Immunology
UNIVERSITY OF TORONTO

IMM1200H 2024-2025
Scientific Skills for Immunologists

Course & Instructor Information

Course Instructors

Jasty Singh (Course Coordinator)
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Lectures
Thursdays 4:00 – 5:00 PM

**Any changes to the course schedule or mode of delivery will be communicated to all students in advance.*

Course Description

This course focuses on developing core competencies and skills for first year graduate-level scientists through advancing their understanding of research in Immunology in accordance with scientific methodology. Students will critically appraise scientific articles, design and analyze scientific experiments, and develop the core skills of scientific communication and data literacy.

Course Learning Outcomes

- Cultivate oral and written communication abilities through understanding research terminology and the fundamental problems of science in Immunology.
- Generate hypotheses and design research studies to address fundamental gaps in Immunology.
- Learn how to effectively conduct scientific research and experimental analysis, and describe quantitative, qualitative and mixed methods approaches to research.
- Use *R* statistical software and other inference tools to generate data summaries, conduct statistical tests, and draw scientific conclusions.
- Understand best practices to organize, manage and analyze data in the laboratory.
- Cultivate collaborative skills through group work with peers and/or instructors.

Evaluation Scheme & Course Assessments

Assessment	% of Grade	Due Date
Attendance/Participation	5%	Ongoing
Individual Development Plan Assignment	10%	Sept 26, 4pm
Scientific Communication Assignments		
a) CGS-M Scholarship Proposal	15%	November 14, 4pm
b) Lay Abstract	10%	December 5, 4pm
Applied Biostatistics & Experimental Design Assignments		
a) R practice assignment	5%	January 9, 4pm
b) Article Critique	20%	February 27, 4pm
c) Data Analysis Assignments (3 of 4)	15% (3x5%)	March 13-April 3, 4pm
d) Designing an Experiment – Oral Presentation	20%	April 17, 4pm

Attendance/Participation (5%):

Class attendance is mandatory and an integral part of your learning experience in this course. Students are expected not only to attend in-person classes, but also complete pre-class activities and actively participate during class discussions, activities and polls. These classes will, in part, be student-led, and each student will receive a grade out of 5 at the end of the course, based on their demonstrated participation in course activities throughout.

Assignment 1 (10%): Individual Development Plan (IDP)

Discuss three, specific SMART goals you have set for yourself for this year and a potential meaningful engagement which you hope to achieve during your graduate experience in a written report of 700-1000 words.

Criteria	Points
Reasonable SMART goals with specific next steps and insightful new ideas regarding action plans for a meaningful engagement during graduate school	5
Clarity, grammar, professionalism	5

***Due Date**: Sept 26 by 4pm through Quercus*

Assignment 2A (15%): Final CGS-M Scholarship Proposal

The objective of this assignment is to compile a proposed research plan for the Canada Graduate Scholarship – Master's (CGS-M) program. More details about this award can be found here: https://www.nserc-crsng.gc.ca/Students-Etudiants/PG-CS/CGSM-BESCM_eng.asp.

Provide a brief summary (maximum of **one page**, excluding citations) of your Outline of proposed research in language that the public can understand.

As you write your proposal, consider the following questions:
Is the description clear, easy to follow, minimal amounts of jargon?
Is there sufficient background to understand the area being addressed?
Has the problem been expressed in the form of a testable hypothesis?
Are the proposed techniques appropriate, reasonable, and doable?
Is there a logical, experimental plan?
Is it exciting?

Format: single-spaced, 12-point font (such as Times New Roman), 1-inch margins.

Your Research Proposal will be assessed based on the following criteria as per the grading rubric below:

Formatting and Refs. (15 pts)	Writing Clarity (20 pts)	Background (10 pts)	Hypothesis (5 pts)	Technical (20 pts)	Experimental (20 pts)	Exciting (10 pts)
Adheres to guidelines. Within size limits, correct font. References are cited correctly and consistently.	Clear, easy to follow, no run-on sentences, minimal jargon.	Background is sufficient to understand the problem being addressed.	Has the problem been expressed in terms of a testable hypothesis?	Are the proposed techniques appropriate, reasonable, doable?	Is there a logical experimental plan?	Is the project exciting?

***Due Date**: November 14 by 4pm through Quercus*

Assignment 2B (10%): Lay Abstract

Communicating results to a non-scientific audience is an important skill that requires tailoring the message to be clear, understandable, exciting and relevant. Choose a journal article from Medrxiv (www.medrxiv.org) that has only a Technical Abstract. The article should be immunology-based, or a related topic.

Write a version of the Abstract targeted to a non-expert (Lay) audience. The Lay Abstract should be written so that an individual with high school science education can understand it.

The Lay Abstract should be no more than 200 words and should describe the problem addressed, the approach, results obtained and significance. Provide your name and student number at the top, The authors, title, link to the paper and a copy of the Technical Abstract. 12-point Font, 1-inch margins, PDF format uploaded to Quercus.

10% of your grade will be based on proper formatting, while 90% will be based on content, as described in the rubric below:

Formatting and Refs. (10 pts)	Description of Problem (20 pts)	Approach (20 pts)	Results (25 pts)	Significance (25 pts)
Adheres to guidelines. Within size limits, correct font.	Clear description of the problem addressed	Succinct and clear approach including methods.	What were the most important findings?	What are the implications of the study?

***Due Date**: December 5 by 4pm through Quercus*

Assignment 2A (5%): R Practice Assignment

Students will be given a sample immunological dataset and its associated publication (where applicable), and be asked to produce data and numerical summaries using R software. The purpose of this assignment is to have students gain familiarity with R/R Studio, and understand the expectations for all subsequent assignments.

Recommended resources: R for data science; Fundamentals of Data Visualization; R Studio Cheat Sheets

***Due Date**: January 9 by 4pm through Quercus*

Assignment 3B (20%): Article Critique

Students will select an article of their choice. The critique should communicate their understanding of an article's main points in the form of a brief literature review, while offering an analysis of its strengths and weaknesses, including considerations of study design, data presentation and statistical analysis. Focus should be placed on critical analysis and concision.

Feedback from this assignment will be instrumental for the final 'experimental plan' oral presentations.

***Due Date**: February 27 by 4pm through Quercus*

Assignment 3C: Data Analysis Assignments (3x5% = 15%)

You will receive different types of immunological data (flow cytometry, immunofluorescence, ELISA, RNA Seq, cell culture, etc.) and the associated publication (where applicable) during select weeks of the course (February 29-March 28). There will be four (4) equally weighted assignments assigned during each of these weeks. Students are required to complete at least 3 of 4 of these assignments **independently** (no collaboration permitted) and submitted through Quercus by 4:00PM the following Thursday. The schedule is included on the last pages of the syllabus. Assignment questions will be posted on Quercus no later than the Monday of a given assignment week. Assignments must be completed and submitted in the correct format(s) through the appropriate Quercus assignment link by the deadlines. *There are no extensions nor make-ups available for these assignments, particularly given the flexibility in the grading scheme.* **Late assignments and assignments in other formats or submitted in different ways (e.g., over email) will not be accepted.**

**Assignment 2A, the "R practice assignment," will familiarize you with the expectations for all subsequent assignments. Thorough completion of this practice assignment is highly recommended.*

Due Dates: *March 13, March 20, March 27, March April 3 by 4pm through Quercus*

Assignment 3D (20%): Designing an experimental plan (group oral presentation)

Students will receive different types of immunological data (flow cytometry, immunofluorescence, ELISA, QPCR, cell culture, etc.) and the associated publication (where applicable) during the Jan. 16th class. The purpose of this assignment will be to deconstruct the paper, and describe and critique the type of study design and sampling methods used by the authors to make conclusions.

Using the raw dataset, students will reproduce effective data summaries in R, and perform inferential analyses. Are the results comparable to the authors' results? What key similarities/differences are observed? Propose 2-3 additional experiments that could be done to follow-up on the authors' study.

Complete assignment instructions will be posted on Quercus, but briefly, student grades will be based on:

a) Finalized R markdown file of analysis showing R code that was used to analyze the data.

b) A separate, curated .csv file that contains the appropriate headings, data columns and annotation (brief 100 word or less description) of the data (if applicable).

c) In-class oral presentation (Apr. 17) and ability to critically analyze study design, describe experiments performed, propose alternatives.

***Due Date**: Apr. 17, in class presentations & submission of PPT slides, R markdown and CSV (if applicable) through Quercus*

Missed Assessment Policy

There are no make-ups nor extensions for missed assessments (assignments, Quercus Reflection Surveys, etc.). Students encountering extenuating circumstances are encouraged to contact the course coordinator (Dr. Jasty Singh; jastaran.singh@utoronto.ca) *in advance of* assessment deadlines (if possible) – each case will be dealt with on an individual basis. Nevertheless, if you submit an assignment, it will be assumed that you deemed yourself fit enough to do so and your grade will stand as calculated. No accommodation will be made based on claims of medical, physical or emotional distress ***after*** the fact.

Statistical Software – R Studio

R is an open source statistical package that is widely used in academia, research and industry and is quickly becoming a standard platform. It is available for download from: https://cran.r-project.org/ for use on Windows, Mac OS, and Linux (there is also a version for use on Android). RStudio provides a nice interface for R and offers some very useful functionality.

We will be using the University of Toronto JupyterHub to access the R Studio computational environment in IMM1200. To access RStudio on JupyterHub, use your UTORid and password to login at http://r.datatools.utoronto.ca (make sure you have RStudio selected on the login screen). Alternatively, if you would prefer to run RStudio on your own machine, R and R Studio (both available free-of-charge) can be downloaded and installed on your own machine.

Information on how to get set up on JupyterHub, and if you wish, to download and install R and R Studio on your computer, will be posted on Quercus. You will need to be familiar with basic R code and output and will need to generate and interpret R code/output on some of your IMM1200 assignments/reflection surveys.

Statement on Academic Integrity

All students, faculty and staff are expected to follow the University's guidelines and policies on academic integrity. For students, this means following the standards of academic honesty when writing assignments, collaborating with fellow students, and writing tests and exams. Ensure that the work you submit for grading represents your own honest efforts. Plagiarism—representing someone else's work as your own or submitting work that you have previously submitted for marks in another class or program—is a serious offence that can result in sanctions. Speak to your course instructors for advice on anything that you find unclear. To learn more about how to cite and use source material appropriately and for other writing support, see the U of T writing support website at http://www.writing.utoronto.ca. Consult the Code of Behaviour on Academic Matters for a complete outline of the University's policy and expectations. For more information, please see http://www.artsci.utoronto.ca/osai and http://academicintegrity.utoronto.ca.

Can I use Generative AI Tools in IMM1200?

The work you submit for this course must be your own, and may not include any content from generative artificial intelligence (AI) tools, either verbatim or with edits. You may, however, use generative AI to support your work on assignments in this course in the following ways:

- To answer general questions about high-level concepts covered in this course or assignment
- To summarize information and generate assignment outlines

- To generate test cases for your code or understand unfamiliar code/packages
- To assist with understanding and debugging errors

Please note that any uses of generative AI beyond the ones listed above are not permitted, and will be considered use of an unauthorized aid, which is an academic offense. Submissions will be assessed at the discretion of the course coordinator, and students will be asked to show evidence of their work if a case of Academic Integrity and the inappropriate use of Generative AI tools is suspected.

Accessibility Needs

Students with diverse learning styles and needs are welcome in this course. If you have an acute or ongoing disability issue or accommodation need, please feel free to approach the course instructors, as well as register with Accessibility Services (AS) at the beginning of the academic year by visiting http://accessibility.utoronto.ca.

Questions & Additional Course Help

All course content or course administration questions can be posted to the online Discussion Board on Quercus. We encourage you to work with your peers and learn from one another, particularly as you encounter new content. Any messages of a more personal nature (e.g., medical documentation for a missed class/assignment) should be emailed to Dr. Jasty Singh (jastaran.singh@utoronto.ca). You can expect a response within 48 hours (Monday-Friday) to a discussion board posting or to an email.

Course Schedule

The tentative schedule for course topics is shown on the following pages. Some adjustments may be made to weekly topics as the course progresses.

	Lecture Topic (In-person)	To Do
Module 1: Planning and Meaningful Engagements (Dr. Stuart Berger)		
Sept. 5	**Course Introduction & Welcome!** • Course outline, upcoming dates • Q&A: Navigating the student-supervisor relationship	*Recommended Pre-Class Reading:* https://www.universityaffairs.ca/career-advice/graduate-matters/finding-the-right-supervisor-student-match/
Sept. 12	**Planning** Strategies, IDP, SMART goals	
Sept. 19	**Meaningful Engagements** • The Professional Relationship, meetings, conflict resolution, social media	
Module 2: Scientific Communication (Dr. Stuart Berger)		
Sept. 26	**Introduction to Effective Oral Communication** • Importance of communication in science & life • What do we mean by effective communication?	**Assignment 1 (IDP) due**
Oct. 3	**Short Talks & Seminar Presentations** • Memorable scientific talks – what do they have in common? • Student seminars	Students are provided with 3MT guidelines for next week
Oct. 10	**COFFEE BREAK 1 – Choosing a Supervisory Committee**	
Oct. 17	**Three-minute Thesis (3MT)**	Students are assigned scholarship proposal for Oct. 31 class – 1 pg.
Oct. 24	**Introduction to Scholarship Applications (& Other Types of Proposals)** • The peer review process – theory and reality • Examples of proposals	
Oct. 31	**Peer Feedback on Scholarship Proposals** • Students in pairs & critique each others' proposals (5 min markup + 5 min discussion) in Breakout Groups	Feedback collected for peer-reviewed proposals for **final proposal** (Assignment 2A) due Nov. 14
Nov. 7	**Introduction to Manuscript Writing** • Storytelling through scientific manuscripts? How to read a scientific paper	*Pre-Class Reading*: "Is the scientific paper a fraud?" (Sir Peter Medawar)
Nov. 14	**Peer Discussion of Manuscript Writing** • Students organize into breakout groups and discuss four different manuscripts on a similar topic	**Assignment 2A due** Students are assigned Lay Abstract Assignment 2B (due Dec. 5)
Nov. 21	**COFFEE BREAK 2 – Exploring Career(s) in Immunology**	
Module 2: Applied Biostatistics & Experimental Design (Dr. Jasty Singh)		
Nov. 28	**Introduction: Statistics Training in Immunological Research** • What is reproducibility and why is it important? • Coding and why learn it	

	Lecture Topic (In-person)	To Do
Dec. 5	**Variables & Summarizing Data** • Summarizing data for quantitative and categorical variables • Explore relationships between variables using numbers and graphs	**Assignment 2B due**
Dec. 12	**Introduction to R** • Get to know R Studio • Completion of "Assignment 3A" together Learn the steps to complete and submit future assignments	
No Classes – Winter Break (Dec. 14 – Jan. 8)		
Jan. 9	**Introduction to R (continued)**	**Assignment 3A (R practice assignment) due**
Jan. 16	**Sampling** • Common sampling designs in immunological research (*in vitro* and *in vivo*) • Sampling error vs. selection bias • Sampling methods & limitations **Study Design** • Observational vs. experimental study design • Confounding • Principles of study design: randomization, replication, control **Sampling vs. study design**	What does "n" represent for *in vitro* and *in vivo* experiments? ID common experiments done in students' own research, describe study design.
Jan. 23	**Introduction to Inference** • Confidence interval > hypothesis test • Understanding hypothesis tests: p-values, power and errors in hypothesis testing • The T-test (one-sample, two independent samples) • Type I and Type II errors • What is a p-value? Significance level?	T-tests in R; dataset-based application Simulations to show effects of power, n and significance levels (α)
Jan. 30	**Inference II** • Assessing normality (Q-Q plots) • Non-parametric test alternatives • Paired data	Case study from paper. Which test would you use?
Feb. 6	**ANOVA: Partitioning and comparing data variation** • Checking conditions – independence, normality, constant σ • Corrections for multiple hypothesis testing	Inappropriate uses of ANOVA in papers.
Feb. 13	**Clinical Trials Data** • Types of clinical trials and study designs • RR and OR	
Feb. 20	***COFFEE BREAK 3 – TBD***	
Feb. 27	**Using Your Statistics Toolkit** • Resources for what to use when • Knowing when to seek statistical expertise	**Assignment 3B due**

	Lecture Topic (In-person)	To Do
Mar. 6	**A Focus on Data Types** • Best practices for setting up experiments • Flow cytometry, imaging, western blot, QPCR, RNA Seq • Data and papers will be posted before class	Each class will focus on a given experiment type, how to set it up, associated output data and strategies for analysis. **3 of 4 Assignment 3Cs due** (Mar. 13-Apr. 3)
Mar. 13		
Mar. 20		
Mar. 27		
Apr. 3		
Apr. 10	**Peer Feedback and Discussion About Oral Presentation Assignment**	
Apr. 17	**Oral Presentations – Experimental Design**	**Assignment 3D Due (in class, online)**
Apr. 24	**Course Wrap-Up**	