BIOLOGY 446
MICROBIAL GENOMICS
SPRING 2013
4 UNITS

Instructor: **Prof. José R. de la Torre, Ph.D.**
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Lectures: Tuesday/Thursday, 10:10AM – 12:00PM • SCI 249
Office Hours: Wednesdays, 1:00PM – 3:00PM • SCI 249

Prerequisites:

- This class is open to all Biology, Biochemistry, and Computer Science students.
- BIOL 401/402 (General Microbiology Lecture/Lab) and BIOL 355 (Genetics) are required. BIOL 442 (Microbial Physiology) highly recommended.
- Regular access to a computer and internet connection outside of class are required.

Course Description:

The increasing ease and decreasing costs of large scale sequencing are revolutionizing the field of Microbiology. Over the past fifteen years, the cost of sequencing the average microbial genome has dropped from over $50,000 to less than $5,000. Consequently, new microbial genome sequences are appearing at an exponential rate: fifteen years after the publication of the first microbial genomes, the number of genome sequencing projects stands at over 5000. Microbiologists now operate in a world where genome sequences are the norm rather than the exception, and coping with that vast amount of information is now more of a challenge than generating it. In this class, we will delve into the world of microbial genomics, drawing examples from both the medical and environmental branches of Microbiology. Students will be introduced to basic methodologies involved in genome sequencing, assembly and annotation, as well as the tools required evaluate the quality of genomic data. Students will then apply this newly gained knowledge to analyze a real, unannotated microbial genome sequence. The results of these analyses may be incorporated into peer-reviewed publications with course participants listed as contributing authors.

Learning Objectives:

- Understand the general methods utilized in the microbial genomics (including metagenomics).
- Analyze and annotate a microbial genome fragment.
- Describe and use the methods for comparing microbial genomes.
- Use genomic databases and bioinformatic resources to explore microbial processes in the environment.
- Read, understand and critically evaluate relevant papers published in the scientific literature.
- Research and select a primary research article and present the findings to an audience of their peers.
- Conduct an original comparative microbial genomic study based on independent reading. This includes the identification of interesting questions that can be addressed using methodology discussed in class, designing and executing an experimental approach to answer the research goals and communicating the findings to scientific peers.

Alignment between student and program learning outcomes:

One of the objectives of the degree program in Microbiology is to develop students with the knowledge and skills necessary for entering laboratory positions as experienced scientists. This course combines traditional lectures with project-based learning in a rapidly advancing field. In addition, this course will serve as an upper-division elective for Biology Majors with Concentration in Microbiology or Cell and Molecular Biology.

Textbook:

Select readings will be chosen from ***Computing for Comparative Microbial Genomics*** by Ussery, Wassenaar & Borini (Springer) and ***Genomes 2*** By T.A. Brown (Oxford) and other texts available online:

http://www.springerlink.com/content/978-1-84800-254-8
http://www.ncbi.nlm.nih.gov/books/NBK21128/

Additional readings will be assigned in class and made available through iLearn.

Data Usage Policy:

A large amount of the data to be used in the class are confidential at the property of Dr. de la Torre. Students are not to share these data with people outside of the class under any circumstance. Any questions regarding the use of the class data should be addressed to Dr. de la Torre.

Evaluation and Grading:

Assignments (100 points). Five take-home assignments will be given over the course of the semester. These assignments will focus on building critical skills necessary for success as developing scientists. Assignments will include reading and analyzing primary research articles, presenting project progress reports to the class or conducting more in-depth analysis (computational or otherwise) of material or data examined in class. *All late assignments will be marked down 10% for every class period they are overdue. There will be NO make-up assignments.*

Quizzes (50 points). Over the course of the semester, there will be five short quizzes on the reading assignments and lecture material. These quizzes will be available through iLearn. *There will be NO make-up quizzes.*

Class Participation (100 points). Individual participation is critical for productive class discussions and for the completion of a large group project. Participation will be evaluated based on involvement in class discussions, completion of peer-evaluations and completion of the individual project objectives established in class in consultation with peers and the instructor.

Project Proposal & Peer Evaluation (75+50 points). Students will prepare a short (2 page) proposal of the final project they intend to complete. We will discuss these proposals and how to write them in class. To generate feedback, proposals will be evaluated by students as well as by the instructor.

Final Project (150 points). All students will be required to complete the annotation and analysis of a region or biochemical subsytem of the genome being analyzed by the class. This annotation will be performed using the bioinformatic tools described in class. Students will give a 10 minute oral presentation during the scheduled Final Exam period describing the annotation and analysis of their assigned genome segment or biochemical subsystem. Students will also be required to peer-evaluate these presentations using a rubric distributed in class. Evaluations will be done anonymously and returned to the presenters as feedback.

Take-Home Assignments	*15%*
Class Participation	*25%*
Project Proposal	*10%*
Annotation Project	*25%*
Final Presentation (poster @ COSE Showcase)	*25%*
Total	*100%*

A = 96-100%	B+ = 86-89%	C+ = 76-79%	D+ = 66-69%	F = 59 or less
A- = 90-96%	B = 83-86%	C = 73-76%	D = 63-66%	
	B- = 80-83%	C- = 70-73%	D- = 60-63%	

Attendance:

Students enrolled in BIOL 446 are expected to attend all class sessions. Students missing class are responsible for obtaining the information covered in class from a classmate.

Note: Too many absences or late arrivals will negatively impact the Class Participation grade.

Class Website & E-mail Policy

Course material, including handouts and assignments, will be made available online through the iLearn system (*http://iLearn.sfsu.edu/*). If you encounter any problems downloading or printing these files, please contact the instructor immediately. Students are encouraged to e-mail questions to the instructor. Whenever e-mailing questions, please include "**BIOL 446**" in the subject line and identify yourself by signing the message with your **full name** and **SFSU ID number**. If appropriate, responses will be posted on iLearn or discussed in class—without identifying the student. *Be advised that, in general, e-mails will receive responses within a day or two.*

Changes to the Syllabus or Lecture Schedule

The syllabus and lab schedule are subject to change. Changes to the syllabus or lab schedule will be announced in class and/or posted on iLearn.

Statement on plagiarism and cheating

Students are expected to maintain a high level of academic integrity in all work pursued at SFSU. ***Cheating or plagiarism will not be tolerated under any circumstances in this class.*** Plagiarism, defined as either direct copying or loose paraphrasing of text from any published work (including online) without appropriate referencing, or use of another person's work or ideas without appropriate attribution, will result in an automatic zero points for that entire assignment. ***Plagiarism includes computational results and mis-appropriation of software code without giving proper credit to the author(s).*** There will be no second chances. Any incidence of cheating or plagiarism will be reported to the Chair of the Biology Department, the Dean of the College of Science and Engineering, and the Office of Student Affairs for possible disciplinary action. Consequences can include penalties up to expulsion from the University.

Cell phones & pagers

Please silence cell phones and pagers before arriving in class.

American with Disabilities (ADA) Accommodation

SFSU is committed to providing reasonable academic accommodation to students with disabilities. Students with disabilities who need reasonable accommodations should contact the instructor. The Disability Programs and Resource Center (DPRC) is available to facilitate the reasonable accommodations process. The DPRC is located in the Student Service Building and can be reached by telephone (voice/TTY 415-338-2472) or by e-mail (*dprc@sfsu.edu*).

Important Deadlines for Add/Drop/Withdrawal:

February 8, 2013

Deadline to drop courses using GATOR REG.

February 22, 2013

Deadline to add courses with instructor-issued permit number.

February 8 – April 26, 2013

Withdrawal period -- no documentation required.

Withdrawals will result in a "W" grade on transcript records.

April 27 – May 17, 2013

Withdrawal is permissible only for **serious and compelling reasons**. Students must file a petition to be reviewed by the Instructor and the Department Chair. Approved withdrawals will result in a "W" grade on transcript records.

> ***"Withdrawals are not normally permitted during the final three weeks except in verified cases of accident or serious illness where the cause of withdrawal is due to circumstances clearly beyond the student's control and where the assignment of an incomplete is not practical. Ordinarily, withdrawals in this category will involve total withdrawal from the University."*** (SFSU Bulletin)

TENTATIVE SCHEDULE (ver. 1)

Date	Topic
Jan 28	Introduction to the Microbial Genomics: General Principles
Jan 30	Working with sequences: databases & web-based tools
Feb 4	Properties of Genomes
Feb 6	Unix for Biologists: *"Fear Not the Command Line"*
Feb 11	Sequencing & Assembly
Feb 13	Gene Finding & Annotation
Feb 18	**NO CLASS**
Feb 20	BLAST & PSI-BLAST
Feb 25	Pathway-Based Annotation
Feb 27	Non-Coding RNAs
Mar 4	Introduction to Class Project
Mar 6	Gene Expression: DNA Microarrays & Transcriptomics
Mar 11	Gene Expression: Proteomics
Mar 13	Systems Biology
Mar 18	Phylogenetics
Mar 20	Phylogenetics Workshop
Mar 25	**NO CLASS – SPRING RECESS**
Mar 27	**NO CLASS – SPRING RECESS**
Apr 1	**NO CLASS – CESAR CHAVEZ DAY**
Apr 3	Comparative Genomics
Apr 8	Phylogenomics
Apr 10	Microbial Communities & Population Genetics
Apr 15	Metagenomics
Apr 17	*Annotation Project*
Apr 22	Genomics & Evolution
Apr 24	*Annotation Project*
Apr 29	Lateral Gene Transfer
May 1	*Annotation Project*
May 3	***FINAL PROJECT POSTERS @ COSE SHOWCASE (4-6pm)***
May 6	What Are Microbial Species?
May 8	*Annotation Project*
May 13	Origin of Eurkaryotes *t*
May 15	*Annotation Project*
May 24	***FINAL ANNOTATION PROJECT DUE***