

AOHS Biotechnology

Course Scope and Sequence

Biotechnology is a lab course designed to introduce students to the scope of biotech research and product development across many fields. Students learn proper lab techniques and recordkeeping with a scientific notebook. They learn the methods of gel electrophoresis and restriction enzyme digestion. Students explore the ethical issues in applied biotech, as well as the rights and responsibilities of the stakeholders involved in the development, production, and use of biotechnology products. For the culminating project, students research and analyze the feasibility of developing a new biotechnology product.

Note: One year each of Biology and Chemistry are prerequisites for this course.

This course is expected to take a total of 73 50-minute class periods.

Unit 1: Foundations of Biotechnology

Lesson 1: Course Introduction

Estimated # of Class Periods: 2

Learning Objectives

- Infer the skills and knowledge about biotechnology needed to be successful in an authentic project
- Identify biotechnology terms with which to build a taxonomy

Lesson 2: What Is Biotechnology?

Estimated # of Class Periods: 5

Lab: Cheese-Making Lab

Learning Objectives

- Describe the historical development of biotechnology
- Identify modern technologies that fall within the realm of biotechnology
- Characterize how and where biotechnology is used in various fields, including medicine, agriculture, environmental protection, forensic science, and basic science
- Demonstrate the ability to follow a lab procedure

Lesson 3: Bioethics

Estimated # of Class Periods: 6

Learning Objectives

- Compare and contrast differing societal views of biotechnology
- Identify the rights, interests, and responsibilities of the stakeholders involved in the development, production, and use of biotechnology products
- Describe examples of how biotechnology has led to benefits and risks to society, and how advances in biotechnology affect human lives on a personal level

- Demonstrate the ability to make complex decisions about a bioethical question related to biotechnology, taking into account risks, benefits, and the social factors involved

Unit 2: Biotechnology Lab Practice

Lesson 4: Introduction to the Laboratory

Estimated # of Class Periods: 6

Lab: Root Beer Lab

Learning Objectives

- Develop and maintain a scientific notebook that includes an account of all laboratory procedures and data that models college-level documentation and industry standards.
- Practice standard safety laboratory operating procedures, including the use of sterile technique
- Demonstrate the ability to use the scientific method to conduct a valid experiment, including hypothesis formation, data collection, and data analysis.
- Evaluate the validity of results obtained during lab experimentation using scientific method.

Lesson 5: Model Organisms, Ethnobotany, and Drug Development

Estimated # of Class Periods: 7

Lab: Plant Bioassay

Learning Objectives

- Describe the uses of model organisms
- Identify examples of model organisms specific to the biotechnology industry
- Identify ways of developing new pharmaceuticals, especially through ethnobotany
- Demonstrate the ability to perform an experiment using a model organism as a tool
- Interpret the results of an experiment using a model organism

Lesson 6: Working with DNA in the Laboratory

Estimated # of Class Periods: 5

Lab: DNA Extraction from Cheek Cells

Lab: Using a Micropipet

Lab: Making and Loading Gels

Learning Objectives

- Demonstrate the ability to micropipet with accuracy
- Explain the basic principle of gel electrophoresis
- Demonstrate the ability to pour, load, run, and interpret a gel

- Predict how DNA will behave in a gel

Unit 3: DNA Technology

Lesson 7: Recombinant DNA

Estimated # of Class Periods: 7

Lab: Restriction Digest Experiment

Learning Objectives

- Explain the relevance of DNA isolation and gene identification to the development of genetic engineering
- Describe how plasmids, restriction enzymes, and ligases are used in genetic engineering
- Demonstrate the ability to perform a restriction digest and confirm results using gel electrophoresis

Lesson 8: Bacterial Transformation

Estimated # of Class Periods: 6

Lab: GFP Transformation Experiment

Learning Objectives

- Summarize the steps in a bacterial transformation, including competency, recovery, and selection
- Create recombinant *E. coli*
- Demonstrate how transformants may be selected, including antibiotic resistance
- Evaluate the validity of results obtained during experimentation and compose a concluding statement addressing possible sources of error and potential applications
- Explain key bioethics questions surrounding the application of recombinant DNA, including the controversy associated with genetically modified crops

Unit 4: The Biotechnology Industry

Lesson 9: Industry, Academia, Government, and Regulation

Estimated # of Class Periods: 7

Learning Objectives

- Identify the major centers that are developing and using biotechnology
- Categorize the types of laboratories that use biotechnology and the relationships among them
- Evaluate companies based on the presence or absence of bioethics considerations in their mission statements
- Categorize the biotech-related regulatory functions of government agencies

- Summarize the role of society and culture in shaping regulation

Lesson 10: Bringing a Product to Market

Estimated # of Class Periods: 7

Note: The culminating project is launched in this lesson

Learning Objectives

- Summarize the steps in clinical testing for new biotechnology products
- Evaluate motivations for bringing products to market
- Categorize constraints on bringing products to market

Unit 5: Careers and Culminating Project

Lesson 11: Careers in Biotechnology

Estimated # of Class Periods: 6

Learning Objectives

- Display understanding of potential employment opportunities in biotechnology
- Evaluate personal experiences and qualifications for potential employment opportunities
- Develop a cover letter for an internship

Lesson 12: Culminating Project and Course Closure

Estimated # of Class Periods: 9

Learning Objectives

- Analyze the feasibility of creating and bringing to market a new biotech product
- Demonstrate the ability to develop and present a biotech product feasibility analysis
- Summarize key learning across the subject of biotechnology
- Evaluate personal experience and performance in the course