Every voice matters**
- **Every individual is treated with respect, dignity and equality**
- **We will establish a safe, inviting and caring environment so we can share our thoughts and ideas with one another and learn from each other**
- **Everyone shares the responsibility for making our course a POSITIVE, engaging, respectful and fun environment**

Class Time **Term 2: Mondays, 10:30 am-12:20 pm in room: To Be Announced (TBA)**

Lab Times **Term 2: Fridays, 1:30 – 4:20 pm in HSC 1H1-8**
Please note: No food or drink is allowed in the lab (includes empty food containers, wrappers, bottles, gum). No cell phones, tablets, laptops allowed during the lab.

Materials and Fees ① **Lab notebook** - available for purchase from our undergraduate teaching labs (\$15). This course also has a lab manual which will be provided for you both digitally (on the A2L 3LA3 course), and as a printout with the purchase of your lab notebook from the teaching labs.

① **Safety goggles** – please purchase a pair of UV protective safety goggles which must be worn at all times during the labs.

① McMaster standard calculator and safety goggles (must be UV protective) must be **purchased** by each student and brought to each lab. Lab consumables (timer, sharpies, etc.) will be provided for you in the lab. We provide you with a disposable

lab coat for use in Biochem 3LA3, however if you wish to provide your own lab coat you are free to do so. The lab coat remains in the teaching labs for the remainder of the course.

Please bring your lab notebook, lab manual, safety goggles, black pen and calculator to all labs. During the labs please ensure that you wear close-toed shoes (no flip flops), and long hair is tied back. Please come prepared to each lab and please respect your peers and your environment.

Session Details Term 2 recess: February 15 – February 21 (no classes/ labs)

3 COURSE EXPECTATIONS

Includes missed work and re-grading request policy. Before we get started, we have some expectations we would like to share with you:

- ✓ **The lab times are extremely important for this course and so they are mandatory.** However, if the lab time must be missed due to unforeseen circumstances (such as illness), proper documentation (such as an MSAF) must be provided. Once proper documentation is provided, we will accommodate the missed lab on a case-by-case basis. Additionally, you must complete all requirements of the missed assessment component.
- ✓ Missed assessment components also require supporting documentation. We will tackle these on a case-by-case basis, but we typically ask that you complete the assessment at a later time.
- ✓ Try not to be late when handing in your assignments. Late penalties are usually 10%/day unless otherwise specified.

3.1 USE OF AVENUE2LEARN

(<http://avenue.mcmaster.ca>)

This course uses A2L to post the course outline, lab results and other notices. You should be aware that when you access the electronic components of this course private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure.

3.2 ACADEMIC INTEGRITY

The Academic Integrity Policy (<http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf>) states that students are responsible for being aware of and demonstrating behaviour that is honest and ethical in their academic work. Breaching of academic ethics is ultimately destructive to the values of the University; it is, furthermore, unfair and discouraging to those students who pursue their studies with integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. It can result in serious consequences such as a grade of zero, loss of credit or even expulsion from the university.

3.3 STUDENT ACCESSIBILITY

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information, consult McMaster University's Policy for [Academic Accommodation of Students with Disabilities](#).

3.4 ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

3.5 EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

4 COURSE ASSESSMENT

Assessment Type	Percent (%)
Lab preparedness and participation This mark encompasses: lab notebooks, in-lab participation, team flowchart presentation	15
Quiz	7.5
Lab practical test	7.5
Written Test	25
CRISPR module report	15
qPCR module report	15
Antibodies module report	15

"The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes."

5 ASSESSMENT DESCRIPTIONS

1. Quiz, practical test, written test– 1 quiz and 2 tests in total.

Learning outcomes					
Knowledge Define, describe, name, label, recognize, memorize, recall information.	Understand Demonstrate a comprehensive understanding of 2L06 course material.	Apply Apply knowledge to solve problems posed.	Analyze Analyze data and explain it in the context of the problem given.	Evaluate Critically analyze problems.	Create Create experimental procedures for given problem sets.

2. Module reports – 3 reports in total.

Learning outcomes					
Knowledge Describe techniques, recall information, observe trends, and practice writing style.	Understand Demonstrate a comprehensive understanding of the 2L06 project.	Apply Apply data analysis knowledge and discuss results.	Analyze Analyze data and troubleshoot. Explain scientific data in a written format.	Evaluate Critically analyze data and formulate discussions which encompass the 2L06 project and make connections to the current state of the research field.	Create Create a scientific body of work to summarize main findings of the 2L06 project and demonstrate a thorough understanding of the research field.

3. Participation includes:

- ☺ **Weekly lab notebook entries** – weekly lab notebook entries, of which only a select number will be handed in.
- ☺ **In-lab participation and preparation-** each lab day you will be assessed by your lab mentor (with input from Felicia/Vivian/Cait).

Lab notebook learning outcomes					
Knowledge Read the lab protocol. Label data.	Understand Summarize lab. Explain data.	Apply Interpret protocol. Interpret data.	Analyze Break down protocol and connect ideas.	Evaluate Evaluate and critically analyze data obtained.	Create Collaborate with team on critical data analysis.

Participation learning outcomes					
Knowledge Listen to and read the week's content.	Understand Discuss and interpret the week's content.	Apply Demonstrate the week's lab Interpret the week's content.	Analyze Correlate basic techniques to real-life biomedical problems Explain technical connections.	Evaluate Measure technical data, interpret data, predict data, conclude information and make connections between techniques and data.	Create Assess and investigate multiple connections between theory, practice and biomedical problems.

6 COURSE SCHEDULE

Rotation 1 – Teams A2 and B2 please follow this course schedule			
Class time: Mondays 10:30 am – 12:20 pm		Lab time: Fridays 1:30-4:20 pm in HSC 1H1-8	
		Jan 8	Lab basics and module prep
Jan 11	Room to be announced: Course overview, team flowcharts	Jan 15	CRISPR module – Pass cells and count cells
Jan 18	HSC 1H1-8: Pass cells	Jan 22	CRISPR module – CRISPR transfection
Jan 25	HSC 1H1-8: Check cells, change media (+ puromycin)	Jan 29	CRISPR module – Single cell dilution
Feb 1	HSC 1H1-8: Check cells, change media (20% FBS)	Feb 5	CRISPR module – Genomic DNA prep. Set up PCR
Feb 8	ROOM TO BE ANNOUNCED: Lab practical prep	Feb 12	CRISPR module –Agarose gel/ Prep buffers for Antibodies module
Midterm recess, Monday February 15 – February 21. No classes/labs			
Feb 22	HSC 1H1-8: Quiz	Feb 26	Antibodies module – IgG purification using AKTA start
Mar 1	Lab practical test	Mar 5	Antibodies module – SDS-PAGE/ Western blotting
Mar 8	To Be Announced (TBA)	Mar 12	Antibodies module – Western blotting/ Bradford assay
Mar 15	To Be Announced (TBA)	Mar 19	Antibodies module –ELISA
Mar 22	To Be Announced (TBA)	Mar 26	qPCR module – RNA prep
Mar 29	ROOM TO BE ANNOUNCED: Written test	Apr 2	Good Friday/ no labs
Apr 5	To Be Announced (TBA)	Apr 9	qPCR module – cDNA/qPCR

Rotation 2 – Teams C2 and D2 please follow this course schedule			
Class time: Mondays 10:30 am – 12:20 pm		Lab time: Fridays 1:30-4:20 pm in HSC 1H1-8	
		Jan 8	Lab basics and module prep
Jan 11	Room to be announced: Course overview, team flowcharts	Jan 15	qPCR module – RNA prep
Jan 18	To Be Announced (TBA)	Jan 22	qPCR module – cDNA/qPCR
Jan 25	HSC 1H1-8: Prep buffers for Antibodies module	Jan 29	Antibodies module – IgG purification using AKTA start
Feb 1	ROOM TO BE ANNOUNCED: Lab practical prep	Feb 5	CRISPR module – Pass cells and count cells
Feb 8	HSC 1H1-8: Pass cells	Feb 12	CRISPR module – CRISPR transfection
Midterm recess, Monday February 15 – February 21. No classes/labs			
Feb 22	HSC 1H1-8: Quiz	Feb 26	CRISPR module – Single cell dilution
Mar 1	HSC 1H1-8: Lab practical test	Mar 5	CRISPR module – Genomic DNA prep. Set up PCR
Mar 8	HSC 1H1-8: Check cells, microscope	Mar 12	CRISPR module – Agarose gel
Mar 15	To Be Announced (TBA)	Mar 19	Antibodies module – SDS-PAGE/ Western blotting
Mar 22	To Be Announced (TBA)	Mar 26	Antibodies module – Western blotting/ Bradford assay
Mar 29	ROOM TO BE ANNOUNCED: Written test	Apr 2	Good Friday/ no labs
Apr 5	To Be Announced (TBA)	Apr 9	Antibodies module – ELISA

Rotation 2 – Teams E2 and F2 please follow this course schedule			
Class time: Mondays 10:30 am – 12:20 pm		Lab time: Fridays 1:30-4:20 pm in HSC 1H1-8	
		Jan 8	Lab basics and module prep
Jan 11	Room to be announced: Course overview, team flowcharts	Jan 15	Antibodies module – IgG purification using AKTA start
Jan 18	To Be Announced (TBA)	Jan 22	Antibodies module – SDS-PAGE/ Western blotting
Jan 25	To Be Announced (TBA)	Jan 29	Antibodies module – Western blotting/ Bradford assay
Feb 1	Lab practical prep	Feb 5	Antibodies module –ELISA
Feb 8	To Be Announced (TBA)	Feb 12	qPCR module – RNA prep/ cell culture aseptic technique for CRISPR module
Midterm recess, Monday February 15 – February 21. No classes/labs			
Feb 22	HSC 1H1-8: Quiz	Feb 26	qPCR module – cDNA/qPCR
Mar 1	HSC 1H1-8: Lab practical test	Mar 5	CRISPR module – Pass cells and count cells
Mar 8	HSC 1H1-8: Pass cells	Mar 12	CRISPR module – CRISPR transfection
Mar 15	HSC 1H1-8: Check cells, change media (+ puromycin)	Mar 19	CRISPR module – Single cell dilution
Mar 22	HSC 1H1-8: Check cells, change media (20% FBS)	Mar 26	CRISPR module – Genomic DNA prep. Set up PCR
Mar 29	ROOM TO BE ANNOUNCED: Written test	Apr 2	Good Friday/ no labs
Apr 5	To Be Announced (TBA)	Apr 9	CRISPR module –Agarose gel

7 DUE DATE SCHEDULE

Term 2

Assessment name	<input checked="" type="checkbox"/>	Details	Submission type	Student date due		
Quiz	<input type="checkbox"/>	Individual submission, in-class written quiz	In person	End of class Feb 22		
Lab practical test	<input type="checkbox"/>	Individual and team submission, in-class/lab practical test	In person	End of class Mar 1		
CRISPR module report	<input type="checkbox"/>	Individual submission	A2L electronic submission	Team A2/B2 Feb 22, 11:59 PM	Team C2/D2 Mar 18, 11:59 PM	Team E2/F2 Apr 12, 11:59 PM
qPCR module report	<input type="checkbox"/>	Individual submission	A2L electronic submission	Team A2/B2 Apr 12, 11:59 PM	Team C2/D2 Jan 28, 11:59 PM	Team E2/F2 Mar 4, 11:59 PM
Antibodies module report	<input type="checkbox"/>	Individual submission	A2L electronic submission	Team A2/B2 Mar 25, 11:59 PM	Team C2/D2 Apr 12, 11:59 PM	Team E2/F2 Feb 11, 11:59 PM
Written test	<input type="checkbox"/>	Individual submission, in-class written test	In person	End of class Mar 29		

Your preparedness and participation mark is broken down as follows:

Lab preparedness and participation	Lab participation	Lab notebooks	*Team flowchart
	4 % (of 15% preparedness and participation mark)	10 % (of 15% preparedness and participation mark)	1 % (of 15% preparedness and participation mark)

* This is a team mark. However, if there is a discrepancy with respect to individual participation in the team, we can assign different marks for individual members in a team to best reflect this.