University of New Brunswick
Faculty of Science
BIOL 4523/6523, Phylogenetics, Fall 2020

COURSE SYLLABUS

Instructor:	René Malenfant	**Lecture Time:**	MWF: 9:30–10:20 (Atlantic)
Email:	rene.malenfant@unb.ca	**Lab Time:**	Th: 14:30–17:20 (Atlantic)
Phone:	458-7462	**Locations:**	Lecture & Lab: MS Teams
Office Location:	B111 (But meet by MS Teams)	**Office Hours:**	By appointment (MS Teams)

Course Description:

Methods for inferring evolutionary trees and their applications to the fields of comparative biology, molecular evolution, and systematics. Topics to be covered include sequence alignment, phylogenetic inference, ancestral character state reconstruction, comparative methods, and molecular adaptation. Labs emphasize practical experience in data analysis.

Course Prerequisites:

BIOL 2013, BIOL 2018, BIOL 2263, and BIOL 2268 or equivalents, or permission of the instructor. Credit cannot be obtained for both BIOL 4523 and BIOL 6523.

Recommended Textbook:

Baum, D. A. and S. D. Smith. 2013. *Tree Thinking: An Introduction to Phylogenetic Biology.* New York, NY: W.H. Freeman and Company.

Other Course Resources:

A list of recommended readings is available on D2L.

Library Information:

www.lib.unb.ca

UNB Libraries provides access to a vast collection of online and print resources. Use Research by Subject on the library website to find the best resources for this course.

Research help is available by phone, e-mail, chat, and in-person.

The libraries offer quiet and group study space. Book a Group Study Room online at http://www.lib.unb.ca/services/group_study.php

Online Materials:

Online course materials can be found in Desire2Learn (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 by pasting lms.unb.ca into your browser address bar.

Course Outcomes:

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

- Describe the algorithms used by various phylogenetic reconstruction methods, as well as the philosophy underlying these methods, the assumptions they make, and their pros and cons.
- Use sequence data to statistically test the monophyly of a traditionally defined group.
- Explain why relationships between species invalidate many classical statistical tests, and use alternate methods that account for relationships between species.
- Detect evidence of natural selection from multi-species sequence data.
- Describe how species can be delimited based on sequence data.
- Critically evaluate and discuss claims in the phylogenetics literature.
- Write a scientific research paper that includes phylogenetic reconstruction and the testing of a novel hypothesis and present this material to an audience.

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 Scale:

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

Course Marking Scheme

Item	Value	Date Due	Details
Assignments	40%	See below	Five assignments (8% each; due approximately biweekly)
Presentation	10%	Dec. 10	Presentation of one's term project
Final report	40%	Dec. 21	A scientific manuscript based on your term project
Participation	10%	N/A	Based on attendance, paper discussions, etc.
Total:	**100%**		

Course Policies:

Assignments

Labs are designed for you to gain familiarity with analyses required for the assignments and your final paper. As such, most assignments will involve analyzing your chosen dataset (or datasets provided by the instructor). Additional questions will be included to make sure that you are learning more than what buttons to press. **BIOL 4523 students will have shorter assignments than BIOL 6523 students will.**

Project (Presentation & Report)

You will need to acquire a dataset with the following minimal specifications: (1) it should comprise 30–50 taxa for which alignable sequence data are available either from your own work (or from GenBank, etc.); (2) it should contain at least two partitions – sequences from two genes or two distinct types of data (e.g., sequence vs. morphology); and (3) there must be a good biological reason for studying these data. If you would like to work on a gene family, please see the instructor about defining partitions and other specifications. If you are having difficulties obtaining/deciding on datasets, please talk to the instructor. Each student will submit an original research manuscript based on these data and give a 12-minute oral presentation describing the project (plus three minutes for questions)

Further details regarding expectations for the report and the presentation will be given in class and posted to D2L. **Expectations for final papers and presentations are different for BIOL 4523 and BIOL 6523 students.**

Participation

Course participation is evaluated based on attendance, preparedness, contribution towards discussions, evidence of comprehension and critical interpretation of paper, and thoughtful feedback (i.e., questions) to end-of-semester presentations. Because there are no exams in this course, attendance to all labs and lectures is crucial for student understanding. Please consult UNB's regulations on class attendance and on safety & decorum:

- Attendance: http://go.unb.ca/tls1viWva
- Decorum: http://go.unb.ca/tlsmWzKLL

Approximately every Friday, lecture will be devoted to the discussion of an empirical paper. Papers for discussions as well as papers for background reading for lecture will be posted 1–2 weeks before class. Students are expected to have read the paper and any other background literature necessary for comprehension before class. Discussions will be led by two students. **BIOL 4523 students can choose the date on which they wish to lead a discussion for a grade; BIOL 6523 discussion leaders will be determined randomly at the start of class.** Leaders are not expected to present the paper, but rather facilitate discussion through questions and/or comments.

Other policies:

- All assignments and the final project must be submitted to D2L by 11:59 PM on the due date. Unless a student has prior approval from the instructor, there is a 20% penalty for each day a submission is late.
- I try to answer all email questions as soon as I see them, time permitting. This means that you will usually receive a reply very 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.
- Cell phones are to be turned off during lectures and labs.
- Assignments (and the final project) are individual work, and collaboration among students should not exceed the kind of help you would expect from an instructor or a TA. For instance, helping another student by troubleshooting an analysis or by explaining phylogenetics concepts is okay, but directly giving/receiving answers or sharing script files (etc.) would obviously be forbidden. Any contributions from others must be clearly attributed, and the nature of any collaboration or assistance should be explained (e.g., in an Acknowledgements section). Any academic offenses will be dealt with strictly according to UNB policy. (See below.)
- Extra credit for additional work will not be granted.

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 UNBF Student Accessibility Centre (SAC) (http://www.unb.ca/fredericton/studentservices/academics/accessibility/) so that you may receive appropriate services and accommodations. Once you are registered with SAC, the instructor will be notified via the UNBF SAC Accommodation Letter of your specific accommodations. If you would like to discuss your particular needs with the instructor, please book a time for a confidential appointment.

Privacy Statement for Online Course Recordings

The recordings of your online classes are for your personal use for course purposes only and not to be shared with others.

- Be respectful of your peers and instructors. Sharing of any personal information, including but not limited to personal views and opinions with others, other than for course purposes, is not permitted and may violate UNB's Policy for the Protection of Personal Information and Privacy.
- Personal opinions, views, and commentary provided in the course of online delivery may be considered personal information, which requires the consent of the person who provided it in order to share it ethically and legally.
- The content shared by faculty and instructors is subject to copyright and cannot be shared without the explicit permission of the copyright owner, which may include but not be limited to the course instructor, their colleagues, textbook publishers, and multimedia vendor.

Course Topics

Topics covered in the course are:

1. Constructing phylogenetic trees (e.g., parsimony, likelihood, Bayesian searches)
2. Using phylogenetic trees (e.g., testing hypotheses)
3. Advanced topics in phylogenetics & systematics (e.g., species delimitation)

Weekly Schedule

Below is the intended schedule. 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	Assignments
Sept. 9	W	Introduction to phylogenetics	
Sept. 11	F	Genome organization & evolution	
Sept. 14	M	Characters and homology: multiple-sequence alignment	
Sept. 16	W	Overview of phylogeny reconstruction	
Sept. 18	F	Maximum parsimony	
Sept. 21	M	Phylogenetic signal, goodness of fit, and clade support	
Sept. 23	W	Substitution models	
Sept. 25	F	Distance methods	
Sept. 28	M	Maximum likelihood	
Sept. 30	W	Bayesian inference I	Ass. 1 due (11:59 PM)
Oct. 2	F	**Paper discussion – TBA**	
Oct. 5	M	Bayesian inference II	
Oct. 7	W	Combining data and testing alternative hypotheses I	
Oct. 9	F	**Paper discussion – TBA**	
Oct. 12	M	*Thanksgiving – no class*	
Oct. 14	W	Testing alternative hypotheses II	Ass. 2 due (11:59 PM)
Oct. 16	F	**Paper discussion – TBA**	
Oct. 19	M	Gene trees in species trees	
Oct. 21	W	Mid-semester review	
Oct. 23	F	**Paper discussion – TBA**	
Oct. 26	M	Ancestral state reconstruction (discrete characters)	
Oct. 28	W	Ancestral state reconstruction (continuous characters)	Ass. 3 due (11:59 PM)
Oct. 30	F	**Paper discussion – TBA**	
Nov. 2	M	Comparative methods	
Nov. 4	W	Molecular adaptation	
Nov. 6	F	**Paper discussion – TBA**	
Nov. 9	M	*Reading week – no class*	
Nov. 11	W	*Reading week – no class*	
Nov. 13	F	*Reading week – no class*	
Nov. 16	M	Coalescent theory	
Nov. 18	W	Molecular dating I	Ass. 4 due (11:59 PM)
Nov. 20	F	**Paper discussion – TBA**	
Nov. 23	M	Molecular dating II	
Nov. 25	W	Species delimitation	
Nov. 27	F	**Paper discussion – TBA**	
Nov. 30	M	Historical biogeography	
Dec. 2	W	Tree shape, key innovations, and SSE methods	Ass. 5 due (11:59 PM)
Dec. 4	F	**Paper discussion – TBA**	
Dec. 7	M	*Final project help session – optional*	
Dec. 9	W	*Final project help session – optional*	

Lab/Tutorial Schedule

The schedule is subject to change – watch for e-mails; announcements in class on days of the tutorial or via Desire2Learn).

Week #	Date	Topic
	Sept. 10	*No lab*
1	Sept. 17	Introduction to GenBank and multiple sequence alignment
2	Sept. 24	Parsimony search strategies: trees, roots and weights
3	Oct. 1	Phylogenetic signal, goodness of fit, and clade support
4	Oct. 8	Substitution models and likelihood searches
5	Oct. 15	Bayesian searches
6	Oct. 22	Combining data and testing alternative hypotheses
7	Oct. 29	Simulating data and conducting parametric bootstrapping
8	Nov. 5	Ancestral state reconstruction
	Nov. 12	*Reading week – no lab*
9	Nov. 19	Molecular adaptation
10	Nov. 26	Molecular dating in BEAST
11	Dec. 3	Project help session
12	Dec. 10	Project presentations

Lab Safety Procedures and Conduct:

Food and drink are not permitted in the lab.

Writing and Study Skills Support:

UNB's Student Services 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

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 (Fredericton Campus) 657-2222 (Saint John Campus), email - itservicedesk@unb.ca, or visited in person at the Harriet Irving Library Learning Commons. http://www.unb.ca/its/get-it-help.html

Academic Advising:

For academic advising information and assistance, see: www.unb.ca/student-toolkit

Academic Offences

Academic offences include, but are not limited to, the following:

Plagiarism

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.

Examples of other academic offences include: cheating on exams, tests, assignments or reports; impersonating somebody at a test or exam; obtaining an exam, test or other course materials through theft, collusion, purchase or other improper manner, submitting course work that is identical or substantially similar to work that has been submitted for another course; and more as set out in the academic regulations found in the Undergraduate Calendar.

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.