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Course overview:

BIOL 549 focuses on the use of genetic approaches to understand the physiology of bacteria and phages (and touching on the genetics of other microbes, including Archae and yeast). The course emphasizes problem-solving, using data to understand microbial processes as well as how these approaches can be used to solve novel problems.

Course schedule:

The class is scheduled for Monday and Wednesday 2:00 – 3:15 PM. This course will be taught in a “flipped” format. Most of the lecture content for this course will be delivered online, and posted on Blackboard. Class sessions will focus on additional lectures, problem solving, discussion of manuscripts, reviews, exams, etc. The schedule for the in class sessions is posted on Blackboard and will be updated as needed. Students are responsible for keeping track of the course calendar and regularly monitoring the course announcements for any changes.

Instructor:

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Office hours:

Online and by appointment; Group office hours will be announced prior to exams.

Prerequisites:

This course will assume that you have a basic knowledge of microbiology (BIOL 350), and molecular & cellular biology, and biochemistry (as taught in BIOL 366). Before beginning this course you should be familiar with the following concepts:

- DNA structure (antiparallel double-helix, Watson-Crick base pairing, base stacking interactions, 5’ and 3’ ends,)
- DNA replication (DNA polymerase, primers, origins, Okazaki fragments)
- Transcription (RNA polymerase, promoters, terminators, transcription factors)
• Translation (ribosomes, mRNA, tRNA, codons, start and stop sites)
• Basic molecular biology tools (restriction enzymes, DNA ligase, hybridization, DNA sequencing, PCR)
• Basic properties of bacteria and viruses
• Basic eukaryotic cell biology

Lectures:
Most of the lecture content will be provided online. Weekly lecture topics will require approximately 2.5 hours of to review carefully. In addition, examples demonstrating how to solve certain types of problems, and “boxes” with important review materials or interesting applications of concepts discussed in lectures will be posted online. You will be expected to have thoroughly read all of the concepts posted online.

Reading Assignments:
There is no assigned textbook for this course – all of the lecture materials and supplemental lecture materials will be posted online.

Several published research papers will be assigned reading over the course of the semester. The manuscripts have been chosen to demonstrate real-world scientific problems that relate to the topics discussed in class. The manuscripts will be posted as pdf files at least a week before they are discussed. Each student is expected to read the manuscript and to be prepared to answer questions and participate in a group discussion. Questions about the manuscripts may also be asked on the homework and exams.

Special Assignments:
Occasionally a visiting scientist will give a special lecture outside of regular class times that is relevant to this course. We will provide students with 5 additional points for attending these lectures and answering key questions about the lecture. Alternative assignments will be available on request for students unable to attend the lecture.

Homework:
Most weeks there will be homework assignments worth 5-10 points each, for a total of 100 points. You must show all your work logically and legibly for credit. It is OK to discuss the homework with other students, but copying the answer is not acceptable and will result in a score of zero on that assignment.

Homework assignments will be posted online. Homework should be deposited in the assignments page on Blackboard by midnight on the date indicated. Any homework received after this deadline will be depreciated by 10% per day. Answers will be posted on Blackboard. No credit will be given for homework turned in after the answers are posted.

For each student the homework assignment with the will lowest score will be dropped. This includes any assignment not turned in because you are ill or miss an assignment for another reason.
As a rule, you will not be able to find the answers to the homework problems by simply reviewing the lectures or readings – to solve the problems you will need to integrate this information and apply it. The lectures and boxes will provide examples about how to solve certain types of problems, and we will demonstrate how to solve problems in class. A good source of sample problems can be found online at: http://www.sci.sdsu.edu/~smaloy/MicrobialGenetics/problems/

Exams:

There will be three exams and a cumulative final exam, each worth 100 points. The lowest score of these four exams will be dropped. There will be no make-up exams – if you miss an exam, that score will be dropped. You must take three of the four exams to pass this class.

If you believe a question on your exam was incorrectly graded, you must contact the instructor within two weeks of the day the exam was returned – no grade changes will be made after this two week window.

Exams will focus on critical thinking and problem solving related to concepts covered in lectures, homework, and assigned readings.

The exams will be given during the regularly scheduled class times. Answers for the midterm exams will be posted on Blackboard. Use of books, notes, or calculators will not be allowed during exams.

The Final Exam will include material from the entire course. The objectives, format, and the level of difficulty will be similar to (but NOT identical to) that of the midterm exams. Final exams will not be returned, but you may make an appointment to peruse your exam if desired.

Course grades:

Course grades will be based upon a total score, including 300 possible points for the lecture exams plus 100 points for the homework questions. The course grade will be based upon the percentage of total points obtained using the following scale:

A > 90%
B = 80-89.9%
C = 65-79.9%
D = 50-64.9%
F < 50%

Plus and minus grades will be assigned within the indicated ranges. The percent cutoff for a grade may be lowered but will not be raised above that shown.

While requirements are the same for graduate and undergraduate students, graduate students will be held to a higher standard for grading purposes on each of the assignments.
Participation:
The lectures and readings will all be posted online, and sample problems will be available online. Based upon our experience students who come to every class, ask questions, and interact with other students do much better in the course than students who miss classes.

In addition, you will benefit from communicating with other students on the discussion board – one of the best ways to learn is to explain a concept to someone else, and sometimes it is easiest to grasp concepts by talking with someone who has just learned them.

Studying:
How should you study for this course? Carefully go over the notes for each lecture. Then review the lectures while the material is still fresh on your mind. Although some memorization is invariably necessary when learning a new "language", the goal of learning is to understand the information, not to simply memorize a bunch of disconnected "facts". This course will focus on using genetic approaches for understanding and manipulating bacterial physiology. This demands problem solving, and the best way to get good at problem solving is to practice with many different types of problems.

A major purpose of studying is to discover what you don't understand so that you can do something about it. Don't expect to passively absorb the lectures – think about the concepts, and ask yourself questions. Do you understand what was said? Does it make sense and why? Compare and contrast the new information with things that you have already learned.

Online discussion groups can be very helpful for helping you understand difficult concepts. Many examples of sample problems and solutions will be posted online. Go over these examples for practice, and use them for study aids.

Keep up! Read the online lectures and supplements every week. Do the homework assignments before Monday so you can ask questions in class before the homework is due on Wednesday. You can't cram all of the information into your brain the night before an exam, and we may not be available to answer your questions at the last minute. As a rule of thumb you should spend an hour on the course material and a minimal of 2 hours studying outside of class each week for every credit hour.

Special accommodations:
If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and we cannot provide accommodations based upon disability until receipt of an accommodation letter from Student Disability Services.
Letters of recommendation:

Please see the post on letters of recommendation before requesting a recommendation from the instructors.

BIOL 549 Student Learning Outcomes

At the end of this course, students will be able to:

• describe the relationship between genotype and phenotype
• describe the difference between genetic selections, screens, and enrichments and how each can be used to isolate particular types of mutants
• distinguish different types of mutations and their impact on phenotype
• distinguish between mutation rate and frequency and determine these values from experimental data
• describe basic mechanisms of mutagenesis and the expected frequencies of mutagenesis
• describe the mechanisms of gene exchange by transformation, conjugation, and transduction
• describe how Hfr’s are formed and how they can be used to map genes
• draw a genetic map given data from Hfr crosses
• draw a genetic map given data from genetic crosses
• identify complementation groups given data from bacterial or phage complementation experiments, and explain caveats with the interpretation of complementation data
• describe different types of suppressors that can mask the phenotype of a mutation, and the uses of each type of suppressor
• describe the major classes of transposons, the mechanism of transposition, and the utility of transposons for genetic analysis
• describe transposon delivery systems, and how these systems could be used to isolate transposon insertions in or near a gene
• describe the difference between operon and gene fusions
• predict mechanisms of genetic regulation given results from operon and/or gene fusion experiments
• describe restriction-modification systems, and how they exclude foreign DNA
• predict the results of PCR given a genomic DNA sequence and the sequence of oligonucleotide primers, and design primers to test for specific sequence features
• describe the mechanism of transcriptional regulation by repression vs activation
• explain how these mechanisms can be experimentally distinguished using genetic approaches
• describe mechanisms of translational regulation by occlusion of ribosome binding sites and by degradation
• describe how genome sequences can be used to predict gene functions, and how this information can be tested using oligonucleotide directed genetic approaches such as site-directed mutagenesis and Red-mediated recombination
• describe the mechanism of common regulatory systems including the lac operon, the ara operon, catabolite repression mediated by cAMP-CRP, SOS, hin inversion, and two-component regulatory systems
• describe the developmental cycles of phage, and how genetic and molecular approaches can be used to identify these processes