

# Sample Syllabi – Subject to Change

## BIOS 11140-94 - Biotechnology for the 21<sup>st</sup> Century

### ***Instructor***

Navneet Bhasin, Ph.D.

### ***Course Description***

This course is designed to provide a stimulating introduction to the world of biotechnology. Starting with an overview of the basic concepts of molecular biology and genetics that serve as a foundation for biotechnology, the course will segue into the various applied fields of biotechnology. Lectures and some of the corresponding hands on experiments will include microbial biotechnology, agricultural biotechnology, biofuels, cloning, bioremediation, medical biotechnology, DNA fingerprinting and forensics and the associated tools like DNA isolation, PCR, gel electrophoresis, CRISPR mediated mutagenesis, DNA sequence analysis etc. The goal of this course is to provide students with an appreciation of important biotechnology breakthroughs, the techniques involved and the associated bioethics issues.

### **TENTATIVE SCHEDULE**

*Depending on the progression of the class, we may move around some course components on a day to day basis. Below are the proposed time allocations for lab and lecture content for each day:*

**9 – 10:30 - Lecture**

**10:30 – 12:00 - Lab**

**12:00 – 1:30 – Lunch**

**1:30 – 3:00 – Lab, lab write-up and Discussion**

### ***Week 1***

**Introduction to Biotechnology**

**Lab Safety Training**

**Lab**

- Lab basics (Micro-pipetting)
- Lab 1 - Antibiotic resistance in bacteria – Part1 (serial dilutions)

***Lab write-up:*** Lab basics

***Reading:*** New ways to Squash Superbugs (Supplement - The Ultimate Social Network)

**Lecture**

- Review of cell structure
- Molecule of Life

**Lab**

- Lab 2 – Light microscopy using butterfly wings and pre-stained plant cells and Fluorescent Microscopy of GFP transgenic tobacco plants and stained Ptk cells

***Lab Write-up:*** Lab 2

## Lecture

- Transcription and Translation
- Mutations: Causes and Consequences

## Lab

- Lab 3 - Genotypic and Phenotypic analysis of the Tas2R38 gene –
  - Part I – Extraction of chromosomal DNA
  - Part II – PCR amplification of Tas2R38 gene
  - Part III – Analysis of PCR product by gel electrophoresis and clean-up of the amplicon for DNA sequencing

**Discussion:** New ways to Squash Superbugs (Supplement - The Ultimate Social Network)

**Reading:** Alternative Genome (Supplement - Cloning of the Insulin gene)

## Lecture

- Regulation of gene expression
- DNA Cloning

## Lab

- Lab 4 – Generation of *ade*<sup>-</sup> mutants from WT yeast and reversion of *ade*<sup>-</sup> mutants to WT yeast using CRISPR as a tool.
  - Part I (Transform yeast using plasmid constructs)
- Lab 5 – Protein Folding – *in silico* protein modeling and write up

## Lecture

- Recombinant DNA Technology

## Lab

- Lab 1 - Antibiotic resistance in bacteria
  - Part II (pGreen Plasmid purification, DNA quantification)
  - Part III (Transformation of Rif<sup>r</sup> mutants with pGreen plasmids carrying Amp<sup>r</sup> gene)

**Discussion:** Alternative Genome (Supplement - Cloning of the Insulin gene)

**Reading:** Microsatellites paper (Supplement – Forensics, Fingerprinting and CODIS)

## Week 2

### Lecture

- Forensic Sciences – Criminal evidence and Familial relationships

### Lab

- Lab 1 - Antibiotic resistance in bacteria
  - Part IV – Calculate the frequency of appearance of drug resistance – both spontaneous and as a result of transformation.

**Lab Write-up:** Lab 1

**Discussion:** Microsatellites paper (Supplement – Forensics, Fingerprinting and CODIS)

**Reading:** – Transgenics – a new breed of crops (Supplement – Superweeds)

*Choose a topic for your “end of the quarter poster presentation”*

**Tour:** The Crerar Library

## Guest Lecture

- Dr. Peter O'Donnell – PI of “The 1200 Patient Project”

**Activity:** Tour the Comprehensive Cancer Center **DNA Sequencing and Genotyping Facility.**

**Lab**

- Lab 4 – Generation of *ade*<sup>-</sup> mutants from WT yeast and reversion of *ade*<sup>-</sup> mutants to WT yeast using CRISPR as a tool.
  - Part II – Streak purify mutant colonies
- Lab 6 - Fingerprinting – Analysis of the D1S80 Locus
  - Part I – Extraction of chromosomal DNA
  - Part II – PCR amplification of the D1S80 locus
- How to write scientifically

**Week 3**

**Lecture**

- Microbial Biotechnology – Vaccines, Genomes, Diagnostics and bioterrorism

**Lab**

- Lab 8 - Fermentation Foods Lab
- Lab 4 – Generation of *ade*<sup>-</sup> mutants from WT yeast and reversion of *ade*<sup>-</sup> mutants to WT yeast using CRISPR as a tool.
  - Part IV – Colony PCR

**Lab Write-up:** Lab 8

- Lab 4 – Generation of *ade*<sup>-</sup> mutants from WT yeast and reversion of *ade*<sup>-</sup> mutants to WT yeast using CRISPR as a tool.
  - Part V – Gel electrophoresis and analysis
- Lab 7 - RNA interference in *C. elegans* – Part II

**Lab Write-up:** Lab 4 and 7

**Discussion:** A very personal problem and Paradox of precision medicine

- Lab 3 - Genotypic and Phenotypic analysis of the Tas2R38 gene
  - Part IV – Analysis of DNA sequence

**Lab Write-up:** Lab 3

**Poster Preparations**

**Poster Presentations**

**Reference Books and required Text**

You could refer to any basic Biology/Biotechnology book from the library. If you need help with a specific topic, you could borrow books from my personal library as well.

Additional reading materials will be posted on Canvas.

**Grading**

1. Lab Participation/Write-ups – 25%
2. Assignments, Class Discussions and Activities – 30%
3. Daily Quizzes – 25%
4. Poster Presentations - 20%

## ***Acknowledgements***

Some of the Lab materials for this course were adapted from the “University of Chicago Cell Biology & Genetics lab manuals of Tom Christianson and Chris Schonbaum”.

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