

**BIOL 5591**

**Advanced Genomics**

**Fall 2024**

MR 5:15 - 6:55 pm | Behrakis 320

**Professor:** Jamie Henzy

**Office:** Mugar 205F

**Office hours:** by appt

**Material:** Readings consist of a mix of research papers and reviews available through PubMed; some of the exercises require online genomics tools that you can access on a laptop.

**Prerequisite:** BIOL 2301 Genetics and Molecular Biology

**Course objectives:** Generally, become familiar with the approaches, techniques, and tools of analysis that genomicists use and the types of research questions they pursue, for example:

- Describe various techniques used in sequencing, assembling, and annotating genomes.
- Explain techniques used to determine, analyze, and visualize transcriptional information.
- Demonstrate understanding of the concepts underlying phylogenetic analysis.
- Interpret data and findings from research articles.
- Describe how structure prediction is performed.

**Course format:** Please note that this is a fully in-person course. Class sessions will include a mix of lecture, discussion of papers, and exercises. Twice during the semester pairs of students will give presentations, followed by a class quiz.

<b>Grading:</b>	Paper summaries:	30 pts x 9	= 19% of grade
	In-class discussion:	30 pts x 9 (drop 2 lowest)	= 16% of grade
	Exercises:	50 pts x 10	= 30% of grade
	Presentation:	200 pts	= 12% of grade
	<u>In-class quizzes:</u>	<u>200 pts x 2</u>	<u>= 23% of grade</u>
			<b>100</b>

**Grading scale:**

A: 90 - 100%    B: 80 - 89%    C: 70 - 79%    F: 69% or less

Pluses and minuses will distinguish between higher or lower performance within each letter range. To ensure fairness, everyone will be graded according to the same standards. If you identify a calculation error in any score, please let me know. However, please do not ask for special consideration in terms of extra credit, more generous rounding, or any other type of "grade bump". Such requests are inappropriate, unprofessional, and have zero chance of being granted.

**Paper summaries:** A major component of the course is summary and discussion of papers. For each paper, you can earn 3 pts for submitting a summary by the due date (which is always the start of the class in which we'll discuss the paper). If you miss the due date, you can still submit a summary within the next 24 hours but you will not be able to earn the in-class discussion points for that paper.

**In-class discussions:** For each paper, you can earn 3 pts for **being present and prepared to discuss** the figures and other key elements addressed in your submitted summary. Because a discussion involves the submitted summaries, the 3 in-class discussion pts are only available if you have submitted your summary by the start of class. Since absence on a discussion day (see schedule below) will cost 3 pts, as a buffer against the various events (sickness, travel, "mental health" days) that might prevent you from attending class on any of these dates, the two lowest discussion-day scores will be dropped.

**Exercises:** There will be 10 exercises worth 5 pts each to introduce you to various genomics methods and techniques. You'll have a week to complete each, after which we'll go over the solutions in class. No submissions will be accepted after we have gone over solutions.

**Presentation and in-class quizzes:** Pairs of students will each give a 5-min presentation on selected topics from the papers we have discussed. Half the class will present on **Thu Oct 10** and half on **Mon Nov 25**. Each pair will also supply (to me) two multiple-choice questions and answers that anyone who has listened to their presentation should be able to answer. After all groups have presented, the class will take a quiz composed of the questions from each group along with questions drawn from the exercises. **The two dates for presentation/in-class quiz should be treated as exam days and cannot be made up. Please mark these on your calendars.**

**Getting help:** Please post any questions about course material or assignments -- questions that other students may also be interested in -- in the "Ask the prof" Discussion forum on Canvas. For more specific issues, please sign up for a Zoom office hours slot, using the link found on the Office Hours page.

**Expanding the field:** Although science is considered an "objective" endeavor, most research questions, discoveries, and applications have been influenced by the experiences of the scientists involved, who have been predominately white males. Science and the society it serves is greatly enriched by the participation of people from diverse backgrounds, who can bring fresh views and priorities, driving new lines of inquiry and application. A hurdle is that students who have traditionally been under-represented in science often feel insecure in their ability to participate and express their views. A secret: anyone who has curiosity and wants to use data to solve a mystery is a scientist at heart! Please let me know if you have any concerns of this nature.

**Cheating policy:** Honesty, integrity, and ethical behavior are of utmost importance in science, and can make or break a scientific or medical career. Anyone caught cheating (for example, copying from the work of other students, or collaborating during quizzes) will receive a zero and be referred to the Office of Student Conduct and Conflict Resolution. Please make sure you have read and understand the student code of conduct: <http://www.northeastern.edu/osccr/code-of-student-conduct/>

**Schedule of Topics** amenable to changes based on student interest or publication of new research papers. Following the schedule is the list of readings. All readings are freely accessible through the Northeastern PubMed database or elsewhere online.

### Reading list:

1. **Burian AN, Zhao W, Lo TW, Thurtle-Schmidt DM.** "Genome sequencing guide: An introductory toolbox to whole-genome analysis methods." *Biochem Mol Biol Educ*. 2021 Sep;49(5):815-825. doi: 10.1002/bmb.21561. Epub 2021 Aug 11. PMID: 34378845; PMCID: PMC9291972.
2. **Palazzo, Alexander F., and T. Ryan Gregory.** "The Case for Junk DNA." *PLoS Genetics* 10, no. 5 (May 8, 2014): e1004351. <https://doi.org/10.1371/journal.pgen.1004351>.
3. **Hughes, Jennifer F., Helen Skaletsky, Peter K. Nicholls, Alexis Drake, Tatyana Pyntikova, Ting-Jan Cho, Daniel W. Bellott and David C. Page.** "A gene deriving from the ancestral sex chromosomes was lost from the X and retained on the Y chromosome in eutherian mammals." *BMC Biology* (2022) 20:133. <https://doi.org/10.1186/s12915-022-01338-8>.
4. **Lu, Roujian, Xiang Zhao, Juan Li, Peihua Niu, Bo Yang, Honglong Wu, Wenling Wang, et al.** "Genomic Characterisation and Epidemiology of 2019 Novel Coronavirus: Implications for Virus Origins and Receptor Binding." *Lancet* 395, no. 10224 (2020): 565–74. [https://doi.org/10.1016/S0140-6736\(20\)30251-8](https://doi.org/10.1016/S0140-6736(20)30251-8).
5. **Mishina, Tappei, Ming-Chung Chiu, Yasuyuki Hashiguchi, Sayumi Oishi, Atsunari Sasaki, Ryuichi Okada, Hironobu Uchiyama, et al.** "Massive Horizontal Gene Transfer and the Evolution of

- Nematomorph-Driven Behavioral Manipulation of Mantids.” *Current Biology: CB* 33, no. 22 (November 20, 2023): 4988-4994.e5. <https://doi.org/10.1016/j.cub.2023.09.052>.
6. **Li L**, Comi TJ, Bierman RF, Akey JM. Recurrent gene flow between Neanderthals and modern humans over the past 200,000 years. *Science*. 2024 Jul 12;385(6705):eadi1768. doi: 10.1126/science.adi1768. Epub 2024 Jul 12. PMID: 38991054.
  7. **Klunk**, Jennifer, Tauras P. Vilgalys, Christian E. Demeure, Xiaoheng Cheng, Mari Shiratori, Julien Madej, Rémi Beau, et al. “Evolution of Immune Genes Is Associated with the Black Death.” *Nature* 611, no. 7935 (2022): 312–19. <https://doi.org/10.1038/s41586-022-05349-x>.
  8. **Chaconas G**, Castellanos M, Verhey TB. Changing of the guard: How the Lyme disease spirochete subverts the host immune response. *J Biol Chem*. 2020 Jan 10;295(2):301-313. doi: 10.1074/jbc.REV119.008583. Epub 2019 Nov 21. PMID: 31753921; PMCID: PMC6956529.
  9. **Chang NC**, Wells JN, Wang AY, Schofield P, Huang YC, Truong VH, Simoes-Costa M, Feschotte C. Gag proteins encoded by endogenous retroviruses are required for zebrafish development. *bioRxiv [Preprint]*. 2024 Mar 25:2024.03.25.586437. doi: 10.1101/2024.03.25.586437. PMID: 38585793; PMCID: PMC10996621.