Bi 430 / 530

(CRN 60373 /60390)

Theory of Recombinant DNA Techniques

Syllabus, Spring 2021

Lecture/discussion:

M-W-F, 10:15 – 11:20. In light of the continuing (but hopefully waning) COVID-19 pandemic, our class meetings will be held remotely at the scheduled times, using Zoom. Class meetings will generally cover a set of lecture materials, posted as a powerpoint file ahead of class. All Zoom class meetings will be recorded, and can be accessed later if you need to miss a class for any reason.

Instructor:

Dr. Michael Bartlett --- SRTC Room 458 --- 503-725-3858 --- micb@pdx.edu

Office hours:

Mondays 2 – 3:00 PM, Thursdays 11AM – noon, or by appointment. All office hours will be held using Zoom.

Required reading:

All course readings will be posted online.

Prerequisite:

Bi 334 – Molecular Biology, or equivalent.

Course Description:

Theory of Recombinant DNA Techniques (Bi 430/530) concerns techniques by which the genetic programs of living systems can be modified and studied. Methods for genetic manipulation and transformation are described from the test tube to the organism. The applications of these methods and their implications are explored through selections from the current and recent scientific literature.

Learning Objectives:

Upon completion of Bi 430/530, students should be able to:

- Describe the methods used for isolation, quantitation, and detection of DNA and RNA
- Design protocols for manipulating and modifying DNA in the test tube
- Describe methods for sequencing and analysis of DNA molecules
- Analyze DNA and protein sequences for function using bioinformatics tools.
- Define molecular cloning, and interpret models for molecular cloning vectors
- Design strategies for cloning various kinds of DNA molecules
- Describe the determinants of gene expression and their utility in cloning experiments
- Explain the utility of recombinant DNA techniques for human health and biotechnology

- Utilize design principles for engineering microbes for industrial purposes
- Explain methods for genetic manipulation in animals and plants, while weighing costs, benefits, and ethical considerations
- Define organismal cloning, and describe its agricultural utility
- Describe methods for generating stem cells, and for utilizing stem cells in research and medicine
- Apply molecular biology techniques to distant fields, including archaeology and nanotechnology
- Effectively utilize the vocabulary of molecular cloning and recombinant DNA

Skills Development:

During this course, students will learn how to:

- Read and analyze methods for molecular manipulation
- Determine probable functions of sequences using basic bioinformatics software
- Read and analyze selections from the primary scientific literature
- Solve problems in molecular cloning
- Design protocols for analyzing, manipulating, moving, and testing biomolecular sequences

Course Web Pages:

The PSU online resource 'Desire 2 Learn' (D2L) will be used for posting daily notes, announcements, assignments, grades, and other course materials. Log in at https://d2l.pdx.edu

Grading:

Bi 430	Bi 530*	
40%	30%	Quizzes: lowest two quiz scores are dropped
30%	20%	Homework: lowest homework score is dropped
15%	15%	Midterm exam
15%	15%	Final exam
-----	20%	* In-class presentations, to be given during the second half of the class

Grading cut-offs will be as follows: 93% and up, A; 90 and up, A-; 88 and up, B+; 82 and up, B; 80 and up, B-; 77 and up, C+; 68 and up, C; 65 and up, C-; 62 and up, D+; 53 and up, D; 50 and up, D-; under 50, F.

There are no makeup exams. You must take both exams or you cannot earn a passing grade.

Academic dishonesty (cheating, plagiarism, etc.) will result in a zero for the assignment, and will be reported to student affairs, as described in the PSU Code of Conduct: https://www.pdx.edu/dos/psu-student-code-conduct

If you are a student with a documented disability and have registered with the Disability Resource Center, please contact me immediately to arrange academic accommodations.

Class Schedule

Week	Date	Topics	Quiz/ assign	Questions to address
1	M	The molecular revolution; DNA manipulation and biosafety		How are recombinant DNA risks defined and managed?
	W	Isolation of DNA and RNA		How is useful DNA and RNA isolated?
	F	Isolation of DNA and RNA II	Q1	
2	M	Visualization and detection of DNA, RNA, and protein		How are DNA, RNA and proteins detected and measured?
	W	Detection of *specific* DNA, RNA, and protein molecules	Q2	How can specific DNA, RNA and protein molecules be identified in a complex mixture?
	F	Enzymes for manipulation of nucleic acids	A1	How can DNA be modified in the test tube?
3	M	DNA amplification by PCR	Q3	Why is PCR such a versatile tool for nucleic acid studies?
	W	DNA sequencing	(A1 due)	What DNA sequences exist in nature, and what are they for?
	F	The human genome and its implications	Q4	How is the human genome accessed and used?
4	M	Bioinformatics		How is biological sequence and functional information used?
	W	Bioinformatics II	Q5	
	F	Genome-scale measurements: microarrays, RNAseq, chromatin immunoprecipitation, proteomes	A2	How can all of the genes in a genome be studied at once?
5	M	Cloning genes I: plasmids and transformation	Q6	How is DNA moved into and between biological systems?
	W	Cloning genes II: special vectors and large DNA fragments	(A2 due)	
	F	**Midterm exam**		

6	M	Cloning genes III: library construction and screening, recombination-based engineering, cloning in prokaryotes other than *E. coli*		How can a specific piece of DNA be identified and cloned?
	W	Protein expression I		How can cells be made to produce useful products?
	F	Protein expression II	Q7	
7	M	Mutagenesis, protein engineering, altering the genetic code		How can genes & organisms be altered for practical purposes?
	W	Applied mutagenesis: metabolic engineering, genome shuffling, synthetic genomes	Q8	
	F	Applied mutagenesis II	A3	
8	M	Cloning in *Saccharomyces cerevisiae*. Cloning in higher eukaryotic cells: cell culture, embryonic and induced pluripotent stem cells, organismal cloning	Q9	Why is yeast such a useful model system for eukaryotes? Why are stem cells so useful? How can an organism be cloned?
	W	Cloning in eukaryotic cells: transformation and viral transduction	(A3 due)	How is new DNA added to eukaryotic cells?
	F	Cloning in eukaryotic cells: selection strategies and genetic control	Q10	How are added genes controlled?
9	M	Gene therapy and CRISPR-Cas9		How is gene therapy being done? How is Crispr-Cas9 being used
	W	CRISPR-Cas9 II	Q11	
	F	Nucleic acid vaccines	A4	How can the immune system be programmed to prevent infectious diseases?
10	M	*Memorial Day (no class)*		
	W	Transgenic animals	Q12	How and why are transgenic animals and plants made?
	F	Genetic manipulation of plants	(A4 due)	
Finals		**Final exam**, Wed. June 9, 10:15 – 12:05		