Marine Invertebrate Zoology
BIOL 3843/3840L

Instructor: Garett Allen (he/him/his)
Office: MacAskill Hall 100
Office hours: Tuesdays, 9 – 10 AM
Fridays, 2 – 3 PM
Others by appointment
E-mail: garett.allen@acadiau.ca

Lecture: Huggins Science Hall, 016
M/W/F, 10:30 - 11:20 AM

Lab: MacAskill Hall 240
Wednesdays, 1:00 - 3:50 PM

ACADIA BIOLOGY

Evaluation	Percentage	Date
Midterm #1	15%	October 5th, 2026
Midterm #2	15%	November 9th, 2026
Species Spotlight (Paired Oral Presentation)	5%	Submission due October 27th, 2026 Presented in Lab on October 28th, 2026
Night in the Museum (Independent Project)	10%	November 25th, 2026
Laboratory Assignments	25%	Records due at the end of each session
Final Exam	30%	TBD by Registrar's Office

Part 1: Course Information

Course Description

A survey of the major invertebrate phyla, their morphology, taxonomy and evolutionary relationships. Local marine species are emphasized and studied from both living and preserved materials within labs (3h lab/week). Field trips are typically required, depending on tides and weather.

Prerequisite(s): BIOL 2073/2070L with minimum grades of C-, or departmental permission.

Course Materials & Requirements

Recommended Textbook:
Invertebrates, 4th edition, by Brusca, Giribet, and Moore, Oxford University Press, 2022.

Much of the course content follows the above textbook and while it is not required, suggested reading material will be posted alongside most lectures. For those interested in invertebrates outside of this course, this text is also a good reference to have on hand!

The library has recently ordered at least one copy of this text to be on hand for the course!
Physical copies are available in the bookstore, though electronic copies are likely available or

rentable online at reduced rates. Note that past editions or other popular invertebrate zoology texts are likely suitable, though taxonomic classifications are often changing – the relations from the recommended text will be accepted as accurate, others may not.

Electronic Requirements:
Access to Moodle and a computer or tablet to take online quizzes, tests and literature hunts. If this requirement poses a challenge, please let the instructor know as soon as possible.

Laboratory Requirements:
Access to a laboratory coat and, if desired, safety glasses. Gloves will be provided.
For field work, you will need appropriate clothing – rubber boots are essential!
If these requirements pose a challenge, please let the instructor know as soon as possible.

Course Structure

Lectures (50 mins) will be delivered in person from 10:30-11:20 AM on Monday, Wednesday, and Friday in Huggins Science Hall 016. Students are expected to attend all lectures, though attendance at non-guest lectures is not recorded and absences not directly penalized. Attendance at guest lectures is recorded – students that attend ***all*** guest lectures will have an opportunity to gain bonus points toward their final exam (See Assessments and Grading).

Labs (3h) will take place in person from 1:00-3:50 PM on Wednesdays in MacAskill Hall 240. Lab attendance is mandatory, and attendance will be taken. If you are unable to attend the laboratory for reasons that are unprecedented and unavoidable, please contact your instructor as soon as possible. If the instructor deems the explanation for your absence to be acceptable, alternate assessments or make-up sessions will be arranged based on feasibility. If the instructor does not deem your absence acceptable, grades associated with the missed laboratory session will receive an evaluation of zero (0%).

Please note that per our policy in Biology, you must receive a passing grade in the laboratory section to receive a passing grade in the entire course.

Student Learning Outcomes

1. Recognize functional values of morphological/adaptive traits across marine invertebrates
2. Recognize the types of ecosystem services provided by marine invertebrates
3. Acquire practical skills identifying, dissecting and sampling marine invertebrates

How to Meet the Learning Outcomes

1. **Attend lectures, take notes, and participate in class discussions.**
2. **Keep up with and review materials** posted on Moodle well in advance of evaluations.
3. **Take your time in the laboratory exercises** – they typically have a deep connection with

lecture content as you will have a chance to observe and explore the specimens. **The museum is also a great resource to explore invertebrates** if you have the time, especially for your species spotlight projects! Access can be arranged on request with Jenn Kershaw (jennifer.kershaw@acadiau.ca) – your instructor is also happy to contact Jenn Kershaw on your behalf if you prefer.

4. **Ask questions!** Some of the best learning opportunities come from impromptu discussions, especially in broad fields like marine invertebrate zoology where even fundamental questions are often still being resolved by the academic community!

Part 2: Course Plan

The instructor reserves the right to amend the course plan with reasonable notice, and in consultation with the class.

Lecture Topics:

Please note that the timing of these lectures is tentative and may change based on pace of instruction, the occurrence of relevant and timely world events, and in-class discussions. Suggested readings from the recommended textbook when relevant and PowerPoint slide sets will be available on the class Moodle site before corresponding lectures begin.

Date	Topic
Sept. 9-11	Introduction; Review of Systematics and Animal Architecture
Sept. 14-18	Porifera – Sponges x2; Ctenophora and The Great Debate
Sept. 21-25	Cnidaria – Anthozoans; Hydrozoans; Scyphozoans and Cubozoans
Sept. 28-Oct. 2	Traits of the Bilateria and Lophophorates Part 1; **National Day for Truth and Reconciliation – No Class**; Lophophorates Part 2
Oct. 5-9	**Oct 5 - Midterm #1: Non-Bilaterians and Lophophorate Zoology**; Annelida – the Errant and Wandering; The Sedentary and Tube Dwelling
Oct. 12-16	**Thanksgiving and Fall Reading Week – No Classes**
Oct. 19-23	Annelida – The Specialized Allies; Mollusca – The Aculifera and Monoplacophora; Bivalvia and Scaphopoda
Oct. 26-30	**Guest lecture w/ Dr. Jeffrey Clements (DFO) – Applying Bivalve Ecology to Fisheries Management in Atlantic Canada**; Mollusca – Shelled Gastropods; Shell-less Gastropods
Nov. 2-6	Mollusca – Cephalopoda; Nemertea – Ribbon Worms; Platyhelminthes – Flat Worms
Nov. 9-13	

	Nov. 9 – Midterm #2: Annelid through Flatworms Zoology, **Remembrance Day – No Class**, Introduction to the Ecdysozoa and Chelicerata
Nov. 16-20	Crustacea – Diversity, Ecology and Economic Importance; Body Plans, Appendages and Physiology; Continued Physiology and Ecdysis
Nov. 23-27	Crustacea – Reproduction and Development; **Guest lecture w/ Dr. Trevor Avery – Lobster Migrations in Changing Climate**; Introduction to the Deuterostomes and Hemichordates
Nov. 30-Dec. 4	Echinodermata – Anatomy and Physiology; **Guest lecture w/ Dr. Keegan Lutek – Diversity, Development and (Biomechanical) Ecology of Echinoderms**, Invertebrate Chordates from Cephalochordates to Tunicates
Dec. 7-9	Honourable Mentions of the Minor and Less Charismatic; **Review - Q&A**

Lab Topics:

Please note that the timing and topic of the laboratory exercises below are tentative and may change based on the availability of animals which must often be sourced as close to the scheduled laboratory section as possible. In the case of any scheduled field labs, weather predictions near the proposed date must also be considered for safety purposes.

If you have shellfish allergies, or any other allergies/intolerances that place you at risk for handling specimens during laboratory exercises, please inform the instructor as soon as possible!

Date	Topic
Sept. 9	**First Week of Classes – No Labs**
Sept. 16	Lab 1: Comparative Porifera and Cnidaria (Slides and Preserved Materials)
Sept. 23	Lab 2a: Invertebrate Collections at Kingsport Beach (Field Day, **Bring Boots**)
Sept. 30	**National Day for Truth and Reconciliation – No Labs**
Oct. 7	Lab 2b: Identification of Kingsport Beach Invertebrates
Oct. 14	**Fall Study Break – No Labs**
Oct. 21	Lab 3: Comparative Mollusca (Slides, Preserved and Live Materials)
Oct. 28	**Student Presentation Day – Species Spotlight Presented in Lab!**
Nov. 4	Lab 4: 'Pesty' Invertebrates of Aquaculture (Preserved and Live Materials)
Nov. 11	**Remembrance Day – No Labs**
Nov. 18	Lab 5: Comparative Crustacea (Preserved and Live Materials)
Nov. 25	Lab 6: Zooplankton – The Small and Mighty (Slides and Preserved Materials)

Dec. 2	Lab 7: Comparative Echinodermata (Preserved and Live Materials)
Dec. 9	**Last Week of Classes – No Labs**

Note:

- Lab coats and gloves are required when handling preserved specimens and during dissections. Protective eyewear is recommended but not required unless otherwise stated by the instructor.
- Basic dissection tools will be provided, although you may bring your own.
- This course does make use of live, terminally anaesthetized/euthanized, and preserved invertebrate animals. **If you have allergies – especially to shellfish – or concerns relating to dissections and animal welfare**, please let me know before a laboratory exercise begins to allow for accommodation options to be explored.
- Field trips are a great way to see local marine invertebrates and their habitats. Weather, tides, and your ability to safely navigate tidal pools, slippery ground/rocks, and mud are important considerations for safety. Please be careful and dress appropriately if/when field trips occur. **If you are not confident in your ability to participate in field trips, please contact your instructor as soon as possible.**

Part 3: Assessment and Grading

Lecture Components (75% of the final grade):

Lecture Attendance – Students are expected to attend all lectures, though attendance at non-guest lectures is not recorded and absences not directly penalized. **Attendance at guest lectures is recorded – students that attend *all* guest lectures will have an opportunity to gain bonus points (+2%) toward their final exam by submitting a short review of each guest lecture (*i.e.*, 3-4 sentences about what they liked or did not like – there is no 'wrong' answers, so long as the feedback is meaningful).**

Midterms (2 x 15% = 30%) – There will be two non-cumulative midterm examinations completed throughout the course, each accounting for 15% of the final grade. These midterm examinations will take place online *via* Moodle, featuring a combination of multiple choice, short answer, and long answer question formats. Students have 50 minutes to complete the examination, prior to considering approved accommodations.

Midterm #1 will include the content of lectures 1 (Introduction) through 10 (Lophophorates II), unless otherwise stated by the instructor. The midterm will take place on **Monday, October 5.**

Midterm #2 will include content of lectures 11 (Annelids) through 21(Platyhelminthes), unless otherwise stated by the instructor. The midterm will take place on **Monday, November 9.**

Midterm examination dates are generally non-negotiable and failing to attend and complete the examination during the allocated time will result in an evaluation of 0%. In the case of

unprecedented circumstances, which may require appropriate supporting documentation, the instructor may accommodate alternate writing dates.

Final Exam (30%) – The final examination is cumulative, being weighted toward content that was delivered after the second midterm (*i.e.*, lecture 22 onward will represent approximately half of the final exam content). The format will be similar to that of the midterms, though considerably longer and expected to be completed within a 3-hour period. The final examination will occur at a date within the formal examination period and location specified by the Registrar approximately half-way through the term.

Failing to attend and complete the final examination during the allocated time will result in their score being assigned as 0%. If unprecedented circumstances occur, the instructor will defer to the Registrar, requiring a Declaration of Cause form to be submitted and approved. If approved, the procedures for "Setting and Conducting a Special Exam" (detailed under "Examinations" in the Academic Calendar) will be followed and an alternate version of the final examination provided.

Species Spotlight Oral Presentation (5%) – Students will work in pairs to develop and collaboratively deliver a 10–12-minute PowerPoint presentation that 'spotlights' an assigned marine invertebrate species found natively or non-natively throughout Nova Scotia. Group members are expected to contribute equally to the project, including approximate speaking time during the presentation. The presentation must at least address the classification, identifiable key external traits, known distribution and habitat, feeding ecology, lifecycle and reproductive strategies, and its general role within the environment as well as any potential means of ecological services and/or damage of the assigned species. PowerPoints must be uploaded to Moodle before **Tuesday, October 27.** Presentations will take place the following day between 1:00 and 3:50 PM during our laboratory session scheduled for **Wednesday, October 28.**

Exceeding deadlines without explicit permission by the instructor will reduce the score of the presentation by 5% per day – presentations will be expected to occur at the start of the following lecture session as soon as possible. After 5 days, the presentation will not be accepted and scored as 0%.

Night in the Museum Independent Writing Project (10%) – During the first 1-2 weeks of class, each student will arrange with the instructor during office hours to visit the Biology Department's Wildlife Museum and select a marine invertebrate specimen. Students may not select the same specimen/species – they will be allocated on first-come-first-serve basis by contacting the instructor.

Students will then have until November 25 at 11:59 PM to prepare a brief report that describes the specimen. The report will be affixed to the specimen or catalog as a QR code for public viewing after the course, pending permission from the student.

The report must have a title page that includes a photograph, the scientific name of the specimen, your name and the date of submission. It should have sections that describe the specimen based on its…

- **Classification**
  - World Registry of Marine Species is a helpful resource!
  - Phylogenetic trees that *you* make are welcome, though text is sufficient

- **Distribution and Habitat Preferences**
  - Maps that *you* make are welcome, though text is sufficient

- **External Morphology and Identifiable Traits**

- **Feeding Ecology**
  - How and what does it eat?
  - How does it digest/process its meal?

- **Lifecycle and Reproductive Strategies**
  - Describe the lifecycle of your specimen from larvae to adult
  - Describe the reproductive strategies of your specimen (some have multiple)

- **Locomotion**
  - How does it move around or, if relevant, prevent itself from moving around?

- **Cardiorespiratory strategies**
  - Does it have an open or closed system? How does circulation occur?
  - How does it breathe? Does it have respiratory pigments – if so, which ones?

- **Excretory strategies**
  - How does the animal get rid of metabolic wastes? *Not* solid wastes/egestion!
    - Does it rely on diffusion? If so, across what surfaces?
    - Does it rely on nephridial structures/glands? If so, which kinds? How many are present in the animal? Where are they located?

- **Prominent sensory and neural structures**
  - What sensory structures characterize your animal's ability to navigate and succeed within its environment? Where are they located / how many are there?
  - What type of nervous system does it have, if relevant? Describe it!

- **References**
  - References can be provided in any consistent format though they must be primary peer-reviewed literature or textbooks. The library is an excellent source for invertebrate texts, though do be mindful of potentially outdated classification systems… some are ***old***.

The report must be prepared as a word document – while it does not have a minimum or maximum length, reports are likely to be ~2000-2500 words if content is adequately described. Diagrams may reduce that word count, though must be incorporated into the text clearly and meaningfully. The report should be formatted as follows:

- Size 12 Times New Roman or Aptos font, double or 1.5-times spacing
- Captions are placed directly above corresponding tables, if used
- Legends are placed directly below corresponding figures and diagrams, if used

As with the presentation, exceeding deadlines without explicit permission by the instructor will reduce the score of the assignment by 5% per day. After 5 days, the assignment will not be accepted and scored as 0%.

Laboratory Components (25% of the final grade)

The laboratory exercises throughout the semester are often focused on exploring the body plans of different marine invertebrates to appreciate and understand their functional morphology – what components does each have, how are they arranged, and what is their (perceived) purpose? On rare occasions in the field or when working with assorted collections, we also explore where marine invertebrates are found and discuss how or why they position themselves in such ways.
Throughout most laboratory sessions, you will be asked to draw and label the structures that you observe – you do not need to be an artist, though you do need to be clear in your work. On most occasions, you will also be asked to describe the function of the structures you label and at times how the structure and/or its position have shifted across related taxa.

These records will be completed during the allocated laboratory sessions using provided journals unless explicit permission is given otherwise by the instructor. Note, the field lab to Kingsport Beach does not carry direct weight, it is treated as a joint lab with its follow-up identification lab.

The records for each lab session are equally weighted and collectively account for 25% of the final grade. As there are 7 laboratory sessions, each represents 3.57% of the final grade.

Lab attendance is mandatory, and attendance will be taken. If you are unable to attend the laboratory for reasons that are unprecedented and unavoidable, please contact your instructor as soon as possible. If the instructor deems the explanation for your absence to be acceptable, alternate assessments or make-up sessions will be arranged based on feasibility. If the instructor does not deem your absence acceptable, grades associated with the missed laboratory session will receive an evaluation of zero (0%).

Remember that for all biology courses where there is a lab, you are required to pass the lab to pass the course.

All evaluations will be follow the numerical:letter and GPA conversion systems approved by the University senate where…

Letter Grade	Numeric Value (%)	GPA
A+	90-100	4.33
A	85-89	4.00
A-	80-84	3.67
B+	77-79	3.33
B	73-76	3.00
B-	70-72	2.67
C+	67-69	2.33
C	63-66	2.00
C-	60-62	1.67
D+	57-59	1.33
D	53-56	1.00
D-	50-52	0.67
F	<50	0.00

Part 4: Course Policies

The intent of this course is for all students to succeed – if you are having difficulties, please contact your instructor. While deadlines and expectations are firm as explained above, many circumstances can unexpectedly occur throughout the semester. When possible, we will work together toward a system that can support your success in an equitable fashion.

Course material will be made available on Moodle before class.

- Slides contain most of the information you will need to succeed in tests, though all material including verbally delivered content is testable. It is your responsibility to be present and to take meaningful notes.
- Guest lecture content is testable!

Please be respectful to those learning around you.

- Learning is a complicated and often individualized process. What may not seem distracting or disruptive to you could be highly distracting and disruptive to peers.
- If you feel specific learning methods that are important for you are not present throughout the course, please inform me. While I cannot guarantee that I can correct this, I will do my best to feasibly improve content accessibility where possible.

Use of Artificial Intelligence (Language Learning Models) is only permitted when:

- The professor has given you explicit permission, **and**

- The use of artificial intelligence is made clear through explicit indication

The use of artificial intelligence tools may not be used in ways that violate Acadia University's Integrity Policy and must only be used as a positive learning tool. Plagiarism and other forms of cheating are considered an act of academic dishonesty. Anecdotally, most language learning models are currently rather poor at describing, identifying and documenting marine invertebrates unless they are among the most popularly known species – they are seemingly unlikely to yield positive returns, even if they are not detected.

Part 5: University Policies

University policies are available in the Acadia University Academic Calendar or through the Registrar's website: https://registrar.acadiau.ca/welcometotheregistrarsoffice.html

Equity, Diversity and Inclusion

Acadia University is committed to becoming a culturally safe and anti-oppressive community. This can only be achieved where there are simultaneous efforts to eliminate all forms of discrimination and harassment from our campus community, including the elimination of all discrimination, harassment and violence based on one's identity, including but not limited to, gender, race, class, ethnicity, sexual orientation, disability, gender identity, gender expression, and Indigeneity. The policy against harassment and discrimination, and resources for students who believe they may have experienced, or witnessed, discrimination or harassment, are available here: https://www2.acadiau.ca/student-life/equity-judicial/equity.html

Last Drop Day

Last day to drop a course and receive a "W". Please check the Acadia University calendar dates, which are available here: https://registrar.acadiau.ca/AcademicCalendars.html

Inform Your Instructor of Accommodations

Acadia University is dedicated to improving access to campus life for all students with disabilities. While we attempt to ensure that all courses are accessible, we recognize that there are barriers that need to be addressed on an individual basis. Students who require accommodations to complete coursework or otherwise fully participate in class should contact Accessible Learning Services directly as soon as possible. https://www2.acadiau.ca/student-life/accessiblelearning.html

The Use of Animals in Teaching and Research

The use of animals in teaching and research at Acadia University is done in accordance with guidelines on the care and use of animals published by the Canadian Council on Animal Care (CCAC). For more information on the CCAC, please visit their website at http://www.ccac.ca

Commitment to Integrity

It is standard practice in Biology to check exams and assignments for cheating and plagiarism. Cheating in the class and/or lab, including plagiarism, will not be tolerated. Please read the appropriate sections of the current Acadia University Academic Calendar: https://registrar.acadiau.ca/AcademicCalendars.html

Information on copy-write and course content from Acadia University is available through the Vaughan Memorial Library: http://libguides.acadiau.ca/c.php?g=433650&p=5027078

The spoken and written course content (including the syllabus, handouts, lectures, presentations, labs, assignments, quizzes, tests, and exams) are the intellectual property of the instructor and may only be copied for personal use. Sharing these materials or uploading them where they may be accessed by others is a violation of copyright. If you wish to make audio, video, or photographic recordings in class, you must first obtain the consent of the instructor and of any other persons (e.g., guest speakers, other students) who may be captured in such recordings. The instructor's consent shall not be unreasonably withheld.

Use of artificial intelligence tools by students to assist with their learning is allowed only if: prior permission has been given by the course professor/instructor, and the student properly credits/cites how the AI technology was used in their work. AI must be used in an ethical and responsible manner as a positive learning tool. AI may not be used in ways that violate Acadia's Academic Integrity Policy. Students are reminded that plagiarism, or other forms of cheating, are both types of academic dishonesty.

Share the Air Policy

In consideration of the difficulties that exposure to scented products causes individuals with sensitivities and allergies, all students, faculty, staff, employees of any companies working on university property, visitors, and guests of Acadia University, or of members of the University community are asked to refrain from wearing scented personal care products such as perfumes / aftershave, lotions, hair spray and deodorant. In addition, users of tobacco and cannabis are asked to be aware that odours associated with product use may impact individuals with sensitivities and allergies. Acadia University in consultation with its contracted cleaning staff, have agreed to use products that do not leave residual odors that may cause difficulties for individuals with sensitivities and allergies. https://hr.acadiau.ca/employment/university-policies.html

Part 6: Program Learning Outcomes

Foundations of knowledge	**Explanation**	**Course specific examples**	**Proficiency** 1-Introduction 2-Reinforcement 3-Proficient
Scientific method, inquiry	Find, understand and apply information from the literature; understand how to use the	Literature searching for presentations and projects, inquiry	2

and hypothesis testing	scientific method to examine problems from different perspectives	through comparative anatomy/dissections	
Historical concepts and contributions by important figures	Explain foundational concepts in biology, Two-eyed Seeing, and ethical implications of scientific discoveries	Past and present views on invertebrate relationships; ethics of using invertebrates in research/teaching; foundational concepts of anatomy and physiology	2
Biodiversity and ecology	Understand the genetic, taxonomic and ecosystem levels of biodiversity; focus on SW Nova including the Acadian Forest and Bay of Fundy ecosystems	Detailed coverage of traits and ecosystem roles across marine invertebrate phyla, focusing on local diversity in lab and some lecture content	3
Genetics and evolution	Understand the chemical basis of heredity, genetics and genomics; integrate concepts across disciplines to understand evolution	Convergent evolution and synapomorphies, evolution of structure:function relationships	2
Human and environmental health	Understand form and function in health and disease within a One Health framework, integrating human and environmental health	Ecosystem services and their contributions toward human and environmental health	2
Lab and field skills	**Explanation**	**Course specific examples**	**Proficiency** 1-Introduction 2-Reinforcement 3-Proficient
Experimental design	Gain experience in applying the scientific method	Building toward understanding how to hypothesize about how traits of an animal relate to its environment and vice-versa	2
Safety	Work safely and productively in lab and field settings	General dissection and laboratory safety while handling animals	1

Lab skills	Gain experience with basic and advanced lab techniques and understand their application in research, health science and industry	Microscopy skills; dissection skills; fluid sampling; sample preservation	2
Field skills	Gain experience in basic and advanced field skills and understand their application in ecology, conservation biology and environmental change	Collection and identification of invertebrates	1
Data acquisition, analysis and interpretations	Collect data, present results both qualitatively and quantitatively, and interpret outcomes in light of the literature	Qualitative descriptions and recording of anatomical features; interpretations of body plans; visualizing hemolymph and fluid sample traits	2
Statistical analysis	Use R and or other programs to analyze biological data	Use of excel to plot hemolymph/fluid traits, when taken	1
Professional skills	**Explanation**	**Course specific examples**	**Proficiency** 1-Introduction 2-Reinforcement 3-Proficient
Ethical practices	Demonstrate ethical conduct, apply principles of academic integrity, and understand the principles of EDI in science	Ethical use of invertebrates and familiarity with their anaesthesia; appropriate use of reference material; representation of diversity in research	2
Collaboration and group work	Work effectively in groups within and across disciplines	Lab exercises generally completed in pairs; presentation collaboratively as pairs	2
Critical thinking	Analyze and evaluate information to make science-based decisions	Independent project and laboratory exercises focus on critical thought of	2

		form-function and environment	
Computer proficiency	Use common and discipline-specific software	Limited use of excel and digital media	1
Scientific communication	Communicate science effectively to both scientific and general audiences	Oral and written communication applied through projects and presentations	2