

J. Sargeant Reynolds Community College
Course Content Summary

Course Prefix and Number: BIO 252 **Credits:** 4

Course Title: Nucleic Acid Methods

Course Description:

Provides students with advanced laboratory skills needed for employment in the biotechnology industry. Focuses on use of basic and specialized lab equipment and techniques such as solution chemistry, cell culture, DNA extraction and analysis, protein extraction and analysis. Emphasizes lab safety, documentation, quality control, and use of SOPs. Lecture 3 hours. Laboratory 3 hours. Total 6 hours per week. Prerequisites: BIO 250 and BIO 253. 4 credits

General Course Purpose:

This course is designed to provide an introduction to nucleic acids and the many techniques that are used to study DNA. Students will be re-introduced to the basic concepts of molecular biology including DNA structure and function, as well as the process and regulation of gene expression. The basic tools and techniques of DNA manipulation will be covered including DNA isolation and purification (genomic and plasmid DNA), gel electrophoresis, DNA restriction/fingerprinting analyses, cloning (transformation and screening of clones), polymerase chain reaction (including real-time PCR), DNA sequencing, microarrays and CRISPR methodologies. Students will be expected to integrate these techniques into a group research project. Students will be introduced to the field of bioinformatics. The application of these DNA techniques to different fields of biotechnology (i.e. forensics, medicine, environmental science, etc.) will be 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

- Detail the structure and function of DNA
- Describe the central dogma of molecular biology, namely the relationship between cellular DNA, RNA, and protein expression.
- Compare/contrast the process and regulation of gene expression in prokaryotes and eukaryotes.
- Explain the difference between DNA and RNA and how each might be used in nucleic acid research.
- Compare the fundamental features of prokaryotic and eukaryotic genes/genomes.
- Define “recombinant DNA” and “cloning” in both a scientific and societal context.
- Describe the basic tools and techniques of DNA science including DNA isolation, restriction analyses, cloning, PCR, and CRISPR methodologies.
- Describe recent methodological developments in biotechnology pertaining to DNA.
- Describe the polymerase chain reaction (PCR) and how it is used in biotechnology.
- Describe the methodology of DNA sequencing including whole-genome approaches.
- Describe how microarrays are used in gene expression studies.

- Relate applications of DNA methods to the fields of human medicine, namely in identifying human disease genes, understanding the genetic basis of cancer, and in pharmacogenomics.
- Discuss the role that DNA analyses have in forensics, agriculture, and environmental science.
- Use computer resources to analyze and compare genomes/genes from different organisms.
- Describe how bioinformatics is used to study the relationship between gene sequence and gene function.
- Work safely in a lab environment.
- Integrate basic lab techniques into the experimental design of a research project.
- Proficiently demonstrate basic lab skills including documentation, aseptic technique, pipetting, cell culture, media preparation, and solution preparation and dilution.

Major Topics to Be Included:

- Introduction to DNA structure and the history of DNA science
- Information flow from DNA to protein
- Control of gene expression
- Basic tools and techniques of DNA science
- Methods for finding and expressing important genes
- Modern methods for analyzing whole genomes
- Basic and applied research with DNA microarrays
- The DNA science of cancer
- Applying DNA science to human genetics
- Other applications of DNA technologies
- Bioinformatics: analysis of gene sequences, genome expression, and the whole genome perspective

Effective Date/Updated: August 28, 2023