Virginia Western Community College
BIO 251
Protein Applications in Biotechnology

Prerequisites
One semester of college biology (NAS 2 or BIO 101); completion of CHM 111 is recommended.

Course Description
Prepares students to understand protein structure and function and teaches the laboratory skills needed to successfully work with proteins. Focuses on levels of protein structure and protein function. Includes common laboratory assays for protein synthesis, purification, detection, and quantification.

Semester Credits: 4 Lecture Hours: 3 Lab/Clinical/Internship Hours: 3

Required Materials

Textbook:
Academic Cell: Biotechnology. Clark and Pazdernik. Elsevier/Academic Press. ISBN: 9780123850157

Other Required Materials:
Molecular Biology Techniques: A Classroom Laboratory Manual. Carson, Miller, and Witherow. Academic Press. ISBN: 9780128180242
Lab Coat
Student Lab Notebook. Hayden. McNeil. ISBN: 9781930882744

Course Outcomes

At the completion of this course, the student should be able to:

- Explain and understand the selection and interpretation of primary scientific literature.
- Effectively communicate scientific findings (both written and orally) and relate these findings to the greater whole (eg: social, ethical, or academic issues)
- Articulate knowledge of key concepts in molecular biology (e.g. transcription/translation, protein structure, regulation of protein production)
- Demonstrate knowledge of key concepts, including applications and limitations of each technology, related to proteins including, but not limited to:
    1. Protein Isolation and Purification
    2. Western Blotting
    3. Immunohistochemistry and Immunofluorescence
    4. Antibody Production and Selection
    5. Protein Assays (Bradford, BCA, Lowry, ELISA)
    6. Chromatography
    7. Mass Spectrometry
    8. Fluorescence Activated Cell Sorting (FACS)

9. Flow Cytometry
10. Recombinant Protein Technologies
11. Microscopy

- Use experimental design to demonstrate knowledge of the available protein applications and the appropriate use of each type of technology
- Demonstrate workplace awareness and readiness as indicated through personal behavior (e.g. timeliness, collegiality, ability to work in a group, etc.)
- Exhibit an appreciation, enthusiasm, and interest for biotechnology and/or laboratory science

Following completion of the laboratory component of this course, the successful student will be able to demonstrate/perform:

- Identification of key pieces of laboratory equipment (e.g. centrifuges, electrophoresis equipment, incubator, microplate reader)
- Knowledge of basic laboratory math, including significant figures, unit conversions, dilutions, and other necessary techniques.
- Solution preparation and pH measurements
- Proper pipetting technique and accurate measurement of small (microliter) volumes
- Proper aseptic technique
- Knowledge of prokaryotic and eukaryotic cell culture
- Protein isolation, purification, extraction, and measurement/visualization techniques such as:
  - SDS-PAGE Electrophoresis
  - Western Blotting
  - Protein Assays (ELISA, Bradford, BCA, Lowry)
  - Immunohistochemistry
  - Column Chromatography
- Proper utilization of bioinformatic techniques
- Troubleshoot an experiment and develop alternative options (if necessary) for experimental design.
- Ability to generate professional and accurate written materials (e.g. lab notebook, report, poster) to document his/her laboratory work.

Topical Description

Topics	Chapter
1. DNA, RNA, and Protein	2
1. Translating the Genetic Code into Protein	
2. Differences between Prokaryotic and Eukaryotic Translation	
3. Mitochondria and Chloroplast Protein Projection	
4. Protein Structure	
2. Immune Technology	6
1. Antibody Structure and Function	
2. Antibodies, Antigens, and Epitopes	
3. Monoclonal Antibodies	
4. ELISA	
5. Visualizing Cell Components using Antibodies	

6. FACS

3. Proteomics 9
    1. Gel Electrophoresis
    2. Western Blotting
    3. HPLC
    4. Mass Spectrometry
    5. Protein Tagging Systems
    6. Protein Interactions
    7. Protein Arrays

4. Recombinant Proteins 10
    1. Expression of Eukaryotic Proteins in Bacteria
    2. Protein Fusion Vectors
    3. Expression of Proteins in Eukaryotic Cells
    4. Expression of Proteins in Yeast Cells
    5. Expression of Proteins in Mammalian Cells
    6. Protein Glycosylation
    7. Protein Stability and Secretion
    8. Issues with Protein Expression

5. Applications of Biotechnology-As time permits at the discretion of the instructor
    1. Nanobiotechnology 7
    2. Protein Engineering 11
    3. Synthetic Biology 13
    4. From Cell Phones to Cyborgs 14
    5. Inherited Defects and Gene Therapy 17
    6. Cancer Biology 19
    7. Biowarfare and Bioterrorism 22
    8. Bioethics 23
    9. Other topics as identified by the instructor TBD

Suggested Laboratory Topics

1. Introduction to Laboratory Safety/Pipetting
2. Making Solutions and Basic Laboratory Math
3. Aseptic Technique/Bacterial Cell Culture
4. Bacterial Transformations
5. Eukaryotic Cell Culture
6. SDS-PAGE Electrophoresis
7. Western Blotting
8. Column Chromatography
9. Protein Assays
10. Immunohistochemistry and Immunofluorescence
11. Microscopy

Notes to Instructors

- Syllabus should state what the course grade will be based on, such as tests, quizzes, a comprehensive final exam, and any other assignments made by the instructor.

- The VWCC Biology Department uses a 10 point grading scale.

- A comprehensive final practical will be given at the end of the semester.

- Comprehensive study of the listed topics is beyond the reasonable expectations of a 15-week Protein Applications course. It is up to the discretion of the instructor to choose which topics are more detailed but each topic should be adequately covered.