



Course Syllabus

What you will learn in this course



BIOTECHNOLOGY 1B: UNLOCKING NATURE'S SECRETS

Dig deeper into the world of biotechnology! Learn how and why biotechnology is so important to the agricultural, pharmaceutical, and genetic fields of study. You'll learn about mapping the human genome, the role of antibiotics, how medicine is created to combat diseases, and the future of the biotechnology field. It's time to explore the depth and breadth of this fascinating field!

Unit 1: The Discovery of Antibiotics

Antibiotics revolutionized medicine. For the first time, the medical profession had a tool to combat infection, reduce the risks of surgical operations, and prevent many medical complications, like scarlet fever and gangrene. From the early research into penicillin to modern antibiotics, the existence of anti-bacterial drugs has changed medicine and altered the course of human life.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Understand the origin of antibiotics
2. Recognize the timeline of antibiotic development
3. Understand how antibiotics treat bacterial infections
4. Recognize the concerns about antibiotic resistance and possible solutions to antibiotic resistance

Unit 1 Assignments	
Assignment	Type
Lesson 01: The Early History of Antibiotics	Lesson
Lesson 02: Role of Bacteria in Illness	Lesson
Lesson 03: Fleming Discovers Penicillin	Lesson
Lesson 04: Other Classes of Antibiotics	Lesson
Lesson 05: Antibiotic Resistance	Lesson
Critical Thinking Questions	Submission
Lab: How can we solve the antibiotic resistance crisis?	Submission
Unit 1 Discussion 1	Discussion
Unit 1 Discussion 2	Discussion
Unit 1 Quiz	Multiple Choice

Unit 2: Agricultural Biotechnology through the Green Revolution

Agricultural biotechnology has moved far beyond early experiments in hybridization, leading to higher yields of food, less labor-intensive food production, and reduced famine throughout the world. Advances in biotechnology and botanical science have created plants that produce more, in less time and with fewer resources, through hybridization and early efforts at genetic modification.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Recognize the changes in agricultural biotechnology in the late 19th century
2. Understand how double cross breeding changed plants
3. Recognize the developments that led to the Green Revolution



Unit 2 Assignments	
Assignment	Type
Lesson 01: Hybridization of Cotton and Potatoes	Lesson
Lesson 02: Heterosis and Mutations	Lesson
Lesson 03: The Green Revolution	Lesson
Lesson 04: DNA Technology	Lesson
Lesson 05: Biotechnological Advances	Lesson
Critical Thinking Questions	Submission
Lab	Submission
Activity: Food and Agriculture Through The Years	Submission
Unit 2 Discussion 1	Discussion
Unit 2 Discussion 2	Discussion
Unit 2 Quiz	Multiple Choice

Unit 3: Mapping the Human Genome

Having developed the technology to sequence DNA, researchers began to contemplate creating a complete map of the human genome. This project would eventually involve laboratories around the world, working together to create a complete map of the 3 billion bases in the human genome. With this data, new projects and research began, looking toward a genetic understanding of cancer, various diseases, and genetic variation between individuals.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Understand the history of the Human Genome Project
2. Recognize the accomplishments of the Human Genome Project
3. Understand developments since the completion of the Human Genome Project
4. Recognize the potential for genetic research and understanding



Unit 3 Assignments

Assignment	Type
Lesson 01: The Human Genome	Lesson
Lesson 02: Overview of the Human Genome Project	Lesson
Lesson 03: Results of the Human Genome Project	Lesson
Lesson 04: Continuing Research on the Human Genome	Lesson
Lesson 05: The Future of Genetics in Medicine	Lesson
Critical Thinking Questions	Submission
Lab: The age of genetic wonder	Submission
Unit 3 Discussion 1	Discussion
Unit 3 Discussion 2	Discussion
Unit 3 Quiz	Multiple Choice

Unit 4: Modern Industrial Biotechnology

Industrial biotechnology offers environmentally friendly, renewable solutions to a number of industrial problems. Enzymes, fermentation and the manipulation of other biological products can produce various products, ranging from biofuels to polymers and plastics. Enzymes can replace chemicals, reduce waste, and reduce energy use in the production of various consumer and industrial goods, from paper to laundry detergent. In this unit, you will learn about various applications of biotechnology in production, industry, and manufacturing, while looking at other applications of the genetic technology studied in past units.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Understand the modern industrial uses for enzymes
2. Recognize the role of genetics in modern industrial biotechnology
3. Understand how and why biofuels are important
4. Recognize the environmental benefits of industrial biotechnology



Unit 4 Assignments

Assignment	Type
Lesson 01: Introduction to Enzymes	Lesson
Lesson 02: Production and Use of Enzymes	Lesson
Lesson 03: Use of Enzymes in Industry	Lesson
Lesson 04: Fossil Fuels vs. Biofuels	Lesson
Lesson 05: Pros and Cons of Industrial Biotechnology	Lesson
Critical Thinking Questions	Submission
Lab: Grow Your Own Clothes	Submission
Activity: Create a Bar Graph	Submission
Unit 4 Discussion 1	Discussion
Unit 4 Discussion 2	Discussion
Unit 4 Quiz	Multiple Choice

Midterm Exam

1. Review information acquired and mastered from this course up to this point.
2. Take a course exam based on material from the **first half** of the course (**Note:** You will be able to open this exam only one time.)

Midterm Exam Assignments

Assignment	Type
Midterm Exam	Multiple Choice
Midterm Discussion	Discussion

Unit 5: Modern Agricultural Biotechnology

Modern agricultural biotechnology is centered on genetic technology and genetic modification. The use of transgenics allows scientists to combine genes from different organisms to achieve desirable traits, from pest resistance to increased vitamin content. These changes are often controversial and may not be accepted by the public. While a great deal of discussion about genetic modification and genetically modified organisms, or GMOs, continues, they are a prevalent part of the food supply, particularly in the United States.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Understand how organisms are genetically modified
2. Recognize the prevalence of GMOs
3. Understand the risks and benefits of GMOs
4. Develop an educated opinion about the role of GMOs in our food supply

Unit 5 Assignments	
Assignment	Type
Lesson 01: Genetically Modified Organisms	Lesson
Lesson 02: Genetic Modification Applications	Lesson
Lesson 03: The Market for GMOs	Lesson
Lesson 04: Benefits and Risks of GMOs	Lesson
Lesson 05: Controversy Over GMOs	Lesson
Critical Thinking Questions	Submission
Lab: The Case for Engineering Our Food	Submission
Unit 5 Discussion 1	Discussion
Unit 5 Discussion 2	Discussion
Unit 5 Quiz	Multiple Choice

Unit 6: Modern Pharmaceutical Biotechnology

In this unit, you will learn about recent advances in pharmaceutical biotechnology, including the development of new types of drugs, cancer treatments, and vaccines. These include a variety of biotechnological advancements, many relying upon the growth in understanding of genetics, genetic modification, and gene therapies. While some forms of biotechnology, like industrial biotechnology, impact your life only in distant ways, you may have a more personal understanding of pharmaceutical biotechnology. You've likely taken medication and had vaccinations. You may have used recombinant insulin or have had a genetically modified vaccination, like the HPV vaccination. Or you may know someone who relies upon the discoveries in pharmaceutical biotechnology to live and thrive.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Explain innovations in pharmaceutical biotechnology
2. Define the importance of genetically modified hormones, insulin, and other compounds typically produced in the body
3. Recognize the potential for new treatments for cancer and other illnesses
4. Describe the use of vaccines and developments in vaccination biotechnology

Unit 6 Assignments	
Assignment	Type
Lesson 01: Insulin and Clotting Factors	Lesson
Lesson 02: Gene Therapy and Monoclonal Antibodies	Lesson
Lesson 03: Cancer Treatment	Lesson
Lesson 04: Drugs to Alter Immune Responses	Lesson
Lesson 05: Vaccines	Lesson
Critical Thinking Questions	Submission
Lab: Programming Bacteria to Detect Cancer	Submission
Unit 6 Discussion 1	Discussion
Unit 6 Discussion 2	Discussion
Unit 6 Quiz	Multiple Choice

Unit 7: The Future of Biotech: Innovation

If you want to be part of a highly innovative industry and change the world, choose biotech! The biopharmaceutical, agricultural, and environmental segments are out-pacing and expanding faster than other industries, including electronics and technology. Let's take a look at these three sprawling diverse segments to get a better idea of how they're positioned to alleviate pain and suffering and help save our planet.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Identify the drivers of innovation in biotechnology and their interrelationships
2. Describe how biotechnology innovations are funded
3. Discuss major advancements in medical biotech innovations
4. Explain areas of agricultural biotechnology that are being developed



Unit 7 Assignments

Assignment	Type
Lesson 01: Drivers of Innovation	Lesson
Lesson 02: Medical Innovations	Lesson
Lesson 03: Agricultural Innovations	Lesson
Lesson 04: Industrial and Environmental Innovations	Lesson
Critical Thinking Questions	Submission
Lab: The Future of Biotech: Innovation	Submission
Unit 7 Discussion 1	Discussion
Unit 7 Discussion 2	Discussion
Unit 7 Quiz	Multiple Choice

Unit 8: The Role of Ethics and Public Policy

Biotechnology is a high-visibility area of science affected by public policy as well as ethics. Researchers, scientists, and healthcare providers are impacted daily by the public policy issues in biotechnology as well as in bioethics. At some point, a professional working in biotech will come face-to-face with decisions related to public policy as well as ethical conduct. Each primary area of biotechnology—medicine, agriculture, industrial/environmental biotechnology—is touched by those two factors.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Define ethics and bioethics
2. Discuss the role of bioethics in medicine, agriculture, and industrial/environmental biotech
3. Evaluate the meaning of public policy and its relationship to biotech
4. Describe public policy principles and practices
5. Explain the roles of regulation and the law as public policy



Unit 8 Assignments

Assignment	Type
Lesson 01: Ethics in Biotechnology	Lesson
Lesson 02: Ethical Decision-Making in Medicine, Agriculture, and Industry	Lesson
Lesson 03: Public Policy and Biotech Regulations	Lesson
Critical Thinking Questions	Lesson
Lab: A Framework for Ethical Decision Making	Submission
Unit 8 Discussion 1	Discussion
Unit 8 Discussion 2	Discussion
Unit 8 Quiz	Multiple Choice

Final Exam

1. Review information acquired and mastered from this course up to this point.
2. Take a course exam based on material from the **second half** of the course (**Note:** You will be able to open this exam only one time.)

Final Exam Assignments

Assignment	Type
Final Exam	Multiple Choice
Final Discussion	Discussion



Course Syllabus

What you will learn in this course

BIOTECHNOLOGY

1a: INTRODUCTION



BIOTECHNOLOGY 1A: INTRODUCTION

Biotechnology is a cutting-edge, high-demand field that encompasses everything from plant and animal breeding to genetics. Discover how biotechnology has changed the world around us, from food to genetics. Explore historical applications with modern discoveries. Understand how regulations and ethics govern the course of biotechnology and learn of its importance to the field of medicine.

Unit 1: Biotechnology Basics

Biotechnology refers to techniques that rely upon living organisms or the products of those organisms to make or modify products, to improve animals or plants, or to develop microorganisms for medical, agricultural, or industrial use. In this unit, you will review the essential foundations for biotechnology, specifically the biology behind biotechnology.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Recognize different types of cells
2. Categorize organisms
3. Define taxonomy and scientific naming of organisms
4. Explain the basics of evolutionary theory

Unit 1 Assignments	
Assignment	Type
Lesson 01: What Is Biotechnology?	Lesson
Lesson 02: Identifying Cells and Cell Parts	Lesson
Lesson 03: Distinguishing Organisms	Lesson
Lesson 04: Classifying Bacteria and Other Organisms	Lesson
Lesson 05: Understanding Evolutionary Theory	Lesson
Critical Thinking Questions	Submission
Lab: A Secret Weapon Against Zika and Other Mosquito Borne Illnesses	Submission
Unit 1 Discussion 1	Discussion
Unit 1 Discussion 2	Discussion
Unit 1 Quiz	Multiple Choice

Unit 2: The Beginning of Biotechnology

The first human experiments and work in biotechnology came as humans made the transition from hunting and gathering to an agricultural means of food production. Domestication of plants and animals led to significant changes through active human interference and selection. Changes in human society, including sedentism, would lead to many early innovations in biotechnology.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Explain the differences between the Paleolithic and Neolithic
2. Describe how humans domesticated plants and animals

3. Categorize the regional variances in agriculture and domestication
4. Summarize the changes that occurred as humans domesticated plants and animals

Unit 2 Assignments	
Assignment	Type
Lesson 01: Biotechnology in Primitive Agriculture	Lesson
Lesson 02: Early Selective Breeding	Lesson
Lesson 03: The Specifics of Selective Breeding	Lesson
Lesson 04: Agricultural Tools & Techniques	Lesson
Lesson 05: The Role of Permanent Settlements	Lesson
Critical Thinking Questions	Submission
Lab: Mesolithic and Neolithic Timeline	Submission
Activity: A Day In The Life	Submission
Unit 2 Discussion 1	Discussion
Unit 2 Discussion 2	Discussion
Unit 2 Quiz	Multiple Choice

Unit 3: Food Preservation and Fermentation

The first use of biotechnology, as you learned in Unit 2, was to improve the food supply. Biotechnology continued to be used for food production as early peoples learned how to ferment their foods, produce alcohol and vinegar, make cheese, and bake bread. These changes in foods improved the food supply and made it safer, and reduced the risk of food-borne illness.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Classify the various ways to store and preserve food
2. Describe the different types of fermentation
3. Explain the process of fermentation
4. Discuss the study of microbiology and the work of Pasteur



Unit 3 Assignments

Assignment	Type
Lesson 01: The Need for Food Storage and Processing	Lesson
Lesson 02: Basic Food Preservation Methods	Lesson
Lesson 03: The Biotechnology of Fermentation	Lesson
Lesson 04: Other Traditional Preservation Methods	Lesson
Lesson 05: Developments Due to Microbiology	Lesson
Critical Thinking Questions	Submission
Lab: Why Raw Milk is More Dangerous than Pasteurized Milk	Submission
Unit 3 Discussion 1	Discussion
Unit 3 Discussion 2	Discussion
Unit 3 Quiz	Multiple Choice

Unit 4: Collection and Breeding

Modern biotechnology requires an understanding of genetics; however, that understanding is relatively recent. Before biologists, microbiologists, and botanists understood genetics, they learned how to crossbreed plants and produce hybrids of their own creation. In many ways, this built upon the domestication of plants discussed in Unit 2 but was far more complex and innovative.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Discuss the importance of early collectors and their collections
2. Describe how collectors bred plants
3. Illustrate the importance of hybridization and the impact of hybrids
4. Explain how early breeding programs led to genetics



Unit 4 Assignments

Assignment	Type
Lesson 01: The Development of Botany	Lesson
Lesson 02: Plant Anatomy and Reproduction	Lesson
Lesson 03: Plant Collection	Lesson
Lesson 04: Hybridization and Breeding	Lesson
Lesson 05: Experiments in Hybridization	Lesson
Critical Thinking Questions	Submission
Lab: It's Time to Question Bioengineering	Submission
Activity: Timeline of Understanding	Submission
Unit 4 Discussion 1	Discussion
Unit 4 Discussion 2	Discussion
Unit 4 Quiz	Multiple Choice

Midterm Exam

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Midterm Exam Assignments

Assignment	Type
Midterm Exam	Multiple Choice
Midterm Discussion	Discussion

Unit 5: The Beginning of Genetics

The study of genetics could not begin until the basic processes of inheritance were well understood. In the middle of the 19th century, an amateur scientist, Gregor Mendel, undertook the first defined scientific experiments in genetics, carefully recording the ratios of inheritance. While his work received little recognition at first, the study of genetics moved quickly from the 20th century onward. Within the first 50 years of the 20th

century, DNA was identified and, by 1977, the first gene sequencers opened up new opportunities for the study of genetics.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Understand the function of genes
2. Recognize the historical development of the study of genetics
3. Understand Mendel's experiments and their significance
4. Create a timeline describing the history of genetics from Mendel through the late 20th century

Unit 5 Assignments	
Assignment	Type
Lesson 01: What is Genetics?	Lesson
Lesson 02: Early Ideas about Evolution	Lesson
Lesson 03: The First Scientific Research of Heredity	Lesson
Lesson 04: Mendelian Inheritance	Lesson
Lesson 05: Genetics Becomes a Science	Lesson
Critical Thinking Questions	Submission
Lab: The Dawn of De-extinction	Submission
Unit 5 Discussion 1	Discussion
Unit 5 Discussion 2	Discussion
Unit 5 Quiz	Multiple Choice

Unit 6: Early Industrial Discoveries

In this unit, you will learn about industrial biotechnology advancements between 1800 and World War II. These innovations required new achievements in microbiology, a new understanding of enzymes and fermentation, as well as the ability to identify bacteria. They fueled industrial growth in various industries, from ammunition production to paints and varnishes, providing key ingredients needed for a growing and changing world.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Recognize the developments in biotechnology that accompanied the industrial revolution
2. Understand the changes that occurred during the period defined as classical biotechnology
3. Explain the role of enzymes in an industrial setting
4. Recognize how war drove productivity and innovation in biotechnology

Unit 6 Assignments	
Assignment	Type
Lesson 01: What Is Industrial Biotechnology?	Lesson
Lesson 02: Leading Figures & Early Microbiology	Lesson
Lesson 03: Early Industrial Uses of Enzymes	Lesson
Lesson 04: War Production of Glycerol	Lesson
Lesson 05: Industrial Fermentation	Lesson
Critical Thinking Questions	Submission
Lab: Are Mushrooms the New Plastic?	Submission
Activity: Biological Essay	Submission
Unit 6 Discussion 1	Discussion
Unit 6 Discussion 2	Discussion
Unit 6 Quiz	Multiple Choice

Unit 7: Regulation of Biotech

Food, drugs, the environment—biotechnology is everywhere! The industry is producing life-changing products across the globe and in our lives. Biotech has an effect on the foods we eat, on the drugs that promote healing, and on the products that protect our environment. The future of biotech is bright but comes with a responsibility to safeguard consumers and our environment. This safeguarding responsibility is known as regulation. Regulation is sometimes seen as a negative, but as we'll see, it actually helps protect us while providing pathways to innovation and change.

What will you learn in this unit?

After studying this unit, you will be able to:

1. Discuss the purpose and development of biotechnology regulation in the United States
2. Identify and describe the primary regulatory agencies in the United States

3. Explain the roles of product development, regulation, and society
4. Consider the need for a balance between regulation and innovation
5. Describe the basic regulatory process and the challenges in the regulatory environment
6. Analyze the on-going process of modernizing biotechnology regulation

Unit 7 Assignments	
Assignment	Type
Lesson 01: Why Are Regulations Necessary?	Lesson
Lesson 02: The Development of Biotech Regulations	Lesson
Lesson 03: Balancing Regulation and Innovation	Lesson
Lesson 04: Obtaining Agency Approval	Lesson
Lesson 05: Difficulties in Regulating Biotech	Lesson
Lesson 06: Keeping Pace with Biotech	Lesson
Critical Thinking Questions	Submission
Lab	Submission
Unit 7 Discussion 1	Discussion
Unit 7 Discussion 2	Discussion
Unit 7 Quiz	Multiple Choice

Unit 8: Healing, Feeding, Fueling

The world of biotechnology is an area of science that does not concentrate on just one scientific area. Biotech applications and innovations heal humans and animals. Biotech supports agriculture by increasing crop yields, improving plant life, and preventing damage to our food chain from pests and insects. We even see biotech developing applications to combat climate change through products such as biofuels that use plant-based formulas instead of fossil-based fuel. Biotech is even in our laundry detergents and dishwashing liquids in the form of special enzymes that replace environmentally harmful chemicals!

What will you learn in this unit?

After studying this unit, you will be able to:

1. Describe the long journey of biotech and major advances in three key areas
2. Identify and describe major advances of biotech in medicine and healthcare

3. Explain the key areas and uses of agricultural biotech
4. Discuss the social and economic impacts of agricultural biotech
5. Consider why environmental and industrial biotech are described as “the third wave of biotech”
6. Identify the key areas and uses of industrial and environmental biotech

Unit 8 Assignments	
Assignment	Type
Lesson 01: How Has Biotech Changed Society?	Lesson
Lesson 02: Medical Biotechnology	Lesson
Lesson 03: Agricultural Biotechnology	Lesson
Lesson 04: Industrial Biotechnology	Lesson
Critical Thinking Questions	Submission
Lab	Submission
Unit 8 Discussion 1	Discussion
Unit 8 Discussion 2	Discussion
Unit 8 Quiz	Multiple Choice

Final Exam

1. Review information acquired and mastered from this course up to this point.
2. Take a course exam based on material from the **second half** of the course (**Note:** You will be able to open this exam only one time.)

Final Exam Assignments	
Assignment	Type
Final Exam	Multiple Choice
Final Discussion	Discussion