

Vertebrate Design: Evolution and Function

BIOL 3326 Fall 2025

Faculty of Science Course Syllabus (Section A)

Department of Biology

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Course Instructor

Name	Email	Office Hours
C. Isabelle Aubé (she/her)	isabelle.aube@dal.ca	Drop-in student support available on Fridays, 12:30-1:30 pm, LSC 2123 (or by appointment)

Course Description

Vertebrate Design explores 600 million years of vertebrate evolution and phylogenetic relationships, with particular attention to origins of major groups and the anatomical and functional innovations associated with their rise and diversification. Functional morphology and physiology of swimming, flying and terrestrial locomotion is also covered.

Course Prerequisites: BIOL 2003.03 (Animal Diversity) and BIOL 2040.03 (Evolution)

Course Exclusions: None

Course Structure

Course Delivery: In-person, synchronous live lectures, with recordings (previous or current year) made available.

Lectures: MWF, 11:35 am - 12:25 pm, LSC C208

Laboratories or Tutorials: None

Instructor EDI, Respect, Accessibility, and Empathy Statement

"I am committed to creating a respectful and inclusive learning environment that is supportive for everyone in this course. This includes an expectation that sharing ideas and learning from each other will be done in a respectful manner. I will also aim to forewarn students about potential triggers of topics, images, and videos that may be traumatizing to some (e.g., common phobias). If you have any questions, concerns, or improvements to suggest, please do not hesitate to reach out." – Isabelle (isabelle.aube@dal.ca)

Course Materials

Textbook

Recommended (purchase eBook or paperback via [Dal Bookstore](#), or available free on reserve via the [Dal Library](#)):

Pough FH, Bemis WE, McGuire B, Janis CM. 2022. Vertebrate Life. 11th Ed. New York (NY): Oxford University Press. 656 p.

Optional (available free on reserve or for loan via the [Dal Library](#)):

Kardong KV. 2019. Vertebrates: Comparative Anatomy, Function, Evolution. 8th Ed. New York (NY): McGraw-Hill Education. 790 p.

Note: Older editions of these textbooks may be used, but the phylogeny trees and other information may be outdated. In the event of conflicting information, use the information provided from the most recent textbook and lectures.

Brightspace:

All course materials, including Lecture PowerPoint slides and "Dr. Pinder's Lecture Notes" (the original creator of the course) will be made available to students via our Brightspace course page.

Brightspace will also be our communication hub for the course regarding announcements, cancellations, deadlines, assignment submission grades, and any other pertinent resources.

In-class Response System:

The course includes in-class quizzes for participation marks only. To participate, you will have the option to use Microsoft Forms via your laptop or mobile phone (free) or record your answers in pen on paper. See the **Course Assessment** and **Course Policies** sections on **Participation Quizzes** for more details.

Course Assessment

Component	Weight (% of final grade)	Date (see schedule)
Participation Quizzes 1-10 (in class, 5 min) <i>In-class review of previous untested material through MS Form or submit a paper copy of your answers. For participation marks only.</i>	<i>0.5% each, best 8/10 for a total of 4%</i>	<i>Most weeks, in class (dates unknown)</i>
Midterm Test 1 (in class, 45 min) <i>Covers Weeks 1-5</i>	20%	<i>Wed Oct 29, in class</i>
Final Exam (in person, location TBD, 120 min) <i>Cumulative, covers Weeks 1-12</i>	40%	<i>Scheduled by the Registrar during exam period</i>
Assignments (online, by 11:59 pm)		
1a: Fossil Species Selection	<i>No marks</i>	<i>Fri Sep 26</i>
1b: Fossil Species Initial Literature Review/Annotation	5%	<i>Fri Oct 3</i>
2: Fossil Species Infographic/Museum Brochure	10%	<i>Fri Oct 31</i>
3: Fossil Species Final Project	15%	<i>Fri Nov 28</i>
4: Fossil Species Peer Evaluation	6%	<i>Fri Dec 5</i>

Conversion of numerical grades to final letter grades follows the [Dalhousie Grade Scale](#):

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Learning Objectives

Before taking this course, you are assumed to already know how to:

1. Identify living vertebrates to taxonomic class (BIOL 2003).
2. Interpret the information available in cladograms (BIOL 2003).
3. Describe the process of adaptation and requirements for evolution by natural selection (variation, heritability, differential reproduction) (BIOL 1000, 2040).
4. Describe basic anatomy and life history characteristics of living vertebrates (BIOL 2003).

At the end of this course, you will be able to:

1. Identify and compare homologous anatomical features between vertebrates.
2. Describe in general terms which vertebrates lived at what time.
3. Relate vertebrate history to geological history.
4. Relate vertebrate history to history of other organisms.
5. Describe important fossils close to major divergences in lineages (also part of your Fossil Species Project).
6. Synthesize a phylogeny showing relationships of arbitrarily chosen lineages of vertebrates.
7. Diagram major anatomical structures (skull, limbs/fins, axial skeleton etc.).
8. Assess new paleontological evidence (fossils) and their implications for interpretations of vertebrate history (also part of Fossil Species Project).
9. Evaluate media accounts of vertebrate history and evolution (scientific literacy, also part of Fossil Species Project).
10. Use cladistic analysis of morphology to evaluate phylogenetic hypotheses.
11. Distinguish between mass extinctions and background extinctions and their implications for adaptation (extinction, evolutionary constraint).
12. Relate morphology to function and selection pressures (form and function, adaptation).
13. Argue for or against interpretations of major events in vertebrate history (e.g., dinosaur endothermy, origin of flight, relationships between legs and fin types etc.).
14. Use principles of allometry to predict differences in structure and function between large and small animals (more in BIOL 3336).
15. Trace the ancestry and evolutionary changes in morphology from modern vertebrates back to early Paleozoic animals.
16. Visually represent scientific information to the general public (Fossil Species Project).
17. Practice peer-review and evaluations.

Course (Tentative) Schedule and Content F2025

¹ All Participation Quizzes are in-class on most weeks and based on the previous untested material. Specific dates will not be divulged to students in advance. Only 8/10 participation marks kept, so you can miss up to 2 quizzes.

² All Assignment are submitted online via Brightspace and are due on Fridays by 11:59 pm.

³ Midterm Test is in-class and non-cumulative. Final Exam is scheduled by the Registrar and cumulative

	Date	Lecture Topic (MWF; 11:35 am – 12:25 pm; LSC C208)	Assessments
Week 1	Wed Sep 24 Fri Sep 26	L01: Admin & Introduction to Vertebrate Design (online recording) L02: Diversity and Phylogeny L03: Chordate Evolution	¹ Participation Quiz 1: TBD (0.5%) ² Assignment 1a: Fossil Species Selection, Fri Sep 26 (no marks)
Week 2	Mon Sep 29 Wed Oct 1 Fri Oct 3	L04: Vertebrate Blueprint L05: Jawless Fishes (Part 1): Extant lineages (Cyclostomata) L06: Jawless Fishes (Part 2): Extinct lineages (Conodonts & “Ostracods”)	¹ Participation Quiz 2: TBD (0.5%) ² Assignment 1b: Fossil Species Initial Literature Review/Annotation, Fri Oct 3 (5%)
Week 3	Mon Oct 6 Wed Oct 8 Fri Oct 10	L07: Gnathostomes and the Origins of Jaws L08: Placoderms and Acanthodians L09: Chondrichthyes (Part 1): Origins & Modern Holocephali	¹ Participation Quiz 3: TBD (0.5%)
Week 4	Mon Oct 13 Wed Oct 15 Fri Oct 17	No Class: Thanksgiving L10: Chondrichthyes (Part 2): Modern Elasmobranchs L11: Osteichthyes (Part 1): Origins of Bony Fishes	¹ Participation Quiz 4: TBD (0.5%)
Week 5	Mon Oct 20 Wed Oct 22 Fri Oct 24	Guest Q&A: Sharks and Rays with Chris Mull (or review day) L12: Osteichthyes (Part 2): Actinopterygii (Ray-Finned Fishes) L13: Osteichthyes (Part 3): Sarcopterygii (Lobe-Finned Fishes)	¹ Participation Quiz 5: TBD (0.5%)
Week 6	Mon Oct 27 Wed Oct 29 Fri Oct 31	L14: Tetrapodomorpha MIDTERM TEST (20%) L15: Transition to Land	³ Midterm Test: Wed Oct 29 (20%); covers Weeks 1-5 material ² Assignment 2: Fossil Species Infographic/ Museum Brochure, Fri Oct 31 (10%)
Week 7	Mon Nov 3 Wed Nov 5 Fri Nov 7	L16: “Amphibians” L17: Amniotes L18: Lepidosaurs: “Lizards” and Snakes	¹ Participation Quiz 6: TBD (0.5%)
Week 8	Nov 10 - 14	Study Break	
Week 9	Mon Nov 17 Wed Nov 19 Fri Nov 21	Guest Q&A: Snakes with Andrea Gigeroff (or review day) L19: Turtles L20: Archosaurs: Origins (Part 1), Dinosaurs (Guest Lecturer: Jen Frail-Gauthier)	¹ Participation Quiz 7: TBD (0.5%)
Week 10	Mon Nov 24 Wed Nov 26 Fri Nov 28	L21: Archosaurs: Origins (Part 2), Crocodylians, and Pterosaurs L22: Theropods and the Origin of Birds (Part 1) L23: Birds (Part 2)	¹ Participation Quiz 8: TBD (0.5%) ² Assignment 3: Fossil Species Final Project, Fri Nov 28 (15%)
Week 11	Mon Dec 1 Wed Dec 3 Fri Dec 5	L24: Birds (Part 3) L25: Synapsids L26: Mammals (Part 1): Origins, Radiation, & Evolutionary Changes	¹ Participation Quiz 9: TBD (0.5%) ² Assignment 4: Fossil Species Peer Evaluation, Fri Dec 5 (6%)
Week 12	Mon Dec 8 Wed Dec 10	L27: Mammals (Part 2): Monotremes, Marsupials, Placentals, & Whales L28: Mammals (Part 3): Primates	¹ Participation Quiz 10 (Final Review!): TBD (0.5%)
	Exams Dec 11 - 21		Final Exam (cumulative): scheduled by Registrar (40%); covers Weeks 1-12 material

Course Policies on Missed or Late Academic Requirements

Students are expected to **read the course syllabus** in full and **keep track of all the deadlines**.

Students with a **Special Accommodations plan must follow their plan's guidelines** to request extensions and/or alternative testing arrangements.

Students who require an alternate deadline and/or testing date due to **cultural and/or religious holidays**, please contact the Instructor (isabelle.aube@dal.ca) beforehand.

Assignments

- If you are unable to complete an assignment by its deadline, you can submit a **Student Declaration of Absence (SDA) form via the Brightspace Assignment Dropbox to allow an automatic extension of no more than 72 hours (3 days)** without the need for a reasonable excuse. Your SDA must be submitted no more than 72 hours past the deadline for that particular assessment. A **maximum number of 2 SDA forms** will be allowed for this course.
- If you require any additional extensions, or an extension that is longer than 72 hours, you must contact your Instructor (isabelle.aube@dal.ca) as soon as reasonably possible.
- Assessments submitted past the deadlines without an SDA or special permission from the Instructor will receive a **10% deduction per day late** (including weekends).

Participation Quizzes

- You **cannot** use an SDA form for missed Quizzes.
- However, since these are for participation marks only, **you can miss up to 2 Quizzes without penalty** (only 8/10 quiz marks are kept).
- Contact your Instructor (isabelle.aube@dal.ca) if you have a reasonable excuse for missing 3 or more Quizzes.

Midterm Tests and Final Exam **(Note: only ONE Midterm will be held in Fall 2025)**

- You **cannot** use an SDA form for missed Midterm Tests or Final Exam.
- Contact your Instructor (isabelle.aube@dal.ca) if you have a reasonable excuse for missing any Midterm Tests or the Final Exam.
- There will be **no makeups** for missed Midterm Tests. If the reason for missing the Test is deemed reasonable by the Instructor, the value of that Test will be added to your cumulative Final Exam.
- A makeup Final Exam **may** be scheduled at the end of the term or at the start of the next term, on a case-by-case basis.

Course Policies related to Academic Integrity

You may collaborate with others in this course while working on your assignments; however, **you must submit your own unique work that is appropriately referenced.**

The use of generative **Artificial Intelligence (AI)** and large language models (e.g., **ChatGPT**) is not a replacement for a student's own voice and creativity. However, students may use these programs to help reduce writing workload (e.g., generate a summary of notes, create practice questions). Please note that these programs are not foolproof, and it is the student's responsibility to **verify ALL the information generated against accuracy, plagiarism, and that the work is appropriately referenced.** If you copy and paste an AI generated sequence without the appropriate editing, **it may be considered cheating.** For any concerns with your use of these programs, you are encouraged to **contact the Instructor (isabelle.aube@dal.ca) in advance** of using them.

If you copy and paste an **AI** generated sequence, image, video, sound (or other media) without the appropriate editing and/or crediting, **it may be considered cheating.**

The use of online assignment help tools (e.g., **Chegg**[®]) is considered cheating and is **prohibited to use for the assignments in this course.**

If an **Academic Integrity offence** is suspected (e.g., plagiarism or cheating) the case will be [forwarded directly to an 3rd party Academic Officer as per Dalhousie University guidelines.](#)

Faculty of Science Course Syllabus (Section B)

University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at:

https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: <https://www.dal.ca/about/leadership-governance/academic-integrity/faculty-resources/ouriginal-plagiarism-detection.html>

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

Faculty of Science Course Syllabus (Section C) Student Resources and Support

University Policies and Programs

Important Dates in the Academic Year (including add/drop dates):

http://www.dal.ca/academics/important_dates.html

Classroom Recording Protocol:

https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html

Dalhousie Grading Practices Policies:

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Grade Appeal Process: https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html

Sexualized Violence Policy: https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.html

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

Learning and Support Resources

General Academic Support – Advising (Halifax): https://www.dal.ca/campus_life/academic-support/advising.html

General Academic Support – Advising (Truro): <https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html>

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): https://www.dal.ca/campus_life/academic-support/On-track.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Indigenous Connection: <https://www.dal.ca/about-dal/indigenous-connection.html>

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803:

<https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf>

Black Student Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre.html

LGBTQ2SIA+ Collaborative: <https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html>

Dalhousie Libraries: <http://libraries.dal.ca/>

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Dalhousie Student Advocacy Services: <https://www.dsu.ca/dsas?rq=student%20advocacy>

Dalhousie Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Human Rights and Equity Services: <https://www.dal.ca/dept/hres.html>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Study Skills/Tutoring: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Faculty of Science Advising Support: <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

Safety

Biosafety: <http://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <http://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Laser Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html>