# Supplementary Materials

MCDB 1161 – Phage Genomics Laboratory I Syllabus

MCDB 1171 – Discovery Laboratory II Syllabus

MCDB 4202 – The Python Project Syllabus

## MCDB 1161 - Phage Genomics Laboratory I

**Course Information**
Lecture: W 3:00-3:50pm, GOLD A2B70
Lab Section 011: T/R 10-11:50 MUEN E0040
Lab Section 012: T/R 12-1:50 MUEN E0040
Lab Section 013: T/R 2-3:50 MUEN E0040
Lab Section 014: T/R 10-11:50 PORT B0026
Lab Section 015: T/R 12-1:50 PORT B0026
Lab Section 016: T/R 2-3:50 PORT B0026
Open Lab: W 4-6pm, F 12-2pm

**Course Description**
This course integrates molecular biology topics and basic laboratory techniques while allowing students the opportunity to participate in a real scientific research project. This course provides students with laboratory experience working on a bacteriophage genomic research project. Students will study novel bacteriophage they isolate from the environment. Topics covered include phage biology, bacteria and phage culturing and amplification, DNA isolation, restriction digestion analysis, agarose gel electrophoresis, and electron microscopy.

**Instructors**

| | Office | Phone | Email |
|---|---|---|---|
| Dr. Christy Fillman | Porter B142A | 303-492-8559 | Christy.Fillman@Colorado.edu |
| Dr. Nancy Guild | Porter B113A | 303-492-5054 | Nancy.Guild@Colorado.edu |

**Lab Coordinator**

| | | | |
|---|---|---|---|
| Megan Greening | GOLD A1B52 | 303-492-1618 | Megan.Greening@Colorado.edu |

**Instructor Office Hours**
Dr. Fillman: Tuesday 4pm, Wednesday 11am
Dr. Guild: Tuesday 4pm, Wednesday 4pm

**Teaching Assistants**
Six per semester

**Lab Assistants**
Six per semester

Required Text: Phage Genomics I Lab Manual, laboratory notebook with carbonless copies (at least 50 pages).

| Day – Date | Topic | Reading | Due |
|---|---|---|---|
| Week 1<br>T – 8/29 | Lab Safety and Pipetting | Pipetting Video<br>7-10 | Introduction Activity |
| W – 8/30 | Course Information<br>Enrichment and Direct Isolation | 5-6, 20,<br>Appendix 1 | |
| R – 8/31 | Sterile Technique<br>Lab Calculations | 11-12 | Sterile Technique Activity<br>Phage Lab Calculations |
| Week 2<br>T – 9/5 | Enrichment and Direct Isolation | 33 | |
| W – 9/6 | Phage Lifecycles | Bacteriophage Video, 13-20 | Problem Set 1 |
| R – 9/7 | Phage Therapy article discussion<br>Plaque Assay Technique | Phage therapy article (D2L see media links), 35-36 | Phage Therapy Discussion<br>Phage Therapy Activity |
| Week 3<br>T – 9/12 | Purification Streak Technique | 37-38 | Lab Notebook 1 |
| W – 9/13 | Phage Titer Assay<br>Archiving | 21, 39-40, 55 | Problem Set 2 |
| R – 9/14 | | | Phage Lifecycles Activity |
| Week 4<br>T – 9/19 | Phage Titer Technique | | Lab Notebook 2 |
| W – 9/20 | Scientific Presentations<br>Diverse Uses for Phage | Appendix 3, 41 | Problem Set 3 |
| R – 9/21 | High Titer Lysate Technique | | Titer Assay Activity |
| Week 5<br>T – 9/26 | | | Lab Notebook 3 |
| W – 9/27 | Reading Scientific Literature<br>Restriction Analysis<br>Agarose Gel Electrophoresis | 23-28, 43-46 | Problem Set 4 |
| R – 9/28 | DNA Isolation Technique | | Restriction Digestion Activity |
| Week 6<br>T – 10/3 | Restriction Digestion Technique | | Lab Notebook 4 |
| W – 10/4 | Scientific Writing<br>Journal Article | Appendix 2, 47-48, Journal article 1 (D2L) | Problem Set 5 |
| R – 10/5 | Agarose Gel Electrophoresis Technique, Practice Gels | | Journal Article Activity |
| Week 7<br>T – 10/10 | | | Lab Notebook 5 |
| W – 10/11 | Phage Clustering<br>PCR<br>Phage Therapy Research | 29-31, 49-50, Phage clustering article (D2L) | Problem Set 6<br>Materials and Methods Draft* |
| R – 10/12 | | | Phage Clustering Activity |
| Week 8<br>T – 10/17 | | | Lab Notebook 6 |

| Day – Date | Topic | Reading | Due |
|---|---|---|---|
| W – 10/18 | Lysogens and Immunity<br>Quality Control | 53, Immunity video, immunity assay example (D2L) | Problem Set 7<br>Results Draft* |
| R – 10/19 | | | Immunity Activity |
| Week 9<br>T – 10/24 | Presentations | | Lab Notebook 7 |
| W – 10/25 | Lab Midterm exam | | Discussion Draft*<br>No Problem Set Due |
| R – 10/26 | Presentations | | |
| Week 10<br>T – 10/31 | | | Lab Notebook 8 |
| W – 11/1 | Central Dogma | Central Dogma (D2L) | Problem Set 8 |
| R – 11/2 | | | Central Dogma Activity |
| Week 11<br>T – 11/7 | | | Lab Notebook 9 |
| W – 11/8 | Scientific Posters, CURE Symposium<br>Power of Genomics<br>Genomics Research | Appendix 4 | Problem Set 9<br>Abstract and Introduction Draft* |
| R – 11/9 | | | Poster Review |
| Week 12<br>T – 11/14 | Last Day for Experiments | | Lab Notebook 10 |
| W – 11/15 | Sequencing Presentations | | Phage Biology Paper*<br>Hard Copy and D2L<br>No Problem Set |
| R – 11/16 | | | Archiving Report<br>Phages db |
| 11/20-<br>11/24 | Fall Break | | |
| Week 13<br>T - 11/28 | Poster Work Day | | |
| W – 11/29 | Positional and Functional Annotation | DNA Master Guide 9-10, 64-35 (D2L) | Problem Set 10<br>Digital Poster Draft (D2L)<br>1/group |
| R – 11/30 | Peer Review | | Final Poster Draft (D2L)<br>1/group PowerPoint file<br>11:59PM |
| Week 14<br>T – 12/5 | Genomics Activity Day 1<br>Poster Presentations | | Poster Voice Recording |
| W – 12/6 | Symposium Practice Talk<br>Comparative Genomics | DNA Master Guide 105-108 (D2L) | Problem Set 11 |
| R – 12/7 | Genomics Activity Day 2<br>Poster Presentations | | Genomics Activity |
| Week 15<br>M – 12/11 | CURE Symposium<br>5:30-9:00PM UMC Ballroom | | |

| **Date** | **Topic** | Reading | Due |
|---|---|---|---|
| T – 12/13 | Final Presentations | | |
| W – 12/14 | Power of Genomics: The Human Genome Project, Microbiomes, and the Future of Genomics | | Problem Set 12 |
| R – 12/15 | Final Presentations<br>Surveys, Lab Clean-up | | |
| T – 12/19 | Final Exam (Gold A2B70) 7:30-10:00 PM | | |

*Assignments noted with a star are due at the beginning of class. Problem Sets are due by 11:59pm on D2L Wednesdays. All other assignments are due at the end of class.

Course Grading

Your grade will be calculated out of 506 points as shown in the chart below

| | |
|---|---|
| Clicker Points and Lecture Participation | 25 |
| Problem Sets | 70 |
| Lab Notebook | 50 |
| Lab Activities | 111 |
| Writing Drafts | 15 |
| Phage Biology Lab Paper | 50 |
| Presentations | 25 |
| CURE Symposium<br>10 Voice recording + in class presentation<br>20 Poster<br>20 Symposium Attendance (10 photo, 10 eval) | 50 |
| Archiving Report | 20 |
| Mid-term assessment | 25 |
| Final Exam | 40 |
| Participation | 25 |
| Total<br>Maximum Extra Credit (6pts) | 506 |

Clicker Points and Lecture Participation

Clicker points will be recorded using iClicker response pads. Points will be awarded for participating regardless of whether the answer is correct. To earn the maximum of 15 points for clicker participation you must answer 80% of the available clicker questions over the semester. Clicker points are only recorded electronically; you cannot get clicker points for writing down answers during a class if you forget your clicker or if your clicker is not working. Ten lecture participation points will be for in-class activities and for your group responding when called on during class.

Problem Sets

Problems based on the reading and lecture material will be due weekly on Wednesdays at 11:59pm (see syllabus). Each problem set is worth 7 points, and your 10 best problem set scores count towards your grade (2 problem sets are dropped).

Lab Activities

Most lab activities are to be completed in class and turned in at the end of that lab period (see the syllabus). Lab activities can be completed as a group, but each group member must participate and must write their own answer in their own words. Copying activity answers from another student is a violation of the Honor Code. Lab activities are in the activities section of your lab manual.

Phage Biology Paper

Each student will write a lab report about the discovery and characterization of their phage. Drafts of each section of the paper will be assigned, so you can get feedback on your writing before you turn in your final report. You must turn in two copies of your final paper: a digital copy must be uploaded to the dropbox on D2L, and a hard copy must be turned in to the instructor. The drafts of the paper must be turned in with the final copy (for points). For more information about writing scientific papers, see appendix 2 of your lab manual.

Participation and improvement

Participation is an important part of the learning experience in this course. How far your project will go depends on how much work you are willing to put into it. You will not be graded based on how many "successful" experiments you complete but rather by your effort and your ability to critically trouble shoot your experiments and make the appropriate changes when you repeat the experiment. You will work with a lab partner for the experiments in this class. Both partners are expected to participate in all aspects of the experiment. If you find it necessary to repeat a procedure, you should discuss your revised procedure with an instructor first.

Participation points may be earned by: following lab etiquette, being helpful in the lab, sharing equipment, etc. Participation points may be lost by: being late to class, not helping your lab partner, not cleaning up after yourself, not following directions or safety protocols, leaving class early when there is still work to be done, or not following other lab etiquette procedures.

Late Work Policy

All lab assignments that are due at the beginning of class must be turned in before class starts. Late work that is turned in the same day it was due will be marked down 10%. You will lose an additional 10% for each additional day the assignment is late. Work that is more than one week late will not be accepted. If you have an excused and documented absence, your work is due at the next lab period or at an earlier date as determined by your instructor. Please note that turning in your work late is much better than not turning it in at all (a 10% deduction is minor in comparison to a 0 grade).

Attendance Policy

A large portion of this course requires your attendance. Every student is allowed to make up one unexcused absence. Every further unexcused and/or undocumented absence results in a 10 point deduction from your final grade and lost points for all late assignments that were due that day. Excused absences require documentation (*i.e.,* a note from a doctor for illness related absences). Excused absences can be made up by attending open lab time on Friday. No more than 6 excused absences are allowed. If you miss more than 6 class, please speak with an instructor about your options for withdrawing from the course.

Open Lab Policy

Open lab times are optional times that you can work in the lab on your experiments or lab activities. Open labs will be held on Wednesdays and Fridays check the syllabus for times. LAs will be available during open lab time to assist you and answer questions. Instructors have office hours at the times noted on the front page of the syllabus. Office hours and open lab time are also a great time to ask questions about activities and problem sets and to get help with your writing.

Spring 2016
Porter B0046

# MCDB 2171

## Drug Discovery Through Hands-on Screens II

Pamela Harvey, PhD
E-Mail: pamela.harvey@colorado.edu
Phone: 617-501-4175 (emergencies)
Lab: 303-492-7191
Office Hours: by appointment

### Overview

Students will work in pairs as some of the activities such as pouring food and adding drugs are best done with two sets of hands. Based on prior experience, we expect each pair of students to screen through and analyze data from approximately 100 compounds per batch. Screening through each batch, from embryo collection to data analysis, will take about two weeks (collect embryos on day 0, irradiate larvae on day 5, count survival on day 15). Done on a rolling basis, each pair of students is expected to screen four batches of compounds from weeks 1-12, for a total of 400 molecules.

### Course Objectives

The overriding goal of MCDB 2171 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 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. Participate in drug screen experiments to identify compounds with potential therapeutic value,
4. Statistically evaluate experimental data,
5. Successfully present your data to a panel during the final exam period,
6. Understand and be able to describe previous research on your compound(s).

### Co-requisite

MCDB 2150 – Principles of Genetics

### Evaluation

| | Weight |
|---|---|
| Lab participation | 10% |
| Quizzes & worksheets | 35% |
| Lab notebook | 15% |
| Final report | 20% |
| Oral presentation | 20% |

### Materials:

1. Fly Pushing: The Theory and Practice of Drosophila Genetics, by Ralph J Greenspan. Cold Spring Harbor Laboratory Press.

2. The Development of Drosophila melanogaster, by Michael Bates. Cold Spring Harbor Laboratory Press.

3. Radiobiology for the Radiologist, by Eric Hall and Amato Giaccia. Lippincott, Williams and Wilkins Publishers.

*(specific chapters will be assigned as required reading and the books will be available as reference)*

1. M. Gladstone & T. T. Su. Screening radiation sensitizers of Drosophila checkpoint mutants. Methods Mol Biol 2011;782:105-17.

2. M. Gladstone & T. T. Su. Chemical genetics and drug screening in Drosoph cancer models. J. Genetics and Genomics, 2011 Oct 20;38(10):497-504

3. A. Edwards, et al. Combinatorial effe of maytansinol and radiation in Drosophila and human cancer cells, Disease Models and Mechanisms. 2011 Jul;4(4):496-503. Epub 2011 Apr 18.

4. M. Gladstone, B. Frederick, et al. A translation inhibitor identified in a Drosophila screen enhances the effect o ionizing radiation and taxol in mammalian models of cancer. Disease Models and Mechanisms. 2012 May;5(3):342-50.

| *Numerical Grade* | *Letter Grade* |
|---|---|
| ≥ 92.5 | A |
| ≥ 90.0 | A- |
| ≥ 87.5 | B+ |
| ≥ 82.5 | B |
| ≥ 80.0 | B- |
| ≥ 77.5 | C+ |
| ≥ 72.5 | C |
| ≥ 70.0 | C- |
| ≥ 67.5 | D+ |
| ≥ 62.5 | D |
| ≥ 59.5 | D- |
| < 59.5 | F |

## Late assignments

Assignments are due at the beginning of class. Electronic submission is preferred. If an assignment is received after the due date/time, a zero will be entered in the grade book. Late assignments will be accepted with a 10% deduction for each class it is late. When a late assignment is received, the grade will replace the zero in the grade book. If you miss an assignment, you should *always* consider submitting it late. A zero can greatly affect your final grade.

## Attendance policy

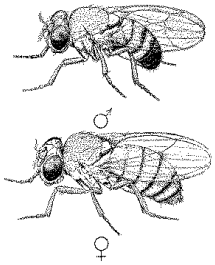
**Attendance is mandatory.** Because lab courses are participatory, your physical presence is required. You will be allowed one unexcused absence without adversely affecting your grade. Each additional unexcused absence will result in the dropping of a full letter grade. An unexcused absence will be defined as failure to notify the course instructor prior to your absence. Notification can be in the form of personal communication, email or contact by cell phone (text or voice mail). However, the onus will be on the student to inform the instructor that he or she will be absent. This includes potential conflicts with other courses that schedule exams when during the time our class meets.

## Make-up Policy

If you anticipate an excused absence will conflict with a laboratory period, please contact an instructor **before** the scheduled class to ensure that your excuse is acceptable (typically medical emergencies, catastrophic loss of a family member, religious holidays, etc.). If you miss a class, it is your responsibility to contact Pamela Harvey to arrange a make-up. The student is responsible for providing satisfactory evidence within one week of the end of the absence to document the necessity of the absence.

## Laboratory Conduct

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. The instructors will gladly honor your request to address you by an alternate name or gender pronoun. Please advise the instructors of this preference early in the semester so that we may make appropriate changes to my records. See policies at http://www.colorado.edu/policies/classbehavior.html and at http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code




## 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 potential hits
- Validate candidate compounds

## Students with Disabilities

If you qualify for accommodations because of a disability, please submit to us a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and http://www.Colorado.edu/disabilityservices.

Disability Services' letters for students with disabilities indicate legally mandated reasonable accommodations. The syllabus statements and answers to Frequently Asked Questions can be found at http://www.colorado.edu/disabilityservices.

## Religious Observances

Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. See full details at: http://www.colorado.edu/policies/fac_relig.html

## Discrimination and Harassment

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. The University of Colorado does not discriminate on the basis of race, color, national origin, sex, age, disability, creed, religion, sexual orientation, or veteran status in admission and access to, and treatment and employment in, its educational programs and activities. (Regent Law, Article 10, amended 11/8/2001). CU-Boulder will not tolerate acts of discrimination or harassment based upon Protected Classes or related retaliation against or by any employee or student. For purposes of this CU-Boulder policy, "Protected Classes" refers to race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, or veteran status. Individuals who believe they have been discriminated against should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Student Conduct (OSC) at 303-492-5550. Information about the ODH, the above referenced policies, and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://hr.colorado.edu/dh/

## Honor Code

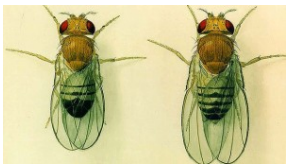
All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at http://www.colorado.edu/policies/honor.html and at http://honorcode.colorado.edu

## Plagiarism and Copyrights

As commonly defined, plagiarism consists of passing off as one's own, the ideas, words, or writings that belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you have the permission of that person. Plagiarism is one of the most serious forms of academic misconduct.

## Course Schedule

(Subject to change at any time due to progression of the research)



| Week | Class | Lecture | Lab | | Experimental set - 700 compounds |
|---|---|---|---|---|---|
| Week of January 16 | Class 1 | | **NO CLASS** | | |
| | Class 2 | Course Introduction and Experimental Design, Pipetting Technique and Exercise Overview & Lab Notebook Overview | Course and pipetting exercise overview | | |
| Week of January 23 | Class 1 | Individual Student Pipetting Results Review, Day 1 | Pipetting Exercise - Day 1 | | |
| | Class 2 | Experimental Protocol Overview, Radiation Safety | Food protocol review, practice pouring food, add yeast to vials, move adult flies from bottle to bottlel, continue pipetting exercise | | Practice with each step of the experimental protocol in an accelerated schedule |
| Week of January 30 | Class 1 | Model Organisms and Fly Biology | Grape juice plates and population cage setup, continue pipetting exercise | | |
| | Class 2 | Fly Development and Husbandry | Embryo observation and collection, different time points for collection tested | | |
| Week of February 6 | Class 1 | Fly Genetics I - chromosomes, balancer chromosome, and maternal effects | New Lab Tour and Safety Overview?, Irradiate and expose flies to positive and negative controls (1 vial per student) | | |
| | Class 2 | Fly Genetics II - checkpoint proteins and grapes mutation | Mark GFP-negative pupae, quantify survival, average, and standard deviation | | |
| Week of February 13 | Class 1 | Lab Meeting & Bioethics and Animal Use | Add yeast to new culture bottles | | Experimental Set #1 - 100 drugs (5 per st |
| | Class 2 | Biostatistics | Transfer adults to new culture bottles | | |
| Week of February 20 | Class 1 | Evolution of Drug Resistance in Cancer | Set up small population cage | **Add yeast to new culture bottles** | Experimental Set #2 - 200 d |
| | Class 2 | Drug Development & Clinical Trials | Egg collection and culture to larval stage | **Transfer adults to new culture bottles** | |
| Week of February 27 | Class 1 | NCI-Developmental Therapeutics Program | Drug/food preparation, larvae collection, and irradiate | **Set up population cage** | |
| | Class 2 | PubMed and Google Scholar | | **Egg collection and culture to larval stage** | |
| Week of March 6 | Class 1 | Tin Tin Research Lecture | | **Drug/food preparation, larvae collection, and irradiate** | |
| | Class 2 | Lab Meeting | Mark GFP and eclosed/not eclosed Thursday evening to Friday morning - (9-10 days after irradiation) | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Week of March 13 | Class 1 | Fly Genetics & Experimental Protocol review - students generate on white board | Quantify survival (vials rechecked Monday evening) | | udent) | rugs (10 per student) |
| | Class 2 | Lab Meeting & Grapes Mutation Exercise | Lab meeting | **Mark GFP and eclosed/not eclosed Wednesday to Friday morning - (9-10 days after irradiation)** | | |
| Week of March 20 | Class 1 | | Add yeast to new culture bottles | **Quantify survival (vials rechecked Monday evening)** | Experimental Set #3 - 200 drugs (10 per student) | |
| | Class 2 | Lab Meeting | Transfer adults to new culture bottles | Lab Meeting | | |
| Week of March 27 | **Spring Break** | | Egg collection and culture to larval stage (Pam) | **Add yeast to new culture bottles (Pam)** | | Experimental Set #4 - 200 drugs (10 per student) |
| Week of April 3 | Class 1 | | Drug/food preparation, larvae collection, and irradiate | **Transfer adults to new culture bottles** | | |
| | Class 2 | | | **Set up population cage** | | |
| Week of April 10 | Class 1 | Scientific Reporting and Ethics | | **Egg collection and culture to larval stage** | | |
| | Class 2 | Anatomy of a Research Article | Mark GFP and eclosed/not eclosed Thursday evening to Friday morning - (9-10 days after irradiation) | **Drug/food preparation, larvae collection, and irradiate** | | |
| Week of April 17 | Class 1 | Lab Meeting & Poster Seesion Presentation | Quantify survival (vials rechecked Monday evening) | | | |
| | Class 2 | Punctuation and Grammar Review, Guidelines for results & disucssion sections - | Lab Meeting | | | |
| Week of April 23 | Class 1 | Guidelines for Introduction Section | | **Mark GFP and eclosed/not eclosed Thursday evening to Friday morning - (9-10 days after irradiation)** | | |
| | Class 2 | Guidelines for Methods Section | | **Quantify survival (vials rechecked Monday evening)** | | |
| Week of April 30 | Class 1 | Lab Meeting & Grammar Review, Guidelines for Results and Discussion sections | | | | |
| | Class 2 | Open Lab | | | | |

# MCDB 4202

## The Python Project

Fall 2017
TTH 1-4 pm, Gold A1B18

Instructor: Pamela Harvey, PhD
Office: Gold B318
E-Mail: pamela.harvey@colorado.edu
Phone: 617-501-4175 (emergencies)
Lab: 303-492-7191
Office Hours: by appointment

TA: Kiley Hartigan
E-Mail: kiley.hartigan@colorado.edu

## Overview

The Python Project is a three-credit laboratory course designed to help upper division students engage in an authentic laboratory experience. During the class, students design experiments to examine the molecular mechanisms of organ growth in the Burmese python. To this end, students will:

- **Use modern molecular biology and bioinformatic techniques** to isolate RNA, synthesize cDNA, design primers, measure expression of candidate molecules of the python genome, and present data in the context of the research project,
- **Generate novel data** that will contribute to an ongoing research project in the Leinwand lab.

## 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 real time 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 somewhat 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 get things to work optimally.

1. Understand how your data contributes to the research being performed in the Leinwand lab,
2. Obtain expertise in real time PCR experiments 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.

## Suggested Prerequisites

MCDB 3120 and 3500, or MCDB 3135 and 3145, and CHEM 4711 and 4731.

## Evaluation

**Quizzes and worksheets:**
Quizzes and worksheets will be completed approximately weekly. Paper submissions will not be accepted. All quizzes and worksheets must be submitted on D2L. Late assignments will be allowed, but 10% will be deducted for each class it is late.

**Midterm Exam:**
The midterm exam for the Fall 2017 semester is scheduled for Thursday, October 26th at 1:00 pm, location to be announced. This date is provided beforehand so students can plan their schedules accordingly. In an effort to be fair to all students taking the course, every effort should be made to attend this exam. A rescheduled exam results in a delay in the other students' exams being returned. The exam will be a cumulative review of laboratory

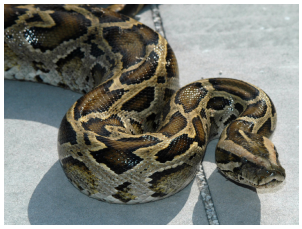
## Materials

There is **no** textbook for this course. All required materials will be posted on D2L.

## Course Milestones

- **RNA Isolation**
- **RNA Integrity & Purity**
- **Primer Design**
- **cDNA Synthesis**
- **PCR Validation of Primers**
- **Production of a Standard Curve**
- **Quantitative PCR**
- **Data Analysis**
- **Data Presentation**

techniques and information covered in the first half of the semester. It should take about two hours to complete.



**Make-up Exam Policy:**
If you anticipate an excused absence will conflict with an exam, please contact me **before** the scheduled exam. If you unexpectedly miss an exam, it is your responsibility to contact me to arrange a make-up. The student is responsible for providing satisfactory evidence within one week of the end of the absence to document the necessity of the absence.

**Final Exam:**
There is no final exam for this course. Final review papers, abbreviated summaries, and completed laboratory notebooks are due at the end of our final exam period. You do not need to be present in lab on that day.

**Point Distribution:**

| | **Weight** |
|---|---|
| Quizzes & worksheets | 15% |
| Review article | 10% |
| Oral presentation | 10% |
| Midterm written exam | 25% |
| Abbreviated summary | 5% |
| Lab notebook | 10% |
| Final research paper | 15% |
| Poster presentation | 10% |

| ***Numerical Grade*** | ***Letter Grade*** |
|---|---|
| ≥ 92.5 | A |
| ≥ 90.0 | A- |
| ≥ 87.5 | B+ |
| ≥ 82.5 | B |
| ≥ 80.0 | B- |
| ≥ 77.5 | C+ |
| ≥ 72.5 | C |
| ≥ 70.0 | C- |
| ≥ 67.5 | D+ |
| ≥ 62.5 | D |
| ≥ 59.5 | D- |
| < 59.5 | F |

## Attendance policy

**Attendance is mandatory.** Because lab courses are participatory, your physical presence is required. You will be allowed one unexcused absence without adversely affecting your grade. Each additional unexcused absence will result in the dropping of a full letter grade. An unexcused absence will be defined as failure to notify the course instructor prior to your absence. Notification can be in the form of personal communication, email or contact by cell phone (text or voice mail). However, the onus will be on the student to inform the instructor that he or she will be absent. This includes potential conflicts with other courses that schedule exams when during the time our class meets.

## Laboratory Conduct

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed,

politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at

http://www.colorado.edu/policies/classbehavior.html and at
http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

## Students with Disabilities

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and http://www.Colorado.edu/disabilityservices.

Disability Services' letters for students with disabilities indicate legally mandated reasonable accommodations. The syllabus statements and answers to Frequently Asked Questions can be found at http://www.colorado.edu/disabilityservices.

## Religious Observances

Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. See full details at: http://www.colorado.edu/policies/fac_relig.html

## Discrimination and Harassment

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. The University of Colorado does not discriminate on the basis of race, color, national origin, sex, age, disability, creed, religion, sexual orientation, or veteran status in admission and access to, and treatment and employment in, its educational programs and activities. (Regent Law, Article 10, amended 11/8/2001). CU-Boulder will not tolerate acts of discrimination or harassment based upon Protected Classes or related retaliation against or by any employee or student. For purposes of this CU-Boulder policy, "Protected Classes" refers to race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, or veteran status. Individuals who believe they have been discriminated against should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Student Conduct (OSC) at 303-492-5550. Information about the ODH, the above referenced policies, and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://hr.colorado.edu/dh/

## Honor Code

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, participating in academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at:
http://www.colorado.edu/policies/honor.html and at http://honorcode.colorado.edu

## Plagiarism and Copyrights

As commonly defined, plagiarism consists of passing off as one's own, the ideas, words, or writings that belong to another. In accordance with this definition, you are committing

plagiarism if you copy the work of another person and turn it in as your own, even if you have the permission of that person. Plagiarism is one of the most serious forms of academic misconduct.

All lectures, exams, handouts and other materials used in this course (including those provided in D2L) are copyrighted. Because these materials are copyrighted, you do not have the right to reproduce, transmit, provide or receive these materials without explicit permission of the instructor/authors. Any other use of these materials is considered "unauthorized" and is thus a form of academic dishonesty and an honor code violation.

## Projected Schedule of Experiments

Note: The nature of the course requires some flexibility in the progression of the semester. Research is unpredictable. We will do out best to adhere to this schedule in terms of experimental procedures. For planning purposes, lecture and assignment due dates will not change.

| Date | Experimental Procedure | Lecture Topic |
|---|---|---|
| August 29, 2017 | NO CLASS | |
| August 29, 2017 | | |
| September 5, 2017 | | Lab Orientation, Introduction to the Python Project |
| September 7, 2017 | Primer Design Part I | Python Transcriptome and WGS |
| September 12, 2017 | Primer Design Part II | |
| September 14, 2017 | Primer Design Part III | |
| September 19, 2017 | Primer Design IV | |
| September 21, 2017 | RNA Isolation | RNA Transcription and Splicing Review, RNA Isolation Protocol |
| September 26, 2017 | RNA gel electrophoresis | RNA to cDNA – qPCR Introduction, Review of Procedure to Date, RNA Concentration, Purity, and Integrity |
| September 28, 2017 | cDNA Synthesis | Conventional PCR, General Chemistry Review |
| October 3, 2017 | PCR Primer Test – Reference Genes | Burmese Python Research |
| October 5, 2017 | Gel electrophoresis & Imaging | Cardiac Physiology I |
| October 10, 2017 | PCR Primer Test – GOI primer set 1, 10 Minute Talks 1 | |
| October 17, 2017 | Gel electrophoresis, 10 Minute Talks 2 | Cardiac Physiology II |

| | | |
|---|---|---|
| **October 17, 2017** | PCR Primer Test – GOI primer set 2, 10 Minute Talks 3 | |
| **October 19, 2017** | Gel electrophoresis, 10 Minute Talks 4 | |
| **October 24, 2017** | 10 Minute Talks 5, Bioneer PCR Kit | Review Session for Midterm |
| **October 26, 2017** | **Midterm Exam** | |
| **October 31, 2017** | Protein Assays | Review Paper Overview, Introduction to Standard Curves & Protein Assays |
| **November 2, 2017** | Protein Assays | |
| **November 7, 2017** | Protein Assays | qPCR I |
| **November 9, 2017** | Protein Assays, qPCR – standard dilution set up | qPCR II |
| **November 14, 2017** | qPCR GOI plate 1 | |
| **November 16, 2017** | qPCR GOI plats 2 | qPCR III |
| **November 21, 2017** | **Fall Break – no class** | |
| **November 23, 2017** | | |
| **November 28, 2017** | qPCR GOI plate #3 | Biostatistics, Poster Presentation Details |
| **November 30, 2017** | Data analysis – CFX96 software, qPCR GOI plate #4 | CFX96 Data Analysis |
| **December 5, 2017** | qPCR, Conventional PCR, Poster Practice | Online Research Resources |
| **December 7, 2017** | qPCR, Conventional PCR, Poster Practice | Review of Poster Presentation Details & CURE Symposium |
| **December 11, 2017** | **CURE Symposium 5:30-9 pm** | |
| **December 12, 2017** | Plan for Spring 2018, Finalize data | Anatomy of a Research Publication, Python Research Paper Introduction Review |
| **December 14, 2017** | Open Lab | Python Methods Review, Expectations for Final Assignments Review |
| **Final Exam Day (TBD)** | Lab Notebooks, Abbreviated Summary, and Final Research Paper Due at end of final exam period | |

## Schedule of Due Dates

| Assignment | Due Date & Time |
|---|---|
| Primer Design I | 9/12/2017, 1 pm |
| Primer Design II | 9/14/2017, 1 pm |

| | |
|---|---|
| Primer Design III | 9/19/2017, 1 pm |
| Primer Design IV | 9/21/2017, 1 pm |
| Primer Design Worksheet | 9/26/2017, 1 pm |
| RNA Transcription & Translation Worksheet | 9/28/2017, 1 pm |
| Conventional PCR & General Chemistry Worksheet | 10/3/2017, 1 pm |
| Python Research Worksheet | 10/5/2017, 1 pm |
| Cardiac Physiology I | 10/10/2017, 1 pm |
| Cardiac Physiology II | 10/17/2017, 1 pm |
| qPCR I & II Worksheet | 11/14/2017, 1 pm |
| Review Paper | 11/16/2017, 1 pm |
| qPCR III & Biostatistics | 11/30/2017, 1 pm |
| Final Poster PowerPoint | 12/1/2017, 5 pm |
| Final Research Paper | End of final exam period (to announced by CU) |
| Abbreviated Summary | End of final exam period (to announced by CU) |
| Final Laboratory Notebooks | End of final exam period (to announced by CU) |