

**J. Sargeant Reynolds Community College
Course Content Summary**

Course Prefix and Number: BIO 251 **Credits:** 4

Course Title: Protein Applications in Biotechnology

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. Lecture 3 hours. Laboratory 3 hours. Total 6 hours per week. 4 credits

General Course Purpose:

This course is designed to provide an introduction to protein structure and function. Students will be introduced to the theory behind protein structure-function relationships and will practice the laboratory skills needed to be successful working with proteins. This course will cover aspects of protein synthesis, including *in vitro* systems for protein production while preserving a protein's structure and function. Assays for protein purification, detection, and quantification are included. Basic principles of enzymology, enzyme kinetics and binding assays will be discussed. Protein chromatography and electrophoresis techniques are also included. Principles of proteomics, diagnostic, therapeutic, and industrial applications of protein products are discussed.

Course Prerequisites and Co-requisites:

Prerequisites: BIO 250 and BIO 253 with a C or better.

Student Learning Outcomes:

Upon completing the course, the student will be able to

- Describe the roles of proteins in cells and organisms
- Recognize and describe the properties of individual amino acids and the steps of protein synthesis (i.e. transcription and translation)
- Name and describe the levels of protein structure and how they are stabilized
- Discuss methodologies used to determine protein structure
- Explain the types and importance of post-translational modifications
- Discuss *in vitro* protein synthesis systems
- Describe the roles of enzymes in cells
- Identify the structures and roles of receptors, transporters, structural and recognition proteins in cells
- Explain how protein functions are regulated
- Summarize the protein sequencing process
- Describe several protocols to purify proteins
- Use GC-MS to generate and interpret data
- Explain the basic principles of bioinformatics and use computer programs, such as BLAST, to compare amino acid sequences in databases.
- Work safely in a lab environment
- Demonstrate proficiency with basic lab skills including documentation, aseptic technique, pipetting, media preparation, and solution preparation and dilution

- Describe how industrial protein production, such as in the pharmaceutical industry, is accomplished
- Describe recent methodological developments in biotechnology pertaining to proteins

Major Topics to Be Included:

- Introduction to protein characteristics
- Classifications of amino acids and their biochemical properties
- Transcription and translation
- Levels of protein structure, primary, secondary, tertiary, quaternary
- Post-translational modifications
- Protein structures and functions, including enzyme structure, function, and regulation
- DNA Mutations and impact on disease states
- Protein Assays with an emphasis on manual assays and an introduction to kits
- Methods of protein purification including extraction, precipitation and differential solubilization, ultracentrifugation, and chromatographic methods
- Methods of protein identification including Edman Degradation, mass spectrometry gas chromatography, and liquid chromatography
- Bioinformatics overview and computer assisted sequence analysis
- Bioprocessing overview, including scale-up of protein production for pharmaceutical and other applications
- Laboratory Safety with an emphasis on biohazards and biosafety levels

Effective Date/Updated: August 28, 2023