

Course Syllabus – BIOL 3943 – Hypothesis Testing in Biology

Instructor:	René Malenfant	Lecture Time:	MWF: 11:30–12:20
Email:	rene.malenfant@unb.ca	Lab Time:	N/A
Office Location:	B111	Class Location:	SL108

How to Contact Me

I want to ensure that I am available to answer your questions, to provide useful feedback, and to connect when needed.

- If you have comments or questions about our course, please feel free to email me at rene.malenfant@unb.ca
- If you wish, we can arrange a time to meet so that we can address whatever questions or issues you have as efficiently as possible.
- Please do not try to contact any other way than email. I will not be checking other avenues, and I don't want to your message to get lost.

I try to answer all email questions as soon as I see them, time permitting. This means that you will usually receive a reply quickly during the workweek (i.e., Monday–Friday, 9:00 AM to 5:00 PM), and much slower (or perhaps not at all) afterhours or on the weekend. **Note:** I will not answer questions about the content of an examination within 24 hours of the exam. This is a motivation for you to start studying early.

Office Hours

There are no official office hours for the course. If you see me in my office with the door open, I am probably available, so feel free to knock. Otherwise, email me to make an appointment.

About the Course

Course Description:

This course provides an introduction to methods that Biologists use to address, develop and test hypotheses in biology. We will ask: How do students, researchers, and professionals in biology set up questions for their research and/or assess evidence? How do they design their experiments? What traps and pitfalls do they know to look out for? How do we know if a scientific study is flawed? This course focuses more on ideas about why we do statistics and how to interpret them, rather than the mathematical details of different tests. Examples will range from cell biology to community ecology. Students will be exposed to a range of computer software necessary to explore, interpret and understand data and test hypotheses. This course will be important for students taking upper-year lab or field courses and Honours by thesis.

Course Prerequisites:

STAT 2264 or equivalent.

Recommended Textbooks (on reserve in the Science Library):

Glass D (2014) *Experimental Design for Biologists*, 2nd edn. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

Pinker S (2021) *Rationality: What It Is, Why It Seems Scarce, Why It Matters*. New York, NY: Viking.

Whitlock M, Schluter D (2020) *The Analysis of Biological Data*, 3rd edn. New York, NY: W. H. Freeman.

Course Topics and Outcomes:

The three major themes covered in the course include:

1. Rationality (i.e., logic, critical thinking, etc.)
2. Experimental design (esp. non-statistical aspects, e.g., system validation, controls)
3. Statistical data analysis (i.e., ANOVA, regression, etc.)

Upon completion of this course, you should be able to:

- Evaluate the logical structure of scientific arguments.
- Design robust biological experiments using appropriate controls, adequate replication, and system validation techniques to isolate causal variables.
- Select and execute appropriate statistical tests for a given experimental design.
- Diagnose and handle violations of statistical assumptions and avoid common analytical pitfalls like *p*-hacking, pseudoreplication, etc.
- Critically audit scientific literature and popular media to identify flaws in experimental design, missing controls, or overstated conclusions.

Students' competency levels on these outcomes may vary. Outcomes achievement requires the meeting of all course expectations, including honouring of all course policies, regular class attendance, and completion of all assigned work in good faith and on time.

Grading, Marks, and Course Policies

Grading Scale

Letter Grade	Percentage Grade	Grade Points
A+	[93–100%]	4.3
A	[85–93%]	4.0 (Excellent)
A–	[80–85%]	3.7
B+	[75–80%]	3.3
B	[70–75%]	3.0 (Good)
B–	[65–70%]	2.7
C+	[60–65%]	2.3
C	[55–60%]	2.0 (Satisfactory)
D	[50–55%]	1.0
F	[0–50%]	0.0

Course Marking Scheme

Item	Value	Date Due	Description
Assignments (×3)	5% each	See below	One per theme
Midterm exams (×2)	20% each	See below	Not cumulative
Final exam	35%	TBA	Cumulative
Attendance/participation	10%	N/A	
Total:	100%		

Course Policies:

- All assignments must be received by 11:59pm of the due date. Unless otherwise stated, assignments should be submitted electronically (i.e., on D2L).
- A student who cannot complete an assignment or attend an examination due to incapacitating illness, severe domestic affliction, or other compelling reasons can apply for a deferral. Without approval, there is a 20% penalty for each day that an assignment is late, where “days” are counted from midnight to midnight including weekends and are judged based on the time submitted to the instructor. In all cases, the instructor may request adequate documentation to substantiate the reason for the absence. Deferral is a privilege and not a right; there is no guarantee that a deferral will be granted.

- Unless otherwise stated, assignments are individual work, and collaboration among students should not exceed the kind of help you would expect from the instructor. For instance, troubleshooting an analysis or helping another student understand concepts are okay, but directly giving/receiving answers or sharing script files (etc.) would obviously be forbidden. If you receive any help from anyone else (including from a site on the Internet, etc.), your assignment must contain an Acknowledgements section in which you thank the person and describe how they assisted you. Any academic offenses will be dealt with strictly according to UNB policy. (See below.)
- Anyone who wishes to video or audio record lecture presentations or distribute course notes or other similar materials provided by instructors must obtain the instructor's written consent beforehand. Otherwise, all such reproduction is an infringement of copyright and is absolutely prohibited and subject to academic penalties (see Academic Offences below). Classes may be recorded by students with documented disabilities for personal and private use.
- Mobile devices are to be turned off during lectures.
- Extra-credit assignments will not be considered.

Lecture Schedule

The intended schedule is found below. It is subject to change in the event of extenuating circumstances, by mutual agreement, and/or to ensure better student learning. Students will be notified if and when changes are made (stay up-to-date via D2L Brightspace).

Date	Day	Topics	Relevant readings	Items due
Sept. 9	W	Introduction; synopsis of an experiment	Glass ch. 34	
Sept. 11	F	Rationality and irrationality	Pinker ch. 1–2	
Sept. 14	M	Logic and critical thinking 1	Pinker ch. 3	
Sept. 16	W	Logic and critical thinking 2	Pinker ch. 3	
Sept. 18	F	Logical fallacies	Pinker ch. 3	
Sept. 21	M	Probability and randomness	Pinker ch. 4	
Sept. 23	W	Beliefs and evidence	Pinker ch. 5	
Sept. 25	F	Philosophies of science	Glass ch. 4–5	
Sept. 28	M	Experimental frameworks	Glass ch. 6–12	
Sept. 30	W	<i>Truth and Reconciliation Day – no class</i>		
Oct. 2	F	System validation	Glass ch. 13–21	Assignment #1
Oct. 5	M	Controls 1	Glass ch. 23–28	
Oct. 7	W	Controls 2	Glass ch. 23–28	
Oct. 9	F	Replicates and repeats	Glass ch. 29	
Oct. 12	M	<i>Thanksgiving – no class</i>		
Oct. 14	W	Statistical aspects of hypothesis testing	W&S ch. 6	
Oct. 16	F	Statistical aspects of experimental design	W&S ch. 14	Assignment #2
Oct. 19	M	<i>Midterm help session</i>		
Oct. 21	W	N/A		Midterm #1
Oct. 23	F	Sampling, statistics, and estimation	W&S ch. 1, 3–4	
Oct. 26	M	Analysing proportion and count data	W&S ch. 7–9	
Oct. 28	W	Comparing groups: z-tests	W&S ch. 10–11	
Oct. 30	F	Comparing groups: t-tests	W&S ch. 12	
Nov. 2	M	Comparing groups: ANOVA 1	W&S ch. 15	
Nov. 4	W	Comparing groups: ANOVA 2	W&S ch. 18	
Nov. 6	F	Correlation, regression, and causality 1	W&S ch. 16	
Nov. 9	M	<i>Reading week – no class</i>		
Nov. 11	W	<i>Reading week – no class</i>		
Nov. 13	F	<i>Reading week – no class</i>		
Nov. 16	M	Correlation, regression, and causality 2	W&S ch. 17	
Nov. 18	W	Handling violations of assumptions	W&S ch. 13	
Nov. 20	F	Common types of experimental designs		
Nov. 23	M	Common pitfalls in statistical analysis	W&S interleaves	Assignment #3
Nov. 25	W	<i>Midterm help session</i>		
Nov. 27	F	N/A		Midterm #2
Nov. 30	M	How to read a scientific paper 1		
Dec. 2	W	How to read a scientific paper 2		
Dec. 4	F	Activity: evaluating an episode of <i>MythBusters</i>		
Dec. 7	M	Activity: evaluating a scientific paper		
Dec. 9	W	TBA		
Dec. 11	F	<i>Final exam help session</i>		

Student Support Information

D2L

Online course materials can be found in D2L Brightspace, UNB's online Learning Management System. You can access it through the MyUNB portal for single login to all UNB services (<https://my.unb.ca/Pages/default.aspx>) or directly at <https://lms.unb.ca/>.

D2L Brightspace Support for Students:

<https://unbcloud.sharepoint.com/sites/adm/SitePages/D2L-Resources-for-Students.aspx>

For D2L technical support, contact: d2l@unb.ca

Key Technologies

During the semester, there are a variety of technologies that students will be expected to use. Students can contact their course instructor or Information Technology Services (ITS) Help Desk (its servicedesk@unb.ca). These (free) resources include:

- Microsoft 365 – can be obtained through your UNB login account (<https://my.unb.ca>)

Libraries

UNB Libraries supports your learning and academic success. Librarians will help you navigate academic resources and guide you through your research and information needs. Examples of this support include finding reliable sources for your assignments, searching scholarly databases, and offering advice on the quality of your research. A vast collection of resources is available to you online and in print at lib.unb.ca. Research help is available by phone, e-mail, chat, and in-person. See: www.lib.unb.ca

The libraries offer quiet and group study space. Book a Group Study Room online at:

http://www.lib.unb.ca/services/group_study.php

Tatiana Zarskaya is the STEM librarian for the Faculty of Science and the Faculty of Forestry & Environmental Management. Tatiana is available to meet one-on-one, online or in person.

Contact information and research guides by subject: <https://lib.unb.ca/profile/tatiana-zarskaya>

Services for Students with Disabilities

If you are a student with a disability of any type (physical, mental, learning, medical, chronic health, sensory; visible or invisible) you are strongly encouraged to register with the UNB Student Accessibility Centre (SAC) (<https://www.unb.ca/fredericton/studentservices/academic-success/accessibility-centre/>) so that you may receive appropriate services and accommodations. Once you are registered with SAC, you'll receive an accommodation letter you can share with instructors. If you would like to discuss your needs with the instructor, please book a time for a confidential appointment.

Student Services Writing and Study Skills Support

The UNB Writing and Study Skills Centre provides many coaching and mentoring services to assist with writing papers, effective study methods, and other skills development related to student success: <http://www.unb.ca/fredericton/studentservices/academics/writing-centre/index.html>

Student Services Learning Strategist Support

Any UNB student wanting to improve their academic skills may book appointments with the Learning Strategist. The Strategist offers instruction on topics such as: “learning how to learn” strategies, memory techniques, time management skills, test preparation and test taking methods, note-taking, and other learning and study skills.

<https://www.unb.ca/fredericton/studentservices/academic-success/accessibility-centre/services-and-support.html>

Math Skills Support

UNB’s Math Learning Centre offers math help drop-in times and opportunity to book appointments: <http://www.math.unb.ca/~mathhelp/>

Technical Support

Information Technology Services (ITS) Help Desk can be reached by phone 457-2222, email - its servicedesk@unb.ca, or visited in person at the Harriet Irving Library Learning Commons. <http://www.unb.ca/its/get-it-help.html>

Student Wellbeing

It is normal for university students to experience mental and physical health challenges. If you or a friend encounter difficulties and need assistance, it’s important to reach out. Consider discussing the situation with a mentor or academic advisor. Learn about resources that assist with wellness and academic success at the University of New Brunswick by visiting:

<https://www.unb.ca/fredericton/studentservices/be-healthy-at-unb.html>

If you are in immediate crisis, please contact CHIMO helpline at 1-800-667-5005.

Plagiarism and Academic Offences

The university has carefully defined what it considers plagiarism, and these regulations are found in the UNB calendar section B.19 IX Academic Offences:

Plagiarism includes:

1. quoting verbatim or almost verbatim from any source, regardless of format, without acknowledgement;
2. adopting someone else's line of thought, argument, arrangement, or supporting evidence (such as, statistics, bibliographies, etc.) without indicating such dependence;
3. submitting someone else's work, in whatever form (essay, film, workbook, artwork, computer materials, etc.) without acknowledgement;
4. knowingly representing as one's own work any idea of another.

NOTE: In courses which include group work, a penalty may be imposed on all members of the group unless an act of plagiarism is identified clearly with an individual student or students.

Please note that plagiarism is not difficult to spot; web sources can be quickly traced through a variety of specialty search engines. Professors are required to follow the disciplinary procedures outlined in the calendar (B.17. IX. A. 1-2).

OTHER ACADEMIC OFFENCES you need to be aware of include:

1. Cheating on examinations, tests, assignments or reports, including but not limited to:
Impersonating a candidate at an examination or test or in connection with any assignment in a course or availing oneself of the results of impersonation.
Obtaining, through theft, bribery, collusion, purchase, or other improper manner,
 - a. an examination or test paper prior to the date and time for writing the examination or test;
 - b. academic materials belonging to another person, e.g., laboratory reports, assignments, papers, computer materials, datasets.
2. Falsifying or knowingly submitting false assignments or credentials, records, transcripts, or other academic documents.
3. Submitting a false health or other certificate.
4. Submitting identical or substantially similar work for one course or program of study, which has been or is being submitted for another course or program of study, without the prior express knowledge and approval of the instructors.
5. Interfering with the right of other students to pursue their studies.
6. Knowingly aiding or abetting any of the above offences.
7. Tampering with, or altering, in any deceptive way, work subsequently presented for a review of the grade awarded.

Penalties for plagiarism and other academic offences range from a minimum of F (zero) in the assignment, exam or test to a maximum of suspension or expulsion from the University, plus a notation of the academic offence on the student's transcript.

For more information, please see the Undergraduate Calendar, University Wide Academic Regulations, Regulation VIII.A, or visit: <http://go.unb.ca/tlsPb0XX5>. It is the student's responsibility to know the regulations.

Statement on Generative Artificial Intelligence

Generative artificial intelligence (AI) can be used for routine tasks (e.g., improving grammar of a student-written document) without specific acknowledgement. Other AI-generated content is not permitted in student work unless there are clear reasons why AI was necessary and the content is clearly identified as being AI-generated. This might include correcting computer code, generating tables/figures, etc. In any of these cases, you must name the program you used (e.g., ChatGPT 5), the date accessed, and provide the prompt used. This should be placed in the Acknowledgements section of the document. Regardless of whether you use generative AI, you are entirely responsible for the content of the work you submit, including any errors, plagiarism, or copyright infringement committed by the AI. It is strongly recommended that you use AI only for purposes of learning, and only to help troubleshoot on tasks you already know how to do well by yourself.