BMMB 551

Genomics

Sample Syllabus

Description

What is it in your DNA that makes you different from chimpanzees, mice or flies? What sequences in your DNA make it more or less likely that you will develop diabetes or cancer?

This course will remind students of the basic molecular biology of genes, introduce them to major DNA sequencing technologies, and explore how genomic technologies are informing principles of genome function globally, with a strong emphasis on identifying genes and gene regulatory modules. Students will use web-based bioinformatics tools for exploring genomic and epigenetic data to complete assignments. Each student also will develop a project on a topic in genomics that interests them. The goal of each project will be determined mainly by the student's interest; it can be research or educational. The student will choose the medium used to convey the results of his/her work. Employing traditional media such as term papers or oral presentations is fine, and creative and effective use of popular media (games, video, music, dance, etc.) is encouraged.

The course proceeds in two phases, first on the basics of genomics, and second on the search for functional elements in genomes.

Objectives

At the end of this course, you will successfully be able to do/perform the following:

- Describe the range of genome sizes and structures of genomes in organisms
- Use a wide range of sequence alignment tools with a strong appreciation of the power and limitations of each for the task at hand

- Use the community-supported online computational platform Galaxy to analyze files with genomic data
- Use online databases and resources to find information on genes, physiologically relevant sets of genes, and entire sets of genes from an organism
- Predict gene structures in long genome sequences
- Analyze processed results from massively parallel RNA determinations (microarray and RNA-seq) to infer functional groups of genes
- Interpret epigenetic patterns around individual genes and groups of genes to infer function
- Mesh results of genome-wide association studies of complex traits with genomic and epigenetic information to improve interpretations

Course Schedule

Week	Topic
1	Introduction to course / Fundamentals of Molecular Genetics
2	Fundamentals of Genomics
3	Sequencing Technologies
4	Aligning Biological Sequences
5	Genome Databases and Browsers
6	Analysis Platforms for Genomics: Galaxy
7-8	Protein-Coding Genes within Genomes
8-9	Transcribed Regions of Genomes
10	Evolutionary Signatures of Function by Comparative Genomics
11	Gene Regulatory Modules in Genome Sequences
12	Other Non-protein-coding Functional Sequences in Genomes
13	Finding Function by Phenotype

14	Genome Editing
15	Phenotyping After Genome Editing

Expectations

Students should complete each of the lessons and a semester project. The course will cover 14 lessons spread over the 15 weeks of the course. Each lesson covers a topic, and it includes reading material, presentations, and homework (no homework for lesson 14). Students should read the assigned texts, listen to the presentations, and do the homework. The text material comes from online textbooks, reviews and research articles. The presentations are provided as VoiceThreads. These are a series of slides on each topic, with a recorded presentation from the instructor. You can interact with the VoiceThread, and ask questions or make additional points.

A homework assignment is made for 13 of the 14 lessons. Students should turn in a report on their work on the assignment. Sometimes you have explicit options on the assignment. You also can tailor the assignments to your particular interests. If you think of an assignment related to the topic that would be more meaningful or more interesting to you, it is very likely that I will approve it. Please check in advance of the due dates.

Students will also complete a semester project. The student will chooses a topic to present or a problem on which they want to work. It is a good idea to discuss your interests with the instructor, so that the scope and content of the project can be reasonable and meaningful. Using the material in the course as a foundation, the student will define the topic or problem, gather material, and analyze data (if appropriate) to describe the topic or solve the problem. The student will make a report on the project by the end of the semester. As stated above, the medium for presentation of the project will be chosen by the student; creativity is welcome. Most reports are papers, but the report can be a presentation (e.g. using the VoiceThread technology), a film, a song, a comic book, a video game, a board game, a sculpture (all have been done in the past), or other medium.

Grading

Assignment	Number	Points (each)	Total Points	% of Course Grade
Final Project	1	250	250	25%
Quizzes / Exercises	13	50	750	75%
Total			1000	100%

Academic Integrity

Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

Accommodating Disabilities

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Student Disability Resources (SDR) website provides contact information for every Penn State campus . For further information, please visit Student Disability Resources website.

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: See documentation guidelines . If the

documentation supports your request for reasonable accommodations, your campus disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early as possible. You must follow this process for every semester that you request accommodations.

Counseling and Psychological Services

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

- Counseling and Psychological Services at University Park (CAPS): 814-863-0395
- Counseling and Psychological Services at Commonwealth Campuses
- Penn State Crisis Line (Available 24 hrs, 7 days a week): 877-229-6400
- Crisis Text Line (Available 24 hrs, 7 days a week): Text LIONS to 741741

Educational Equity / Report Bias

Penn State takes great pride to foster a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, or harassment due to age, ancestry, color, disability, gender, gender identity, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated and can be reported through Educational Equity via the Report Bias website.