MCDB 4202

The Python Project

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 will 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 sponsor 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 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 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 sponsor lab,
2. Obtain expertise in PCR and semi-quantitative 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.

Midterm Exam:

The midterm exam for the Fall 2015 semester is scheduled for Wednesday, October 21 at 3:00pm, 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 review of laboratory techniques and information covered in the first half of the semester. It should take about two hours to

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

Semi-quantitative PCR

Data Analysis

Data Presentation

complete.

Final Exam:

There is no final exam for this course. Final research papers and completed laboratory notebooks are due during the final exam period.

Point Distribution:

	Weight
Quizzes & worksheets	15%
Review article	10%
Oral presentation	10%
Midterm written exam	25%
Abbreviated summary	5%
Lab notebook	10%
Final report	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.

Make-up Exam Policy

If you anticipate an excused absence will conflict with an exam, please contact me **before** the scheduled exam. If you 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.

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 htp://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.

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 Course Schedule

This schedule will change periodically throughout the semester based on the progress of the research. Because of its small text, this schedule has also been uploaded to D2L as a PDF.

MCDB 4202 - Spring 2016

Week	Date	Lecture	Reading	Assignment - Due Date	Relevant Protocol on D2L	Lab	General Experiments Performed	Main Topics Covered
1	1/12/16	Course Introduction, Experimental Design, and Pre-Test	Making Solutions	Worksheet 1 - Gen Chem Review - due January 14				Course Introduction
	1/14/16	Review Worksheet 1, Background Lecture 1 (Python Introduction) and Genes of Interest Review	Python as a Model Organism	Worksheet 2 - Python as a Model Organism - due January 19				
2	1/19/16	Sign up for genes, Primer Design 1	Primer Design 1	Primer Design 1 (find genes in PubMed and Ensembl, document the sequence) - due January 21			Primer Design	Primer Design
	1/21/16	Primer Design 2	Primer Design 2	Primer Design 2 (map contigs, align in Ensembl sequence from the references species) - due January 26				
3	1/26/16	Primer Design 3	Primer Design 3	Primer Design 3 (assemble transcript from BLAST alignment, translate, protein BLAST) - due January 28				
	1/28/16	Primer Design 4	Primer Design 4	Primer Design 4 - Primer 3, Primer BLAST, design control primer - due February 2				
4	2/2/16	Pipetting technique, Overview of protein assay protocol, Lab notebook maintenance		Mouse Primer Set - due February 4	Bradford Assay Protocol	Protein Assay	Pipetting Exercise	Pipetting and Standard Curves
	2/4/16	Overview of standard curves		Protein Assay Unknown Identification - due February 9		Protein Assay, Identify unknown concentration		
5	2/9/16	Background lecture 2 (transcription and translation) Experimental overview, RNA handling, RNA isolation procedure, 10 minute talk signup	RNA handling, Transcription and translation	Worksheet 3 (RNA, transcription & translation) - due February 11	RNA Isolation Protocol	RNA Isolation	RNA Isolation and cDNA Synthesis	Background, RNA, and cDNA
	2/11/16	RNA Gel Electrophoresis Procedure, 10 Minute Talk Guidelines & Demo			RNA Gel Electrophoresis Protocol	RNA gels		
6	2/16/16	Experimental overview, cDNA synthesis protocol review			cDNA Synthesis Protocol			10 Minute Talks, Conventional PCR
	2/18/16	First Four 10-minute Talks, Conventional PCR Lecture						
7	2/23/16	Second Four 10-minute Talks, Conventional PCR Protocol Review	Conventional PCR	Worksheet 4 - Conventional PCR - due February 25		PCR 1, using control primers	PCR Validation	
	2/25/16	Gel electrophoresis review (in lab), Third Four 10-minute Talks	Gel Electrophoresis			Pour gels before talks, load gels after talks		
8	3/1/16	Fourth Four 10-minutes Talks				PCR 2, using designed primer set 1		
	3/3/16	Review paper guidelines		Review paper - due March 18		Gel of PCR 2, PCR 3, using designed primer set 2		
9	3/8/16	PCR optimization techniques review				Gel of PCR 3, PCR 4, optimization of primer sets, if necessary		Introduction to Bile Acids and Cholesterol Homeostasis
	3/10/16	Lab Meeting to discuss PCR results, Bile Acids Lecture 1	Bile Acids Reading 1	Worksheet 5 - Bile Acids I - due March 15				
10	3/15/16	Bile Acids Lecture 2 - Cholesterol Homeostasis	Bile Acids Readings 2	Worksheet 6 - Bile Acids II - due March 17		Gel of PCR 4		
	3/17/16	Introduction to Mindomo, distribute Mindomo tasks	Mindomo Review, Fall 2015 Presentation			Further PCR optimization, if necessary		Concept Maps
11	3/22/16				Spring Break			
	3/24/16							
12	3/29/16	Real time PCR Lecture 1	Standard curves and real time PCR	Worksheet 7 - Standard curves and real time PCR - due March 31		Pipetting practice, new cDNA, if necessary	Pipetting Practice	Preparation for Real Time PCR
	3/31/16	Real time PCR Lecture 2, optional midterm exam review				Pipetting practice		
13	4/5/16				Midterm Exam			
	4/7/16	Midterm Exam Review, Real time PCR Protocol Overview, Anatomy of a Research Article, Research Paper Formatting	Final Research Paper Formatting, Student Research Paper Examples			qPCR Plate 1 (standards only)	Real Time PCR	Preparation for Final Paper
14	4/12/16	Guidelines for Introduction Section		Introduction draft - due April 14		qPCR Plate 2 (GOI)		
	4/14/16	Guidelines for Methods Section		Methods draft - due April 19		qPCR Plate 3 (GOI)		
15	4/19/16	Lab Meeting & Poster Presentation Guidelines and Demonstration	Guidelines for Poster Presentation	Results draft - due April 21		qPCR Plate 4 (GOI)		
	4/21/16	Punctuation and Grammar Review, Guidelines for Results & Discussion sections, Real time PCR Data Analysis and Stats	Punctuation and Common Grammatical Errors, Real Time PCR Data Analysis, Biostatistics Review	Worksheet 8 Data Analysis & Statistics - due April 26		qPCR Plate 5 (GOI)		
16	4/26/16	Lab Meeting & Oral Presentation Practice Session						Preparation for Final Presentation
	4/28/16	Oral Presentation & Poster Practice						
	Date to be determined	Oral Presentation and Poster Session						