Immunology
UNIVERSITY OF TORONTO

Course & Instructor Information

Course Instructor & Coordinator
Dr. Jasty Singh,
Associate Chair, Undergraduate Studies & Associate Professor, Teaching Stream
Department of Immunology
jastaran.singh@utoronto.ca
Office Hours: Tuesday 1:00-2:30pm

Required:

Stable internet connection

Laptop or computer

Working microphone

Working webcam

Part of this course, including lectures, some course assessments, and cross-institutional collaboration will take place online.

Delivery Mode:
Lectures in this course will be held **online, asynchronously**. Lecture videos will be released at the start of a given week, and students will be able to self-pace their learning. Tutorials will be held **in-person** on Thursdays from 1:10-3:00pm. Tutorials will involve discussion and application of content from asynchronous lectures; therefore, please note that attendance for all tutorials is **mandatory**.*

Arts & Science Calendar Course Overview ("24L"/24T)

This course will provide students with an opportunity to advance 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 data and statistical literacy. This course is well suited for anyone interested in discovering knowledge in Immunology, providing students with a methodology for the achievement of scientific research activities.

Prerequisites: IMM250H1, BCH210H1/BCH242Y1, BIO230H1/BIO255H1, BIO260H1/HMB265H1, STA288H1/STA220H1

__Note__: If students have not taken STA288H1 (or another comparable introductory statistics course), please note that there will be a steep learning curve for basic inferential statistics and R programming. While supplementary resources will be provided, it will be the student's own responsibility to ensure they are up to speed with course content via self-study. Extra support will be available in the course through peer collaboration, the course discussion board and instructor office hours.

Course Learning Outcomes

- Understand research terminology and the fundamental problems of science in Immunology by searching for, reading and critically appraising primary and secondary research articles.
- Formulate hypotheses and design research studies to address fundamental gaps in the field of Immunology.
- Use *R* statistical software to generate data summaries, conduct statistical tests, and draw scientific conclusions.
- Cultivate cross-disciplinary and cross-institutional collaborative skills through group work with peers at both the University of Toronto and the University of British Columbia, TAs and/or instructors.
- Learn how to effectively conduct scientific research and experimental analysis, and describe quantitative, qualitative and mixed methods approaches to research.

Required Readings

There is no required textbook for this course. All required papers/content will be posted Quercus (information below) and should be read **prior** to attending the tutorials.

Statistical Software – R/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 this course. 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, is posted on Quercus. You will need to be familiar with R code and output and will need to generate and interpret R code/output on your IMM360 assignments.

Flow Cytometry Analysis Software – FlowJo

FlowJo™ is the leading analysis platform for single-cell flow and mass cytometry analysis. We will be using FlowJo v10 in this course – there is no charge for this in IMM360. You will receive an invitation to FlowJo at your @mail.utoronto.ca email address. After you "Accept Invitation," you will be redirected to the FlowJo Portal. Create an Account using your @mail.utoronto.ca email address. Next, download FlowJo at https://www.flowjo.com/solutions/flowjo/downloads. Once you have accepted your License Invitation, you will be able to sign in to FlowJo using your portal account credentials (https://docs.flowjo.com/portal/flowjo-portal-license-for-flowjo/).

Quercus Course Website

Direct Link to our Course (you will need to sign in with you UTORid and password): https://q.utoronto.ca/courses/357683

It is your responsibility to check Quercus regularly and to monitor your @mail.utoronto email inbox for messages about the course. Here, you will find important announcements, information about how to get set up with R/R Studio and FlowJo, information about assessments, help (via Discussions and office hours), your grades, etc. Several course assessments will also be posted on/submitted through Quercus and outline tutorial slides will be posted there in .pdf format by 11:59pm the night before tutorial. Alternative file formats will not be available. **Note that complete slides/lecture material used in class should <u>not</u> be posted or distributed in any form under any circumstance**.

The Discussions tool is enabled on Quercus. Direct link:
https://q.utoronto.ca/courses/357683/discussion_topics

You can ask questions there and respond to your peers' questions about weekly course content (e.g., lecture, readings, practice questions, etc.) or general course administration. If you email your instructor/TAs with a course content or general administration question, you will be directed to Quercus Discussions. This is a public (to the class) Discussion Board and an extension of our classroom learning community so please be respectful of one another. Derogatory, discriminatory, or otherwise inappropriate language or topics will be removed and dealt with at the instructors' discretion.

Evaluation Scheme & Course Assessments

Assessment	% of Grade	Due Date
Participation (Attendance/In-class Activities)	10% (10x1%)	Weekly
Assignment 1: Article Critique	15%	Oct. 4
Assignment 2: Data Analysis Assignments	20% (4x5%)	Oct. 11, 18, 25, Nov. 8
Assignment 3: Cross-Disciplinary Collaborative Project	Cross-Disciplinary Project Questionnaires (2x1%)	Sept. 20, Dec. 5
	Get-to-know-the-team Assignment (2%)	Sept. 27
	Article Critique – Guided Worksheet (2%)	Oct. 11
	Team Contract Revision + Peer Evaluation I (1%)	Oct. 18
	Proposed Studies Draft (2%)	Nov. 8
	Oral Presentation (15%)	Nov. 29
	Peer Evaluation II (1%)	Dec. 5
Final Exam	30%	TBD

Participation (10%)

Tutorial attendance is **mandatory** and an integral part of your learning experience in this course. Students are expected not only to attend tutorial but also to read required texts and watch required lecture videos before tutorial to engage with the material during class discussions and through the discussion board on Quercus. In some cases, students will be required to complete/submit an activity, completed during tutorial time, on the tutorial date. These activities will be graded for participation only. There are *no extensions nor make-ups available for missed tutorials.*

Refer to the "Missed Assessment/Tutorial Policy" section below for information on how to request accommodation for a missed tutorial and what accommodations may be possible.

Assignment 1: Article Critique (15%)

You will select an article of your choice related to the field of immunology. Your critique of this article should communicate your understanding of an article's main points in the form of a brief literature review, while offering an analysis of its strengths and weaknesses. You will be responsible for generating a preliminary outline of your ideas for peer review in tutorial on **September 26**. Focus for this assessment should be placed on critical analysis and concision.

<u>Due Date</u>: **October 4**, 11:59pm through Quercus

Assignment 2A-D: Data Analysis Assignments (4x5% = 20%)

You will receive different types of immunological data (flow cytometry, immunofluorescence, ELISA, RNA Seq, cell culture, etc.) and the associated publication (where applicable) during Module 2 of the course. There will be four (4) equally weighted assignments to be completed **independently** (no collaboration permitted) and submitted through Quercus by 11:59pm on the Friday following the tutorial dates for those weeks (**October 11, 18, 25, November 8**). 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 <u>no extensions nor make-ups</u> available for these assignments.* **Late assignments and assignments in other formats or submitted in different ways (e.g., over email) will <u>not</u> be accepted.**

*Tutorial 5 (Oct. 3) has an "R practice assignment," which is not mandatory, but will familiarize you with the expectations for all subsequent assignments. Completion of this practice assignment is highly recommended. Tutorials for weeks 6-9 (Oct. 10, 17, 24 and Nov. 7) will provide students with an opportunity to seek extra help for data analysis assignments from instructors and teaching assistants.

<u>Due Dates</u>: **October 11, 18, 25 and November 8**, 11:59pm through Quercus

Assignment 3: Group Presentation – Interdisciplinary, Cross-Institutional Research Study (25%)

For this project, you will have the unique opportunity to work in an interdisciplinary project team of 4-5 students, comprised of biomedical engineering undergraduate students (BMEG 372, University of British Columbia) and immunology undergraduate students (YOU! IMM360, University of Toronto). In your interdisciplinary teams, you will be contributing your own expertise *and* relying on the expertise of your team members to critique an assigned published research article on the topic of immunoengineering. The project components have been designed in such a way that expertise from both fields (biomedical engineering and immunology) is needed; it cannot be accomplished by any single student group alone.

Your group will record an oral presentation, which should be uploaded to Quercus by **11:59pm** on **November 29.** There will be no extensions on the group research study assignment under any circumstances. Late presentations will not be accepted. More information on the group research study presentations will be posted on Quercus.

All group members are expected to contribute to the project equally and provide an outline of their involvement. Information on how individuals' contributions to the group assignment will be assessed will be provided on

Quercus, but students will need to complete a mid-term and final peer evaluation survey to evaluate their group members' contributions. Every group member will earn the grade earned by their group's assignment, <u>unless</u> there is a clear and consistent message in the peer/self-evaluations that an individual's contributions were less than satisfactory. If this is the case, that individual's project grade will be less than the grade earned by the group project. The exact amount less will be determined on a case-by-case basis, based on the contributions of that particular group member.

<u>**Due Date for Video Presentations**</u>: **November 29**, 11:59pm through Quercus

Final Exam (30%)

There will be a 3-hour online final exam (combination of multiple-choice and written answers), to be scheduled during the Final Exam period (December 6-23, 2024). The final will be application-based and cumulative in nature (lectures, tutorials and group presentations over the course of the semester). Information on coverage, along with some sample questions will be posted on Quercus at least one week in advance of the exam.

Final exam conflicts and petitions for a deferred exam must be brought to the Faculty of Arts and Science. Information to follow.

Missed Assessment/Tutorial Policy

- This course follows the University of Toronto's Policies on missed exams, assignments, and tutorials and requires students to complete the <u>Absence Declaration on ACORN</u> if an assessment is missed due to illness. Your Absence Declaration must be accompanied by a <u>Verification of Illness form</u> if applicable, and you must report your absence to the course coordinator, Dr. Jasty Singh (<u>jastaran.singh@utoronto.ca</u>) by email within <u>one week</u> of the assessment due date to request accommodation.
  Note: *If you cannot submit a VOI due to limits on terms of use, you can submit a different form (like a letter from a doctor), as long as it is an original document, and it contains the same information as the VOI (including dates, academic impact, practitioner's signature, phone and registration number).*
- Other reasons for missing an assessment (i.e., assignment, tutorial) will require <u>prior approval</u> by your instructor. If approval is <u>not granted in advance</u> for non-medical reasons, then 0% will be recorded for the missed assessment.
  Note: If you submit an assessment (i.e., assignment, tutorial activity), 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 reports of medical, physical, or emotional distress *after* the fact.
- **Accommodation for a missed tutorial** - There are no make-ups for missed tutorials. If accommodation is requested for a missed tutorial as above and is granted by the instructor, the weighting for that tutorial will be shifted to your exam; otherwise 0% will be recorded for your tutorial. **Since tutorials are important to the course learning outcomes, <u>at most one</u> tutorial can be accommodated in this way.**
- There are no accommodations for individual contributions to the group presentations due to the nature of the assessment (i.e., it is a group assignment).

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 instructor 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.

Students will be required to submit their course assignments to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their assignments to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (https://uoft.me/pdt-faq).

Can I use Generative AI Tools in IMM360?

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 instructor, as well as register with Accessibility Services (AS) at the beginning of the academic year by visiting http://accessibility.utoronto.ca.

Intellectual Property Statement

Parts of this course, sometimes including your participation, will be recorded on video and will be available to students in the course for viewing remotely after each session. Note that all course materials are the intellectual property of the course instructor, and they are made available to you for your personal use in this course. Sharing, posting, selling or using this material outside of your personal use in this course is **not** permitted under any circumstances and is considered an infringement of intellectual property rights. According to intellectual property laws, not asking permission constitutes stealing.

Questions & Additional Course Help

All course content or course administration questions <u>must</u> be posted to the online Discussion Board on Quercus or brought to office hours. Any messages of a more personal nature (e.g., medical documentation for a missed class/assignment) should be emailed to the instructor (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 (Asynchronous)	Date	Tutorial Topic (In-Person)
Module 1 – Engaging with Research			
Sept. 2-8	**Introduction to Scientific Inquiry & Research** • What is scientific inquiry? • Establishing rationale for your study	Sept. 5	Components of a research question & hypothesis Work with datasets and brainstorm research importance
Sept. 9-15	**Finding, Reading & Analyzing Scientific Publications** • Use of research databases for problem solving	Sept. 12	Critical Appraisal – what to look for: deconstructing papers
Sept. 16-22	**Minding the Gap – Finding a Niche for Study** • Developing a research hypothesis	Sept. 19	Characteristics of good research topics and how to create one *Overview of Article Critique Assignment*
Sept. 23-29	**Scientific Communication & Good Laboratory Practice** • Introduction to effective oral/written communication • Project planning and management	Sept. 26	Peer review of Article Critique Assignment outlines – identifying strengths/weaknesses in scientific communication
Module 2 – Working with Immunological Data			
Sept. 30-Oct. 6	**Introduction to Quantitative, Qualitative and Mixed-Methods Research** • Introduction to types of variables • Quantitative vs. qualitative variables	Oct. 3	***Article Critique Assignment 1 Due Oct. 4, 11:59pm*** Variable identification exercise Review of *R and "R Practice Assignment" (in tutorial)*
Oct. 7-13	**Common Techniques in Immunology & Demo of Software** • Flow cytometry, ELISA, QPCR, etc.	Oct. 10	Working with immunological data in R. ***Assignment 2A due Oct. 11, 11:59pm***
Oct. 14-20	• FlowJo analysis **Analysis and Interpretation of Immunological Data**	Oct. 17	Working with immunological data in R. ***Assignment 2B due Oct. 18, 11:59pm***
Oct. 21-27	• Descriptive & inferential procedures • Bridging statistics with immunology	Oct. 24	Working with immunological data in R. ***Assignment 2C due Oct. 25, 11:59pm***
Oct. 28-Nov. 3	**READING WEEK – NO CLASSES**		
Nov. 4-10	**Analysis and Interpretation of Immunological Data** • Descriptive & inferential procedures • Bridging statistics with immunology	Nov. 7	Working with immunological data in R. ***Assignment 2D due Nov. 8, 11:59pm***
Module 3 – Designing a Research Study			
Nov. 11-17	**Study Design** • Types of studies • Sampling vs. study design	Nov. 14	Case studies of various experimental designs & impact on findings
Nov. 18-24	**Drawing Scientific Conclusions & Impact** • Driving research forward • Funding opportunities	Nov. 21	Review & Group work on presentations
Nov. 25-Dec.1	**Course Wrap-Up**	Nov. 28	Review problems ***Group presentations due Nov. 29 at 11:59pm***