Virginia Western Community College
BIO 252
Nucleic Acid Methods

Prerequisites

Successful completion of BIO 101 or BIO 173 within the last 3 years, and ENG 111; completion of CHM 111 is recommended.

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. Introduces students to concepts and skills related to the understanding and application of nucleic acid structure and function. Prepares students to apply knowledge to real-world questions and applications utilizing advanced laboratory skills needed for employment in the field of biotechnology.

Semester Credits: 4 **Lecture Hours: 3** **Laboratory/Recitation Hours: 3**

Required Materials

Textbooks:
Academic Cell: Biotechnology. Clark & Pazdernik. 2nd edition. Academic Press. ISBN: 9780123850638
Molecular Biology Techniques: A Classroom Laboratory Manual. Carson, Miller and Witherow. 2nd edition. Academic Press. ISBN: 9780123855442

Other Required Materials:
Lab Notebook
Lab Coat

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 (e.g. social, ethical, or academic issues).
- Articulate knowledge of key concepts in molecular biology (e.g. transcription/translation, gene expression, role of DNA and RUNA, recombinant DNA technology theories)
- Demonstrate knowledge of key concepts, including applications and limitations of each technology, related to nucleic acids including, but not limited to:
    - Transformations
    - DNA and RNA isolation and purification
    - cDNA synthesis
    - Gel Electrophoresis

  - Immunocytochemistry
  - PCR and modifications to PCR (e.g. reverse-transcription PCR, qRCR)
  - Sequencing (e.g. Sanger, next-generation)
  - RNA based technologies (RNAi, CRISPR-Cas9)
  - Bioinformatics
- Appreciate the variety of recombinant nucleic acid techniques available and demonstrate knowledge of this information through experimental design
- Demonstrate workplace awareness and readiness s 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.

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

- Identify key pieces of laboratory equipment (e.g. centrifuges, electrophoresis equipment, thermocycler, incubator, microplate reader).
- Apply knowledge of basic laboratory math, including significant figures, unit conversions, dilutions, and other necessary techniques.
- Handle solution preparation and pH measurements.
- Apply knowledge of prokaryotic and eukaryotic cell culture.
- Identify key steps related to bacterial transformations (e.g. plasmid preparation, restriction digests and vector preparations, DNA ligation).
- Perform DNA and RNA isolation, purification, and measurement/visualization techniques (e.g. gel electrophoresis, PCR, immunocytochemistry).
- Utilize bioinformatic techniques (e.g. BLAST, sequence mapping and gene annotation, genomic editing).
- Troubleshoot an experiment and develop alternative options (if necessary) for experimental design.
- Generate professional and accurate written materials (e.g. lab notebook, report, poster) to document their laboratory work.

Topical Description

Chapter 1: Basics of Biotechnology

- Advent of the biotechnology revolution
- Chemical structure of nucleic acids
- Packaging of nucleic acids
- Model organisms

Chapter 2: DNA, RNA, and Protein

- Central dogma and gene expression
- Prokaryotic transcription
- Eukaryotic transcription
- mRNA Processing

Chapter 3: Recombinant DNA Technology

- DNA isolation and purification
- Restriction enzymes and electrophoresis
- Methods for detection of nucleic acids
- Hybridization
- Cloning and expression vectors

- DNA libraries

Chapter 4: DNA Synthesis in vivo and in vitro

- Prokaryotic and eukaryotic DNA replication
- Chemical synthesis of DNA
- PCR and its modifications
- Reverse transcriptase PCR

Chapter 5: RNA based Technologies

- Antisense RNA
- RNAi
- Other RNA technologies

Chapter 8: Genomics and Gene Expression

- Genetic mapping
- Sequencing
- Microarrays
- Bioinformatics
- Genetic evolution
- Pharmacogenetics

Chapter 14/15: Transgenic Organisms

- Plant tissue culture
- Cre/loxP systems
- Transgenic plants
- Food safety
- Knock-out organisms
- Transgenes and transgene expression
- Genetically modified organisms
- Transgenic applications

Applications of Biotechnology (as time permits at discretion of the instructor)

Chapter 7: Nanobiotechnology

Chapter12: Environmental Biotechnology

Chapter 17: Gene Therapy

Chapter 18: Cancer Biology

Chapter 23: Biowarfare and Bioterrorism

Chapter 24: Forensic Biology

Chapter 25: Bioethics

Suggested Laboratory Topics

- Introduction to Laboratory Safety/Pipetting
- Making Solutions and Basic Laboratory Math
- Aseptic Technique/Bacterial Cell Culture
- Bacterial Transformations
- Eukaryotic Cell Culture
- DNA Extraction and Purification
- PCR
- Gel Electrophoresis
- Sequencing and Bioinformatics
- RNA Extraction and Purification
- cDNA Synthesis
- qPCR
- Immunohistochemistry
- Independent Project

Notes to Instructors

1. Departmental policy dictates that instructors do not allow students to keep tests.
2. A comprehensive final exam counting 15%-20% of the total grade will be given at the end of the semester.
3. The 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.
4. The VWCC Biology Department uses a 10-point grading scale.
5. Comprehensive study of the listed topics is beyond the reasonable expectations of a 15-week DNA Methods course. It is up to the discretion of the instructor to choose which topics are more detailed but each topic should be adequately covered.