BIOL 420/620: Genomics **Fall 2019 syllabus**

MW 1:30 - 2:20, LSB Room 3131; Friday Lab 1:30 - 3:20, LSB Room 3303

Contact:
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Office hours: By appointment

Course Description: Advanced elective for upper level biology majors and graduate students examining biology and evolution on a genome-wide scale. Topics derive from three major themes: 1) sequence acquisition and annotation, 2) "-omics" fields of study, and 3) practical applications. Although much of the course material is from the assigned text, students will be expected to read and discuss primary literature. Course materials are provided electronically via eCampus.

Text: Genomes 4, T. A. Brown (Garland Science, New York, NY)

Course prerequisites: Biology 219 (or equivalent).

Learning outcomes:
1. Describe techniques involved in sequencing, assembly, and annotation of genomes.
2. Gain exposure to "-omics" fields of study and discuss the applicability of each to the study of organismal diversity, evolution, and disease.
3. Compare and contrast genome architecture across diverse domains of life.
4. Describe how genome architecture and modification effects genome function.
5. Explain how genomic data can be used to address diverse biological questions.
6. Explain basic comparative genomics principles including phylogenetic reconstruction and the application of phylogenies to evolutionary inference.
7. Increase proficiency in reading, evaluating, and discussing primary literature.

Grading:
There will be two midterm exams, one final take-home exam, two homework assignments, lab assignments, and a participation grade for in-class paper discussions and debates. Graduate students will be required to complete a genomics project (see below). The final grade is based on a total of 500 points. There will be no curve in this course.

Undergraduate students:

Exam 1:	50 points (10%)
Exam 2:	50 points (10%)
Final:	150 points (30%)
HW 1:	50 points (10%)
HW 2:	50 points (10%)
Participation:	50 points (10%)
Labs:	100 points (20%)

Graduate students:

Exam 1:	50 points (10%)
Exam 2:	50 points (10%
Final:	150 points (30%)
HW 1:	25 points (5%)
HW 2:	25 points (5%)
Participation:	50 points (10%)
Labs:	100 points (20%)
Project:	50 points (10%)

Overall grade:
450 - 500 points = A
400 - 449 points = B
350 - 399 points = C
300 - 349 points = D
less than 300 points = F

Homework: Homework will involve out-of-class assignments relating to in-class discussion topics. These homework assignments will consist of 5-10 short answer/discussion questions designed to ensure you

are keeping up with the lecture material. Late work will be accepted for five days after the due date with a 5 point penalty per day. Any work submitted after five days will receive zero points.

Labs: Labs will provide you with the opportunity to perform bioinformatic analyses of genome data and to interpret the results. You will receive 10 points for completing each lab assignment: 5 for the eCampus pre-quiz and 5 for the weekly assignment. There are 11 total labs, but your lowest lab grade will be dropped. You will be given more details during the first lab meeting.

Participation: You will co-lead discussions of research papers throughout the semester. You will be responsible for presenting and directing the discussion of a genomics-related research article that will be provided by your instructor. Guidelines for presentations will be provided via eCampus. You will also be expected to participate in two in-class debates by asking and/or fielding questions.

Graduate student projects: Because "genomics" is a tremendously diverse field of study, not all topics of interest can be covered in a single semester. Therefore, graduate students will be required to complete a research project on a particular subject not covered in the formal course curriculum. I will provide a list of **potential** (although you may choose your own if you wish) topics (located on eCampus). Individual student selections must be approved by September 18th. You will then be required to research your topic and write a paper, which should be thought of as a mini-review. There is no required format except the rather obvious one that it be well-written and thorough in coverage and documentation. Figures and Tables may or may not be appropriate; if so, include these in your paper. Similarly, lengths are expected to vary according to topic, although it is likely that you will not be able to do a satisfying job in fewer than several single-spaced pages; some students may be uncomfortable with this brief a treatment and may well carry on for 10-15 pages. Papers are due immediately prior to Thanksgiving Break. The final meetings of the semester will consist of formal presentations by each graduate student (order to be determined by volunteer or lottery). You should plan on giving a 10 minute lecture, using powerpoint. The only requirement is that you impart on the rest of us an understanding of your topic. Feel free to electronically distribute handouts if they will assist in understanding your lecture. Your presentation will be qualitatively graded by everyone in the class according to all of the criteria you would use in evaluating, say, a departmental seminar, i.e., clarity and polish of presentation (orally and visually), intellectual depth, lucidity regarding status of field and where it is headed.

Attendance policy: Attendance is expected at all class sessions. Repeated absences from class will negatively affect your performance. For example, if you are not present, you cannot contribute to paper discussions, which will lower your participation grade.

Make-up policy: If you must miss an exam, you must contact me within 48 hours to reschedule.

Schedule:

Date	Topic	Readings	Notes
	PART 1 - METHODS OF GENOME ANALYSIS		
Aug. 21	Introduction - Syllabus – Pre-test		
Aug. 23	**LAB** –Introduction and background		
Aug. 26	Genomes and Studying DNA	Chapters 1 & 2	
Aug. 28	Genome mapping	Chapter 3	
Aug. 30	**LAB** - Public databases and common file formats		
Sept. 2	**NO CLASS – LABOR DAY**		
Sept. 4	Genome sequencing – Sanger	Chapter 4	
Sept. 6	**LAB** – Working at the command line		
Sept. 9	Genome Sequencing – next generation	Assigned readings	
Sept. 11	Genome annotation	Chapters 5 & 6	
Sept. 13	**LAB** - Getting Started with Qiime2		

Sept. 16	Genome anatomies	Chapters 7 & 8	
Sept. 18	The mobilome	Chapter 9	H1 assigned
Sept. 20	**LAB** - Obtaining data, import, summary statistics		Grad student topics due
Sept. 23	Journal article – genome sequencing	Assigned readings	
Sept. 25	Journal article – mobile elements	Assigned readings	HW1 due
Sept. 27	**EXAM 1**		
	PART 2 – GENOME FUNCTION		
Sept. 30	Transcriptomics	Chapter 12	
Oct. 2	Non-coding RNAs	Assigned readings	
Oct. 4	**LAB** - Data processing and clustering with DADA2		
Oct. 7	tRNA regulation of genome function	Assigned readings	
Oct. 9	Proteomics	Chapter 13	
Oct. 11	**LAB – FALL BREAK**		
Oct. 14	Epigenetic control of genome function I	Chapter 10	
Oct. 16	Epigenetic control of genome function II	Chapter 10	
Oct. 18	**LAB** – Phylogenetics and rarefaction curves		
Oct. 21	Metabolomics	Chapter 13.5	
Oct. 23	Guest speaker		
Oct. 25	**LAB** – Generating diversity statistics		
Oct. 28	Journal article – non-coding RNAs	Assigned readings	
Oct. 30	Journal article – epigenetic control of species variation	Assigned readings	
Nov. 1	**EXAM 2**		
	PART 3 - REAL WORLD APPLICATIONS		
Nov. 4	Molecular phylogenetics for comparative genomics		
Nov. 6	Phylogenetics in anthropological studies		HW2 assigned
Nov. 8	**LAB** – Exploring alpha and beta diversity		
Nov. 11	Genomics in agricultural improvement		
Nov. 13	The human genome		HW2 due
Nov. 15	**LAB** – Sequence classification		
Nov. 18	Medical genomics and ethical issues		
Nov. 20	CRISPR		
Nov. 22	**LAB** – Exploring taxonomic shifts in the presence of AMD		Grad papers due
Nov. 25	THANKSGIVING BREAK		
Nov. 27	THANKSGIVING BREAK		
Nov. 29	THANKSGIVING BREAK		
Dec. 2	Journal paper - GMO		
Dec. 4	Journal paper - CRISPR		
Dec. 6	**LAB** – Differential abundance testing with gneiss		
Dec. 9	Graduate student presentations		
Dec. 11	Ethics debate/CRISPR focus		
Dec. 13	Pick up final exam – take exit exam		

****All materials (final exam, labs, etc…) are due no later than 5PM on Wednesday, December 18th.**

Evacuation plan: In case of emergency, please exit the classroom and building without delay. Use the stairs located immediately beside the LSB 3131 classroom.

Special accommodations: If you have a learning, sensory, or physical disability, and feel you need special assistance in lecture, reading assignments or testing, please contact your instructor during regular office hours or by appointment and make appropriate arrangements with Disability Services (293-6700) as soon as possible. The first week of the semester is the best time for these discussions, and all matters will be held in strictest confidence as the need determines.

Social justice statement: West Virginia University is committed to social justice. The instructor of this course concurs with that commitment and expects to maintain a positive learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veterans status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Disability Services (293-6700).

Academic integrity statement: The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, rigorous standards of academic integrity in all aspects and assignments of this course will be enforced. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at http://studentlife.wvu.edu/office_of_student_conduct/student_conduct_code. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me *before* the assignment is due to discuss the matter.