

**Biology 212 – Scientific Methods in Biology
Fall Term (2022) and Winter Term (2023)**

A hands-on laboratory course that establishes the fundamentals of scientific investigation and applies them to selected biological questions. Students will learn to develop hypotheses, design and execute experiments, and analyze and present results. There are four main modules structured as: Cell, Organism, Population and Ecosystem.

Learning Hours: 130 (9L; 46Lb; 66O; 9P)

Prerequisite: A GPA of 1.90 in (BIOL 102/3.0 and BIOL 103/3.0)

Lab Instructors	Dr. B. Vanderbeld (co-ordinator) Dr. A. Rooke Dr. H. Teresinski Dr. B. Choudhury
Lecturers	Dr. W. Bendena Dr. C. Moyes Dr. C. Eckert Dr. P. Grogan
Office Hours	posted in onQ
All personal inquiries should be directed to biol212@queensu.ca . General course inquiries should be posted on the course forum in onQ.	

Course Format

The course design is based on active learning, which means it emphasizes learning through reading, writing, and active engagement in solving problems. Each module begins with an online component and quizzes to introduce and reinforce background material, followed by several in-lab sessions where students play an active role in designing and running experiments. Students communicate their work through lab reports and conventional scientific papers. In addition to the four main lab modules (cell, organism, population and ecosystem), there are several smaller skills modules (lab, dissection and field skills) thread through the course.

Learning Outcomes

After completing this course, students should have the knowledge and skills to do the following:

1. Apply the scientific method to biological problems by developing hypotheses with testable predictions, determining appropriate treatments/controls, designing unbiased sampling protocols, testing predictions in a statistical context, evaluating hypotheses based on results, and identifying the scope of inference.
2. Write all phases of a scientific article including an introduction that integrates primary literature with the experimental question, methods, results and discussion.
3. Show proficiency in practical research skills, such as maintaining a research notebook, pipetting, working with volumes, general numeracy skills, accurate use of a balance, aseptic technique and cell culture.
4. Identify how biological systems respond to their environment at the hierarchical levels of cells, organisms, populations & ecosystems.
5. Identify and distinguish the mechanisms that allow biological systems to respond over short versus long time periods (cellular, physiological, demographic, evolution, community composition).

Suggested Time Commitment

The table below provides an estimate of hours of study. This is for general reference purposes and is not intended as a precise time allocation, because the nature of course instruction will vary from year to year. A 3.0-unit course normally requires a total of 110 to 130 learning hours (or hours on task) and BIOL212 will fall within that window on any given calendar year. It is prudent to keep in mind that time commitment will vary among students depending upon individual aptitude, level of background, etc.

Teaching method	Avg. hours/week	Number of weeks	Total hours
Online preparation	3	12	36
Scheduled lectures	1	9	9
Scheduled labs	4	11.5	46
Field skills	6	1	6
Writing assignments	2	12	24
Private study	1	9	9
Total			130

Course Materials

Textbook

The only required text for this course is “The Scientist’s Guide to Writing” (second edition) by Stephen B. Heard (2022), which is available in the Campus Bookstore.

You will also benefit from keeping your first-year biology textbook.

Lab notebook

You'll need to have a notebook dedicated solely to the course. You can purchase a hard-cover bound notebook if you'd like, but we recommend just going with an inexpensive soft-cover spiral notebook.

Lab safety

You do not need to purchase any personal protective equipment as gloves, etc. will be provided as required, however, you will need to wear close-toed shoes and have long hair tied back when working the lab.

Field trip

Although not a "course material", please be aware that there is a mandatory field trip component in this course, which typically costs around \$35. No specialized equipment is required, however be sure to be familiar with OCASP and dress appropriately and seasonally for outdoor work (e.g. you should wear boots for the winter term trip).

Grading Scheme

Component	Weight (%)
Pre-Module and Pre-Lab Quizzes	24
Lab Activities/Assignments	28
Writing Activities/Assignments	36
Practical Skills Activities	12

Description of Assessments and Activities

Pre-Module Material

The pre-module components provide the biological background for each module. They connect each module to the material covered in first year biology, build the background needed to understand the research question motivating each module, and explain the experimental approach and evidence needed to test hypotheses.

There are two parts to the pre-module components. The first is a series of online lessons, readings and checkpoints that you work through prior to the start of each of the four modules. The second is a pair of lectures that review the pre-module material, allow for discussion of challenging concepts, and connect the biological concepts with the laboratory activities. You will be quizzed during these lectures to assess your understanding of the pre-module material.

Laboratory Activities

You will spend around 4 hours each week in the laboratory setting up experiments, collecting and analyzing data, and writing reports. Prior to each laboratory period, make sure to read the pre-lab material that orients you to the lab activities, and complete the pre-lab quiz.

Practical Skills

You will learn and practice the foundational skills required to conduct biological experiments. These include laboratory skills, dissection skills, and field skills.

Writing Activities

Writing activities will run concurrently with the modules and are connected to the research questions, methods or results of the experiments you are running. Each module will focus on different aspect of writing and on a different part of a scientific paper (i.e., introduction, methods, results, discussion).

Grading Method

All components of this course will receive, or be converted to, numerical percentage marks. The final course grade will be derived by converting your numerical course average to a letter grade according to Queen's Official Grade Conversion Scale.

Queen's Official Grade Conversion Scale

Grade	Numerical Course Average (Range)	Grade	Numerical Course Average (Range)	Grade	Numerical Course Average (Range)
A+	90-100	B-	70-72	D+	57-59
A	85-89	C+	67-69	D	53-56
A-	80-84	C	63-66	D-	50-52
B+	77-79	C-	60-62	F	49 and below
B	73-76				

Academic Integrity and Queen's Code of Conduct

Queen's students, faculty, administrators and staff all have responsibilities for upholding the [fundamental values of academic integrity](#); honesty, trust, fairness, respect, responsibility and courage. These values are central to the building, nurturing, and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University (see the [Senate Report on Principles and Priorities](#)).

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments and their behaviour conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see [Academic Regulation 1](#)), on the [Arts and Science website](#), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery, use of forged materials, contract cheating, unauthorized use of intellectual property, unauthorized collaboration, failure to abide by academic rules, departure from the core values of academic integrity, and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions appropriate to the severity of the departure that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

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