

Computational biology (BIOSC 1540) Syllabus

University of Pittsburgh | Fall 2026
biosc1540.scient.ing

Modern life scientists rely on tools to probe genomes, model proteins, and screen drug candidates. While many researchers can follow a tutorial to run these programs, a computational biologist knows why they work and, more importantly, when to trust them. We will not focus on running tools, but rather on understanding their foundations.



As an introductory course, our focus is on breadth rather than depth. We will explore the field's wide-ranging landscape to give you an overview of how computation intersects with biology. For those who wish to dive deeper into specific domains, this course serves as the essential precursor to advanced offerings like Computational Genomics (BIOSC 1542) or Simulation and Modeling (BIOSC 1544). Because this course has no programming prerequisite, we will not delve into software implementation; those looking for that level of technical depth will find it in Computational Biology Research (BIOSC 1640).

Prerequisites

Students must have received a C or above in the following classes to enroll in this course.

- Foundations of Biology 1 (BIOSC 0150 | 0155 | 0715)
- Foundations of Biology 2 (BIOSC 0160 | 0165 | 0716)

While the courses above are required to enroll, there is always additional assumed knowledge when starting a course.

Biology

At the molecular level, you should have a working knowledge of gene structure and the Central Dogma, specifically how information flows from DNA sequences to functional proteins. Regarding protein chemistry, you should be familiar with the general properties of amino acids and the basics of protein structure; we do not require the rote memorization of every side chain, but you should understand the physical principles that allow these linear chains to fold into complex 3D shapes. Beyond individual molecules, you should be fluent in the principles of genetics and inheritance. This includes the distinction between haploid and diploid states and a clear grasp of how mutations manifest within a sequence.

Chemistry

We expect an understanding of molecular architecture, including the nature of single, double, and triple bonds. Because computational models frequently simulate molecular recognition and protein folding, you should be familiar with the noncovalent interactions that dictate these processes.

Mathematics

You should be comfortable with basic algebraic manipulation and conceptualizing slopes as a rate of change to understand the logic of a derivative. Proficiency with exponents and logarithms is critical, as we frequently move between these forms to handle probabilities and log-likelihood scores. We also expect you to have a strong intuition for what a probability represents and to be familiar with mathematical shorthand, such as sum and product notation. Finally, you must be able to organize data into tables and navigate them accurately using row and column indexing; while we use these structures constantly to represent biological data, linear algebra is not required for this course.

Meetings

We meet for lectures in person every Tuesday and Thursday from 4:00 am to 5:15 pm in G8 Cathedral of Learning. I expect you to attend every lecture, but attendance itself does not directly affect your grade.

Course logistics

All course announcements will be posted on Canvas. Please check Canvas regularly. If you do not check it often, make sure to turn on notifications. If you miss an announcement, you are still responsible for knowing its content.

The [course website](#) is your main source for accurate information about this class. You can find the schedule, readings, and assignment details on the course website. If you ever notice a difference between Canvas and the website, please contact me as soon as possible.

You will submit your homework on Canvas. All other work will be done on paper and managed in person by the teaching team.

Textbooks

There are no required textbooks for this course.

Assessments

Your grade has two parts. Your *mastery grade* is based on the work I check for correctness under proctored conditions (i.e., exams). Completing the formative work, your homework, then adds a *bonus* on top of your mastery grade, up to 12 points for homework. The most you can add to your grade this way is about 8.5%.

Component	Contribution to your grade	Basis	Conditions
Exams	144 points	Correctness	Proctored
Homework	Up to 12 bonus points	Good-faith effort	Unproctored

The exam measures your skills, so it sets your minimum grade. Formative work adds a capped bonus on top and cannot outweigh what the exams measure.¹ Homework assignments are

¹The formative bonus is capped and gated on purpose. Most students do well on completion-graded work, so letting it add without limit would raise everyone's grades and blur the differences the exams are meant to show.

considered *formative*. These assignments are meant to give you a chance to practice and get quick feedback while you're still learning, not to officially measure your knowledge.² That's why I grade them on effort, not just on getting the right answers. This way, you can make mistakes on homework without losing points. It's a safe way to find out what you still need to work on. It also means there's not much reason to copy answers or use outside help. You earn the bonus by doing the work on your own. If you rely on outside help, you might not be ready for the exam.

You will receive the bonus only if your mastery rating is 60% or higher. This means you first need to show you can pass based on your own understanding. Then, your effort on practice work is rewarded on top of that. The bonus won't cause a failing mastery grade to be raised to a passing one, but for those who have cleared that threshold it does provide genuine flexibility and a lift of up to most of a letter grade.

Exams

Your mastery grade consists mainly of exam marks. The exams will be taken on site and will be supervised. It describes the way each exam functions and the weight given to each section.

The exams are closed-book and closed-note. Don't forget to take a pencil, an eraser and your student ID. There is no need for you to remember constants or equations. The values or formulae that you may need will either be provided in the question or on the reference sheet which I will give out together with the exam. All phones, smartwatches, calculators and any other devices with internet access have to remain in your bag and must be switched off for the entire duration of the exam. If you're unsure about whether something is permitted, you should ask me before the exam rather than trying to work it out while the test is going on.

In all there are five exams: four module exams throughout the term and one final exam that is cumulative. The leveled structure used in the module exams is also employed in the final exam, but on a larger scale to match its longer duration. More questions are included at each level according to the same proportions, thereby ensuring that what a score means remains unchanged.

Missed Exams

I'll drop your lowest exam score, even if that is the final, so only your best four out of five exams will count. Each exam grade is first converted to a percentage, then put on a common 36-point scale. This way, whichever four exams count, they are all weighted the same. Dropping the lowest score is intended as a safety measure. The policy applies in the one exam situation where you

Reserving the grade for demonstrated mastery, and treating low-stakes work as practice rather than credit, is the shared logic of specifications grading ([Nilson & Packowski, 2025](#)) and standards-based grading ([Link & Guskey, 2022](#)); mastery-based grading of this kind is well supported (see the note on the cumulative final). By limiting the bonus to about 8.5% and only giving it if your mastery grade is at least 60%, practice can boost a hardworking student's grade by almost a full letter, but exams still matter most. The bonus is set so that if you master just the basics and finish all the formative work, you'll earn a C, but not more. The particular rule, a capped and gated bonus on a mastery grade, is my own design built from these established principles rather than a scheme tested on its own.

²The distinction between *formative* assessment (feedback gathered during learning, meant to improve it) and *summative* assessment (a judgment of learning made at the end) is standard in educational measurement. See [Black, P., & Wiliam, D. \(1998\). Assessment and classroom learning. *Assessment in Education*, 5\(1\), 7–74.](#) Specifications grading likewise reserves the grade for demonstrated mastery and uses ungraded or lightly graded work for practice.

have a tough week, fall ill, or encounter a difficult topic and this affects your score. There's no need for you to explain or request this drop. That is also the reason why there are no individual makeup exams.

You get a second chance as a result of the cumulative final.³ It applies throughout the entire term, allowing you to demonstrate what you have learned even on subjects which were difficult for you earlier in the semester. The final exam includes 48 questions, whereas a standard module exam has 36. Since your score is converted to a percentage before scaling, the extra questions don't affect the final value. You are given more opportunities to demonstrate what you know, which means that each question you get wrong has less impact. With the lowest score dropped and the final, no single tough day will decide your grade. Rather than having to do individual retakes, your grade will be based on your best and most consistent work throughout the term.

Homework

The homework will be uploaded on Canvas and you should also submit it on Canvas. If you finish all your homework you can earn as many as six bonus points. Homework is set in such a way that it resembles the exam, featuring the same kinds of questions and question levels. Doing it is the best way to practice for the test.⁴ You have two attempts for each homework assignment. I will provide the solutions that have been worked out right after the deadline has passed. After the solutions have been posted, late submissions cease to be genuine practice, so I will not accept any late homework.

My method of grading homework is according to whether it has been completed and whether genuine effort has been put into it, not on whether your answers are correct. This is on purpose, and you should take advantage of it. If marking homework on the basis of correctness caused you to look up the answers, it would give you a false impression of being ready for the exam, which later on the exam would show. Grading homework on the basis of effort enables you to identify what you need to study while there's still time to improve.

Grading scale

Your letter grade comes from your mastery grade plus the formative bonus, read off the bands in the table. You raise your score by showing critical thinking, not by doing more low-stakes work.

³The key aspect of mastery-based grading is that it allows students to demonstrate their mastery on more than one occasion rather than just once, and a large meta-analysis found that this approach increases exam performance by approximately half a standard deviation on average, with the greatest improvements being seen among students who start off behind. See Kulik, C. L. C., Kulik, J. A., & Bangert-Drowns, R. L. (1990). *Effectiveness of mastery learning programs: A meta-analysis. Review of educational research, 60*(2), 265-299; and Guskey, T. R. (2010). *Lessons of mastery learning. Educational leadership, 68*(2), 52-57. The cumulative final is a whole-course reassessment rather than a targeted retake of one topic, a lighter form I use so that a second chance does not require separate make-up sittings.

⁴Practicing with test-like questions is itself one of the most effective ways to learn the material, not only a way to check on it: retrieving an answer from memory strengthens later retention more than re-reading does (the *testing effect*). See Roediger III, H. L., & Karpicke, J. D. (2006). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological science, 17*(3), 249-255; and, for a review ranking practice testing among the highest-utility study strategies, Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public interest, 14*(1), 4-58.

This grading system uses a *criterion-referenced* standard. Your grade is based on what you can do, not on how you compare to others in the class.⁵ If you reach the application level, that is A-level work, no matter how many students achieve it.

Letter	Percentage	GPA	Attainment
A+	97.0 - 100.0%	4.00	
A	93.0 - 96.9%	4.00	Superior
A-	90.0 - 92.9%	3.75	
B+	87.0 - 89.9%	3.25	
B	83.0 - 86.9%	3.00	Meritorious
B-	80.0 - 82.9%	2.75	
C+	77.0 - 79.9%	2.25	
C	73.0 - 76.9%	2.00	Adequate
C-	70.0 - 72.9%	1.75	
D+	67.0 - 69.9%	1.25	
D	63.0 - 66.9%	1.00	Minimal
D-	60.0 - 62.9%	0.75	
F	0.0 - 59.9%	0.00	Failure

Generative AI

Summary

You can choose on your own whether to use AI as a tool for studying, but keep in mind that the purpose of homework is to provide practice. You lose the opportunity to learn if you ask a tool to carry out the task for you. The exam must be taken in person and not using AI, since it is intended to demonstrate what you can do on your own. Pitt provides you with a free Claude account, and when you use it, use it to check your thoughts, not to skip that step.

Generative AI is here to stay. Even if we don't like them, we could end up using these tools over the course of our careers, and ignoring them won't help us get ready. We are still in the early stages of this change. Up to now, no one has observed a whole generation learning with such tools, so anyone who says they know the best way to use AI in education is merely making an educated guess.

I can't say whether using AI as a tool for studying will benefit you, harm you, or do a bit of both. Although I have my own ideas, that doesn't make them proof, and it's better to be honest about

⁵In *criterion-referenced* measurement, a score is interpreted against an absolute standard of what a student can do; in *norm-referenced* measurement, it is interpreted against the performance of other students. The distinction traces to Glaser, R. (1997). Instructional technology and the measurement of learning outcomes: Some questions (1963). In J. M. Notterman (Ed.), *The evolution of psychology: Fifty years of the American Psychologist* (pp. 337–342). American Psychological Association., and Popham, W. J., & Husek, T. R. (1969). IMPLICATIONS OF CRITERION-REFERENCED MEASUREMENT 1, 2. *Journal of Educational Measurement*, 6(1), 1-9.

what we don't know than to present a guess as if it were a rule. The thing I am doing in this course is leading you through the process of learning the material and assessing how well you have understood it. Because I have been working in and studying this field for many years, the advantage I can provide is the benefit of having experience, such as knowing what is important, what presents difficulties, where individuals tend to have trouble, and what it means to understand something rather than simply recognizing it. I am unable to learn it for you. You have to come to an understanding yourself, and no one, not even myself, can know about it from the outside.

Academic Integrity

Students in this course will be expected to comply with the [University of Pittsburgh's Policy on Academic Integrity](#). Any student suspected of violating this obligation during the semester will be required to participate in the procedural process initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring unauthorized materials to an exam, including dictionaries and programmable calculators.

To learn more about Academic Integrity, visit the [Academic Integrity Guide](#) for an overview. For hands-on practice, complete the [Understanding and Avoiding Plagiarism tutorial](#).

Disability Services

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and [Disability Resources and Services \(DRS\)](#), 140 William Pitt Union, (412) 648-7890, drsrecep@pitt.edu, (412) 228-5347 for P3 ASL users, as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

Email Communication

Upon admittance, each student is issued a University email address ([username@pitt.edu](#)). The University may use this email address for official communication with students. Students are expected to read emails sent to this account regularly. Failure to read and respond to University communications promptly does not absolve the student of the obligation to know and comply with their contents. The University provides an email forwarding service that allows students to read their email via other service providers (e.g., Gmail, AOL, Yahoo). Students who forward their email from their [pitt.edu](#) address to another address do so at their own risk. If an email is lost due to forwarding, it does not absolve the student of the obligation to respond to official communications sent to their University email address.

Equity, Diversity, and Inclusion

The University of Pittsburgh does not tolerate any form of discrimination, harassment, or retaliation based on disability, race, color, religion, national origin, ancestry, genetic information, marital status, familial status, sex, age, sexual orientation, veteran status, or gender identity or other factors as stated in the University's Title IX policy. The University is committed to taking

prompt action to end a hostile environment that interferes with the University's mission. For more information about policies, procedures, and practices, visit the [Civil Rights & Title IX Compliance web page](#).

Everyone in the class should strive to help ensure that other members of this class can learn in a supportive and respectful environment. If there are instances of the aforementioned issues, please get in touch with the Title IX Coordinator by calling 412-648-7860 or emailing titleixcoordinator@pitt.edu. Reports can also be [filed online](#). You may also choose to report this to a faculty/staff member; they are required to communicate this to the University's Office of Diversity and Inclusion. If you wish to maintain complete confidentiality, you may also contact the University Counseling Center (412-648-7930).

Religious Observance

The observance of religious holidays (activities observed by a religious group of which a student is a member) and cultural practices are an important reflection of diversity. As your instructor, I am committed to providing equivalent educational opportunities to students of all belief systems. At the beginning of the semester, you should review the course requirements to identify foreseeable conflicts with assignments, exams, or other required attendance. If possible, please get in touch with me (your course coordinator/s) within the first two weeks of the first class meeting to allow time for us to discuss and make fair and reasonable adjustments to the schedule and/or tasks.

Sexual Misconduct, Required Reporting, and Title IX

If you are experiencing sexual assault, sexual harassment, domestic violence, and stalking, please report it to me, and I will connect you to University resources to support you.

University faculty and staff members are required to report all instances of sexual misconduct, including harassment and sexual violence, to the Office of Civil Rights and Title IX. When a report is made, individuals can expect to be contacted by the Title IX Office with information about support resources and options related to safety, accommodations, process, and policy. Please use the services and resources that may be most helpful to you.

As your instructor, I am required to report any incidents of sexual misconduct that are directly reported to me. You can also report directly to Office of Civil Rights and Title IX: 412-648-7860 (M-F; 8:30 am-5:00 pm) or via the Pitt Concern Connection at: [Make A Report](#).

An important exception to the reporting requirement exists for academic work. Disclosures about sexual misconduct that are shared as a relevant part of an academic project, classroom discussion, or course assignment are not required to be disclosed to the University's Title IX office.

If you wish to make a confidential report, Pitt encourages you to reach out to these resources:

- The University Counseling Center: 412-648-7930 (8:30 A.M. TO 5 P.M. M-F) and 412-648-7856 (AFTER BUSINESS HOURS)
- Pittsburgh Action Against Rape (community resource): 1-866-363-7273 (24/7)

If you have an immediate safety concern, please contact the University of Pittsburgh Police, 412-624-2121

Any form of sexual harassment or violence will not be excused or tolerated at the University of Pittsburgh.

For additional information, please visit the [full syllabus statement](#) on the Office of Diversity, Equity, and Inclusion webpage.

Statement on Classroom Recording

To ensure the free and open discussion of ideas, students may not record classroom lectures, discussions, and/or activities without the instructor's advance written permission. Any such recording, properly approved in advance, may be used solely for the student's private use.