BIOL SCI 378: Functional Genomics
Winter 2020
Syllabus

Lectures:	TuTh 3:30 – 4:50 Locy Hall 214
Exams:	Midterm 1 (February 6), Midterm 2 (March 5)
Instructor:	Norman Wickett Hogan 6-140B (sixth floor, room 140B) Office hours: Tuesdays and Thursdays 10:00 – 2:00 or by appointment (email) Phone (MWF) (847) 835-8280 **Preferred contact – email nwickett@northwestern.edu**
Textbook:	*A Primer of Genome Science, Third Edition*, by Gibson & Muse
Other Readings:	Primary literature, assigned weekly, and distributed on Canvas

Course Description

In this class, we will discuss how and why we sequence genomes, how we analyze their content, and how the understanding of genomes from across the Tree of Life (i.e., Comparative Genomics) can illuminate fundamental questions in biology. By the end of the class, you should have a solid understanding of the following topics: (1) methods of sequencing, assembling, and annotating eukaryotic genomes (2) the structure, content, and organization of eukaryotic genomes, (3) the origin, diversification, and evolution of functional elements within genomes, and (4) the application of genomics to evolutionary biology, ecology, population genetics, and biomedical research.

Course Format

This course consists of lectures on Tuesdays and Thursdays, the topics of which are outlined below (Class Schedule). It is expected that the readings corresponding to a lecture will be completed *before* class. A short guide for each paper, along with a list of terms with which you should be familiar, will be posted on Canvas. The course is divided into two sections, with an exam following each section. The first section deals with *how* genome sequences are generated and described. Following the first midterm, we will discuss a number of specific genome papers that deal with *why* we sequence genomes.

Policies

Some of you may have interviews (e.g. graduate school or med school interviews) that interfere with exam or quiz dates. If this is the case, please let me know by email as soon as possible. I will schedule **a single time** for a make-up exam following the original date. I will do my best to schedule a time that works for everyone.

No extra credit will be given in this course.

Any student requesting accommodations related to a disability or other condition is required to register with AccessibleNU (accessiblenu@northwestern.edu; 847-467-5530) and provide professors with an accommodation notification from AccessibleNU, preferably within the first two weeks of class. All information will remain confidential.

All work in this class must follow Northwestern's policies regarding academic integrity; it is recommended that you review the guide to academic integrity here:

www.northwestern.edu/provost/policies/academic-integrity/

Please do not post lecture slides and notes outside of Canvas

Diversity Statement

In this class I adhere to the vision and mission of Northwestern's Office of Institutional Diversity and Inclusion (northwestern.edu/diversity/about/office-diversity-inclusion.html): "To realize an ideal Northwestern University where community members are challenged to engage differences as strengths in an environment that ensures equality of access, opportunity, representation and participation," and, "To help create and sustain a diverse, inclusive and welcoming environment for all Northwestern community members including students, faculty, staff and alumni." I consider this course and all its participants to be a community, and I am committed to creating a space in which all individuals can fully engage in all aspects of learning. Each student has something of value to contribute and students are encouraged to communicate and participate during class. We must take care to respect the individual backgrounds, personal identities, intellectual approaches, and demographics expressed by everyone.

Evaluation

Two exams will be given in this course: a midterm on February 6 and a midterm on the last day of class, March 5. **There will be no final exam during Final Exam Week**. The exams are not cumulative, but it is expected that concepts learned for the first midterm are necessary to understand material covered for the second exam. There will also be five quizzes; your lowest quiz grade will be automatically dropped before calculating your final grade. Finally, everyone will be responsible for presenting a "lightning talk" with a small group of students on the last (non-exam) day of class. An additional small exercise will be assigned in the second half of the course. The breakdown of your final grade is as follows:

Point Distribution		
Exam 1	100 pts	25%
Exam 2	100 pts	25%
Quizzes	100 pts (20 per quiz)	25%
Assignments	100 pts	25%

Grade Distribution					
93 - 100	**A**	90 - 92	**A-**		
87 - 89	**B+**	83 - 86	**B**	80 - 82	**B-**
77 - 79	**C+**	73 - 76	**C**	70 - 72	**C-**
60 - 69	**D**	< 60	**F**		

Class Schedule

Date	Topic	Reading
Tu Jan. 7	Introduction and Overview: What is Genomics?	*PGS* 1-60 (background reading) Dunn & Munro (2016); Richards (2015)
Th Jan. 9	DNA Sequencing I: Background and introduction to second generation methods	*PGS* 65-82 Shendure *et al.* (2017)
Tu Jan. 14	DNA Sequencing II: Second and third generation sequencing	Van Dijk *et al.* (2018); Goodwin *et al.* (2016)
Th Jan. 16	Phylogenetics: The foundation of comparative genomics	*PGS* 120-121 (Box 2.4) Baldauf (2003)
Tu Jan. 21	Genome Assembly I **Quiz 1**	*PGS* 83-95 Myers (2016); Baker (2012); Myers *et al.* (2000)
Th Jan. 23	Genome Assembly II	Simpson & Pop (2015); Ekblom & Wolf (2014)
Tu Jan. 28	Genome Annotation I: Evidence based structural annotation **Quiz 2**	*PGS* 95-112 Mudge & Harrow (2016); Yandell & Ence (2012)
Th Jan. 30	Genome Annotation II: Gene prediction using *ab initio* methods and Hidden Markov Models, and an introduction to functional annotation	Huang et al. (2016)
Tu Feb. 4	Genome Annotation III: Orthology, paralogy, sub- and neofunctionalization, and The Gene Ontology **Quiz 3**	*PGS* 113-128 Guschanski et al. (2017); Voordeckers *et al.* (2012)
Th Feb. 6	**Midterm 1**	
Tu Feb. 11	Genome Size I (Paleopolyploidy): Salmon, strawberry, and grape genomes	Edger *et al.* (2019); Robertson *et al.* (2017); Grapevine Genome Consortium (2007)
Th Feb. 13	Genome Size II (Transposable Elements): Salamander and *Selaginella* genomes	*PGS* 107-109 VanBuren *et al.* (2018); Elewa *et al.* (2017); Sotero-Caio *et al.* (2017)
Tu Feb. 18	Major events in evolutionary history: The coelacanth and green algae genomes **Quiz 4**	Cheng *et al.* (2019); Amemiya *et al.* (2013)
Th Feb. 20	Horizontal Gene Transfer: The tardigrade genome and “Tardigate”	Boothby *et al.* (2015); Koutsovoulos *et al.* (2016)
Tu Feb. 25	Genomic Variation and Genome-wide Association Studies **Quiz 5**	*PGS* 133-187 Wang et al. (2018); Kilpinen & Barrett (2013)

Th Feb. 27	Human Evolution: The Neanderthal genome(s)	Marciniak & Perry (2017); Prüfer *et al.* (2014)
Tu Mar. 3	**Lightning Talks**	
Th Mar. 5	**Midterm 2**	
Tu Mar. 10	**Reading Week Begins**	