eDynamicLearning

CAREER & ELECTIVE COURSES

Course Syllabus

Biotechnology: Unlocking Nature's Secrets

Course Description

Can we bring back extinct species? Will the cures for cancer, malaria, and other diseases come from the combination of natural materials and new technologies? How is science changing the foods we eat? Welcome to the world of biotechnology! In this course, you will explore the history of biotechnology, including early attempts at food preservation, the development of antibiotics, and changes to food crops around the world. You'll also learn more about some of the challenges of biotechnology, such as the growth of antibiotic resistant bacteria and questions about the safety of commercially produced genetically modified organisms (GMOs). Finally, you'll research new biotechnologies and how they are changing the world we live in.

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Unit 1: Biotechnology Basics

Unit Summary

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.

Learning Objectives

- Recognize different types of cells.
- Categorize organisms.
- Define taxonomy and scientific naming of organisms.
- Explain the basics of evolutionary theory.

Assignments

Unit 1 Text Questions	Homework	10 points
Unit 1 Online Lab Questions	Homework	10 points
Unit 1 Discussion Assignment 1	Discussion	5 points
Unit 1 Discussion Assignment 2	Discussion	5 points
Unit 1 Quiz	Quiz	15 points

Unit 2: The Beginning of Biotechnology

Unit Summary

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.

Learning Objectives

- Explain the differences between the Paleolithic and Neolithic.
- Describe how humans domesticated plants and animals.
- Categorize the regional variances in agriculture and domestication.
- Summarize the changes that occurred as humans domesticated plants and animals.

Assignments

Unit 2 Text Questions	Homework	10 points
Unit 2 Online Lab Questions	Homework	10 points
Unit 2 Activity #1	Activity	15 points
Unit 2 Discussion Assignment 1	Discussion	5 points
Unit 2 Discussion Assignment 2	Discussion	5 points
Unit 2 Quiz	Quiz	15 points

Unit 3: Food Preservation and Fermentation Technology

Unit Summary

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.

Learning Objectives

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

Assignments

Unit 3 Text Questions	Homework	10 points
Unit 3 Online Lab Questions	Homework	10 points
Unit 3 Discussion Assignment 1	Discussion	5 points
Unit 3 Discussion Assignment 2	Discussion	5 points
Unit 3 Quiz	Quiz	15 points

Unit 4: Collection and Breeding

Unit Summary

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.

Learning Objectives

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

Assignments

Unit 4 Text Questions	Homework	10 points
Unit 4 Online Lab Questions	Homework	10 points
Unit 4 Activity #1	Activity	15 points
Unit 4 Discussion Assignment 1	Discussion	5 points
Unit 4 Discussion Assignment 2	Discussion	5 points
Unit 4 Quiz	Quiz	15 points

Unit 5: The Beginning of Genetics

Unit Summary

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.

Learning Objectives

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

Assignments

Unit 5 Text Questions	Homework	10 points
Unit 5 Online Lab Questions	Homework	10 points
Unit 5 Discussion Assignment 1	Discussion	5 points
Unit 5 Discussion Assignment 2	Discussion	5 points
Unit 5 Quiz	Quiz	15 points

Unit 6: Early Industrial Discoveries

Unit Summary

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.

Learning Objectives

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

Assignments

Unit 6 Text Questions	Homework	10 points
Unit 6 Online Lab Questions	Homework	10 points
Unit 6 Activity #1	Activity	15 points
Unit 6 Discussion Assignment 1	Discussion	5 points
Unit 6 Discussion Assignment 2	Discussion	5 points
Unit 6 Quiz	Quiz	15 points

Midterm Exam

Learning Objectives

- Review information acquired and mastered from this course up to this point.
- Take a course exam based on material from the first six units in this course (Note: You will be able to open this exam only one time.)

Assignments

Midterm Exam	Exam	50 points
Midterm Discussion Assignment	Discussion	5 points

Unit 7: The Discovery of Antibiotics

Unit Summary

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.

Learning Objectives

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

Assignments

Unit 7 Text Questions	Homework	10 points
Unit 7 Online Lab Questions	Homework	10 points
Unit 7 Discussion Assignment 1	Discussion	5 points
Unit 7 Discussion Assignment 2	Discussion	5 points
Unit 7 Quiz	Quiz	15 points

Unit 8: Agricultural Biotechnology Through the Green Revolution

Unit Summary

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.

Learning Objectives

- Recognize the changes in agricultural biotechnology in the late 19th century.
- Understand how double cross breeding changed plants.
- Recognize the developments that led to the Green Revolution.
- Understand how technological advances led to genetic modification in modern agriculture.

Assignments

Unit 8 Text Questions	Homework	10 points
Unit 8 Online Lab Questions	Homework	10 points
Unit 8 Activity #1	Activity	15 points
Unit 8 Discussion Assignment 1	Discussion	5 points
Unit 8 Discussion Assignment 2	Discussion	5 points
Unit 8 Quiz	Quiz	15 points

Unit 9: Mapping the Human Genome

Unit Summary

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.

Learning Objectives

- Understand the history of the Human Genome Project.
- Recognize the accomplishments of the Human Genome Project.
- Understand developments since the completion of the Human Genome Project.
- Recognize the potential for genetic research and understanding.

Assignments

Unit 9 Text Questions	Homework	10 points
Unit 9 Online Lab Questions	Homework	10 points
Unit 9 Discussion Assignment 1	Discussion	5 points
Unit 9 Discussion Assignment 2	Discussion	5 points
Unit 9 Quiz	Quiz	15 points

Unit 10: Modern Industrial Biotechnology

Unit Summary

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.

Learning Objectives

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

Assignments

Unit 10 Text Questions	Homework	10 points
Unit 10 Online Lab Questions	Homework	10 points
Unit 10 Activity #1	Activity	15 points
Unit 10 Discussion Assignment 1	Discussion	5 points
Unit 10 Discussion Assignment 2	Discussion	5 points
Unit 10 Quiz	Quiz	15 points

Unit 11: Modern Agricultural Biotechnology

Unit Summary

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.

Learning Objectives

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

Assignments

Unit 11 Text Questions	Homework	10 points
Unit 11 Online Lab Questions	Homework	10 points
Unit 11 Discussion Assignment 1	Discussion	5 points
Unit 11 Discussion Assignment 2	Discussion	5 points
Unit 11 Quiz	Quiz	15 points

Unit 12: Modern Pharmaceutical Biotechnology

Unit Summary

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 had vaccinations and taken medication. 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.

Learning Objectives

- Explain innovations in pharmaceutical biotechnology.
- Define the importance of genetically modified hormones, insulin, and other compounds typically produced in the body.
- Recognize the potential for new treatments for cancer and other illnesses.
- Describe the importance of vaccines.

Assignments

Unit 12 Text Questions	Homework	10 points
Unit 12 Online Lab Questions	Homework	10 points
Unit 12 Discussion Assignment 1	Discussion	5 points
Unit 12 Discussion Assignment 2	Discussion	5 points
Unit 12 Quiz	Quiz	15 points

Final Exam

Learning Objectives

- Review information acquired and mastered from this course up to this point.
- Take a course exam based on material from units seven to twelve in this course – the last six units. (Note: You will be able to open this exam only one time.)

Assignments

Final Exam	Exam	50 points
Class Reflection Discussion Assignment	Discussion	10 points