MCDB 1161 – Phage Genomics Laboratory I

Overview

# Bacteriophage are viruses that infect bacteria. These viruses are considered one of the most important new therapies for treating antibiotic-resistant bacterial infections. With support from the Howard Hughes Medical Institute, students in Phage Genomics students purify phage from the environment, visualize them using electron microscopy, and sequence their genomes. The annotated genomes are then published in National Center for Biotechnology Information’s GenBank. At the end of the semester, students present and defend their findings at the CURE Symposium in poster form. Students with an interest in continuing their research can register for MCDB 2161 Phage Genomics Laboratory II. In the second semester, students use modern bioinformatics tools to assemble and fully annotate the genomic of their phage.

## Course Milestones

Collect soil from the environment

Culture bacteria from soil

Identify the presence of phage using a plaque assay

Purify a single phage

View phage particles using transmission electron microscopy

Extract DNA from phage

Restriction enzyme characterization of phage

Prepare phage for DNA sequencing

Analyze data and present results

Course Objectives

MCDB 1161 is a research-based course. Students gain experience with performing several molecular biology and microbiology techniques including PCR, restriction enzyme digest, and bacteria cultures. Importantly, students learn how to optimize approaches to maximize their chances of obtaining reportable results.

<list course objective>

MCDB 1171 – Discovery-based Laboratory I

Overview

# Bacterial resistance to antibiotics is on the rise. The Centers for Disease Control estimate that by 2050, more deaths will result from antibiotic-resistance bacteria than from cancer. There is a critical need for the development of new antibiotics to address this public health issue. The aim of the project in Discovery-based Laboratory I is to identify novel antibiotics by screening in bacteria (*Salmonella*). Students grow bacteria and screen compounds from a compound library from the National Cancer Institute. A different set of up to 150 drugs will be screened each week so that more than 1,000 drugs will be screened over the course of the semester. Students have the opportunity to participate in the screen, choose drugs that are interesting, and pursue further testing. Data generated by students are presented publically in the CURE Symposium and are transferred to the laboratory of Corrie Detweiler for further study.

## Course Milestones

Production of a reliable standard curve using protein as a measure of pipetting technique

Perform antibiotic titration using Salmonella as a second measure of pipetting technique

Inoculate Salmonella into media

Dilute Salmonella culture to 96 well plate

Expose Salmonella to a set of antibiotic candidates

Quantify survival compared to negative controls

Calculate average and standard deviation of library drugs

Determine whether individual drugs are “hits”

Validate candidate compounds

Course Objectives

MCDB 1171 is a research-based course. Students will become familiar with a number of biology concepts and research techniques including approaches to screening for new therapeutics, statistical analyses, and presentation of data to a faculty committee and in a research report. Unlike laboratory exercises that are designed to reinforce concepts that may accompany lecture topics, there is no certainty that any one particular project will succeed, which reflects the inherent risks of novel research. The goal-oriented nature of this research effort means that validation of findings will also be performed.

1. Understand how your data contributes to the research being performed in the Detweiler lab and also to drug discovery in general,
2. Obtain experience in bacteriologic culture methods,
3. Participate in drug screen experiments to identify compounds with potential therapeutic value,
4. Statistically evaluate experimental data,
5. Present and depend research findings at a poster symposium,
6. Understand and be able to describe previous research on your compound(s),
7. Understand and be able to describe how your data relate to previous research.

MCDB 2171 – Discovery-based Laboratory II

Overview

# Current advances in molecular medicine have improved the outcomes of patients with cancer, however, high levels of toxicity make therapies difficult to tolerate. Combinatorial therapies that combine therapeutic approaches may allow patients to experience clinical success with lower toxicities. The aim of the project is to identify novel chemotherapeutics that work additively or synergistically with radiation by screening in fruit flies (Drosophila melanogaster). Students breed Drosophila and screen a library of compounds from the National Cancer Institute. Students follow the development of the flies after exposure to compounds combined with radiation from embryo to adult to quantify survival and to statistically determine whether specific compounds represent potentially useful chemotherapies. After evaluation of the compound library, students have the opportunity to evaluate success of a compound or compounds of their choice. Data generated by students in Discovery-based Lab II are presented publically at the CURE Symposium and are transferred to the laboratory of Dr. Su for continued study.

## Course Milestones

Set up Drosophila population cage

Embryo collection

Embryo culture to larvae

Larvae irradiation

Larvae treatment with drug compounds

Quantify survival

Calculate average and standard deviation of library drugs

Statistically determine whether individual drugs are “hits”

Validate candidate compounds

Course Objectives

MCDB 2171 is a research-based laboratory course.  The overriding goal is for students to become familiar with a number of biology concepts and techniques including model systems, genetics, approaches to screening for new therapeutics, statistical analyses, and compound validation. Unlike laboratory exercises that are designed to “work" and reinforce concepts that may accompany lecture topics, there is no certainty that any one particular project will succeed, which mirrors the inherent risks of novel research. The goal-oriented nature of this research effort means that validation of findings will also need to be performed.

1. Understand how your data contributes to the research being performed in the Su lab and also in drug discovery in general,

2. Obtain experience in Drosophila maintenance and husbandry,

3. Execute drug screen experiments to identify compounds with potential therapeutic value,

4. Statistically evaluate experimental data,

5. Present and defend final research data in a public poster symposium,

6. Understand and be able to describe previous research on your compound(s).

7. Understand and be able to describe how your data relate to previous research.

MCDB 4202 – The Python Project

# Overview

The Python Project is a three-credit laboratory course designed to provide upper division students with an authentic laboratory experience. The Burmese python exhibits remarkable extreme physiology. After feeding, most of the organs in the python nearly double in size within 48 hours. Understanding the mechanisms that mediate this growth could provide important clues to the development of heart and liver diseases. During the class, students design experiments to examine the molecular mechanisms of organ growth in the Burmese python. To this end, students use modern molecular biology and bioinformatic techniques to isolate RNA, synthesize cDNA, assemble and validate a transcript, design primers, measure expression of candidate molecules of the python genome, and publically present data in the context of the research project. The novel data they generate contribute to a larger, ongoing research project in the Leinwand lab.

## Course Milestones

RNA isolation from Burmese python tissues

RNA integrity & purity tests

Primer design

cDNA synthesis

PCR validation of primers

Production of a standard curve using protein

Production of a standard curve using cDNA

Real time PCR

Data analysis & presentation

# Course Objectives

The overriding goal of The Python Project is to provide students with sufficient training & guidance to become proficient in a number of molecular biology techniques including but not limited to gel electrophoresis, isolation of RNA from tissue, cDNA synthesis, PCR, and semi-quantitative PCR. Unlike laboratory exercises that are designed to reinforce concepts that may accompany lecture topics, there is no certainty that any one particular project will succeed, which mirrors the inherent risks of novel research. The linear, goal-oriented nature of this research effort means that repetition of some steps will be required to optimize experimental approaches.

1. Understand how your data contributes to the research being performed in the Leinwand lab,
2. Obtain expertise in designing and optimizing a gene expression study from beginning to end,
3. Design experiments that address specific scientific questions,
4. Successfully present a poster describing your data in a public poster session to be held during the final exam period,
5. Understand and be able to describe previous research on your gene of interest.