

## **Biotechnology: Unlocking Nature's Secrets**

### **COURSE DESCRIPTION**

#### **Biotechnology: Unlocking Nature's Secrets**

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.

### **COURSE METHODOLOGY**

- This is an inquiry-based course. Students will generate knowledge through online readings, asynchronous discussions with students and their instructor, interactions with online tutorials, and online and hands-on simulations.
- The instructor will act as a guide, a facilitator, an events planner, and a resource advisor. He/she will always be available through course message.
- The student must actively construct and acquire knowledge by being intrinsically motivated to succeed. To succeed, students must participate and complete all readings and activities. This course requires the student's active participation.
- Both formal and informal assessment methods will be used in the course. Informal assessment will include an evaluation of the quality and timeliness of participation in class activities. Formal assessment may include multiple-choice quizzes, tests, discussion board participation, and written assignments. A final exam will be given at the end of the course.

### **COURSE PARTICIPATION OBJECTIVES**

This course for which you are registered is a college preparatory, academically rigorous course that covers an entire semester's worth of material. As such, it is important that you adhere to the following guidelines as you manage your time and commit to successfully completing all required coursework:

1. The requirements for this course are equivalent to completion of minimum of 90+ hours of class instruction at a traditional on-site high school
2. Assignments must be submitted for each unit as they are completed so that the teacher may review and assess your performance. Do not hold your work, you must submit each unit's homework as it is completed, demonstrating weekly assignment completions
3. You must log in regularly to your course to demonstrate continued participation, and completion of all course requirements, including assignments, assessments and discussion forums
4. You must complete your individual work and any incident of suspected cheating, plagiarism or collaboration on assignments violates the academic integrity expectations outlined at the time of your enrollment and can result in failure of the course or further action as deemed appropriate

### **Citizenship**

Students are expected to conduct themselves in a responsible manner that reflects sound ethics, honor, and good citizenship. It is the student's responsibility to maintain academic honesty and integrity and to manifest their commitment to the goals of NUVHS through their conduct and behavior. Students are expected to abide by all NUVHS policies and regulations. Any form of academic dishonesty, or inappropriate conduct by students or applicants may result in penalties ranging from warning to dismissal, as deemed appropriate by NUVHS.

### **Communication**

Throughout this course students will need to be in close contact with their instructor and fellow students. Students are expected to communicate via course message and electronic discussion boards. Therefore, students should plan on checking their course messages at least three times a week and participate in the discussion boards during the weeks they are live.

Instructors strongly encourage and welcome open communication. Clear, consistent, and proactive communication will ensure a successful experience in this course. It is the student's responsibility to notify the instructor immediately if and when a personal situation occurs that affects his/her performance in this class. Being proactive with communication will result in a quick solution to any problems that may occur.

**COURSE OUTLINE**

**Unit 1 – Part 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.

**Learning Objectives**

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

**Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 1 – Part 1 Text Questions | Homework   | 10 points |
| Unit 1 – Part 1 Lab Questions  | Homework   | 10 points |
| Unit 1 – Part 1 Discussion 1   | Discussion | 5 points  |
| Unit 1 – Part 1 Discussion 2   | Discussion | 5 points  |
| Unit 1 – Part 1 Quiz           | Quiz       | 15 points |

### **Unit 1 – Part 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.

#### **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.

#### **Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 1 – Part 2 Text Questions | Homework   | 10 points |
| Unit 1 – Part 2 Lab Questions  | Homework   | 10 points |
| Unit 1 – Part 2 Activity       | Activity   | 15 points |
| Unit 1 – Part 2 Discussion 1   | Discussion | 5 points  |
| Unit 1 – Part 2 Discussion 2   | Discussion | 5 points  |
| Unit 1 – Part 2 Quiz           | Quiz       | 15 points |

**Unit 2 – Part 1: Food Preservation and Fermentation Technology**

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 foodborne 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.

**Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 2 – Part 1 Text Questions | Homework   | 10 points |
| Unit 2 – Part 1 Lab Questions  | Homework   | 10 points |
| Unit 2 – Part 1 Discussion 1   | Discussion | 5 points  |
| Unit 2 – Part 1 Discussion 2   | Discussion | 5 points  |
| Unit 2 – Part 1 Quiz           | Quiz       | 15 points |

### **Unit 2 – Part 2: 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.

#### **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.

#### **Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 2 – Part 2 Text Questions | Homework   | 10 points |
| Unit 2 – Part 2 Lab Questions  | Homework   | 10 points |
| Unit 2 – Part 2 Activity       | Activity   | 15 points |
| Unit 2 – Part 2 Discussion 1   | Discussion | 5 points  |
| Unit 2 – Part 2 Discussion 2   | Discussion | 5 points  |
| Unit 2 – Part 2 Quiz           | Quiz       | 15 points |

### **Unit 3 – Part 1: 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.

#### **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.

#### **Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 3 – Part 1 Text Questions | Homework   | 10 points |
| Unit 3 – Part 1 Lab Questions  | Homework   | 10 points |
| Unit 3 – Part 1 Discussion 1   | Discussion | 5 points  |
| Unit 3 – Part 1 Discussion 2   | Discussion | 5 points  |
| Unit 3 – Part 1 Quiz           | Quiz       | 15 points |

### **Unit 3 – Part 2: 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.

#### **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.

#### **Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 3 – Part 2 Text Questions | Homework   | 10 points |
| Unit 3 – Part 2 Lab Questions  | Homework   | 10 points |
| Unit 3 – Part 2 Activity       | Activity   | 15 points |
| Unit 3 – Part 2 Discussion 1   | Discussion | 5 points  |
| Unit 3 – Part 2 Discussion 2   | Discussion | 5 points  |
| Unit 3 – Part 2 Quiz           | Quiz       | 15 points |



**Unit 4: Midterm**

**Midterm Exam Objectives**

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

**Midterm Exam Activities**

|                    |            |           |
|--------------------|------------|-----------|
| Midterm Discussion | Discussion | 5 points  |
| Midterm Exam       | Exam       | 50 points |

### Unit 5 – Part 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.

#### 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.

#### Activities

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 5 – Part 1 Text Questions | Homework   | 10 points |
| Unit 5 – Part 1 Lab Questions  | Homework   | 10 points |
| Unit 5 – Part 1 Discussion 1   | Discussion | 5 points  |
| Unit 5 – Part 1 Discussion 2   | Discussion | 5 points  |
| Unit 5 – Part 1 Quiz           | Quiz       | 15 points |

### **Unit 5 – Part 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.

#### **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.

#### **Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 5 – Part 2 Text Questions | Homework   | 10 points |
| Unit 5 – Part 2 Lab Questions  | Homework   | 10 points |
| Unit 5 – Part 2 Activity       | Activity   | 15 points |
| Unit 5 – Part 2 Discussion 1   | Discussion | 5 points  |
| Unit 5 – Part 2 Discussion 2   | Discussion | 5 points  |
| Unit 5 – Part 2 Quiz           | Quiz       | 15 points |

### **Unit 6 – Part 1: 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.

#### **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.

#### **Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 6 – Part 1 Text Questions | Homework   | 10 points |
| Unit 6 – Part 1 Lab Questions  | Homework   | 10 points |
| Unit 6 – Part 1 Discussion 1   | Discussion | 5 points  |
| Unit 6 – Part 1 Discussion 2   | Discussion | 5 points  |
| Unit 6 – Part 1 Quiz           | Quiz       | 15 points |

### **Unit 6 – Part 2: 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.

#### **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.

#### **Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 6 – Part 2 Text Questions | Homework   | 10 points |
| Unit 6 – Part 2 Lab Questions  | Homework   | 10 points |
| Unit 6 – Part 2 Activity       | Activity   | 15 points |
| Unit 6 – Part 2 Discussion 1   | Discussion | 5 points  |
| Unit 6 – Part 2 Discussion 2   | Discussion | 5 points  |
| Unit 6 – Part 2 Quiz           | Quiz       | 15 points |

### **Unit 7 – Part 1: 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.

#### **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.

#### **Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 7 – Part 1 Text Questions | Homework   | 10 points |
| Unit 7 – Part 1 Lab Questions  | Homework   | 10 points |
| Unit 7 – Part 1 Discussion 1   | Discussion | 5 points  |
| Unit 7 – Part 1 Discussion 2   | Discussion | 5 points  |
| Unit 7 – Part 1 Quiz           | Quiz       | 15 points |

### **Unit 7 – Part 2: 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 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.

#### **Activities**

|                                |            |           |
|--------------------------------|------------|-----------|
| Unit 7 – Part 2 Text Questions | Homework   | 10 points |
| Unit 7 – Part 2 Lab Questions  | Homework   | 10 points |
| Unit 7 – Part 2 Discussion 1   | Discussion | 5 points  |
| Unit 7 – Part 2 Discussion 2   | Discussion | 5 points  |
| Unit 7 – Part 2 Quiz           | Quiz       | 15 points |

**Unit 8: Final Exam**

**Final Exam Objectives**

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

**Final Exam Activities**

|                             |            |           |
|-----------------------------|------------|-----------|
| Class Reflection Discussion | Discussion | 10 points |
| Final Exam                  | Exam       | 50 points |



### **HOW YOU WILL BE GRADED**

**For critical thinking questions**, there are no right or wrong answers. For example, a question on your thoughts on why you think people are shy is a pretty open-ended type of question. Grades will be based on the depth of personal insight you present. **Do not simply agree or disagree** with an insight question. We are looking for critical thinking and possibly a related personal experience with the question.

**It is important to provide detailed answers for insight/opinion questions.**

**For review questions**, you should produce a more academic answer. For example, "What two categories are norms divided into?" This type of direct question requires a specific answer. Please use full sentences and proper grammar.

**When submitting paragraphs**, use these guidelines.

1. The first, second or last sentence contains the main idea and key words from the question or assigned topic.
2. Paragraph contains one to three explanatory sentences.
3. Paragraph contains two to four sentences about specific details related to question.
4. Details are colorful, interesting and appropriate.
5. Paragraph ends with a good closing sentence that refers to the main idea without repeating it.
6. Free of spelling and grammatical errors.

### **GRADE SCALE**

The following grading scale will be used to determine your final letter grade.

| Letter Grade | Percentage Earned |
|--------------|-------------------|
| A            | 95%+              |
| A-           | 90% - 94.9%       |
| B+           | 87% - 89.9%       |
| B            | 84% - 86.9%       |
| B-           | 80% - 83.9%       |
| C+           | 77% - 79.9%       |
| C            | 74% - 76.9%       |
| C-           | 70% - 73.9%       |
| D+           | 67% - 69.9%       |
| D            | 64% - 66.9%       |
| D -          | 60% - 63.9%       |
| F            | 59% and lower     |

## **SUPPORT**

At NUVHS you will have access to multiple support teams. Who you contact will depend on the questions you have. Always start by contacting your teacher through the Message Center in the course. Your teacher should be able to answer your question, but if they can't, then they will direct you to another support team. If you have questions about any of the course content, your grades, or course policies, you should contact your instructor.

For questions about your enrollment, transcripts, or general school-wide policies, you can contact **NUVHS Student Services** at [info@nuvhs.org](mailto:info@nuvhs.org) or by phone at 866.366.8847. For example, if you would like to withdraw from your course, you should contact Student Services. Please note that a refund for your course can only be obtained if you drop within the first seven days of enrolling in the course.

For help with login/password issues, or other technical issues specific to the Blackboard website, you can contact the team at [National University Blackboard Learn](#). They can also be reached by phone at (888) 892-9095.

## **EXPECTED SCHOOL-WIDE LEARNING RESULTS (ESLRs)**

### **Engaged Learners**

- Demonstrate self-directed learning skills such as time management, and personal responsibility through the completion of course requirements
- Develop an understanding of their own preferred learning styles to enhance their overall academic potential
- Incorporate effective and relevant internet and multimedia resources in their learning process to broaden their knowledge base

### **Critical Thinkers**

- Effectively analyze and articulate sound opinions on a variety of complex concepts
- Illustrate a variety of problem-solving strategies that strengthen college preparation and workforce readiness
- Formulate a framework for applying a variety of technology and internet-based research to enhance information literacy and collaborative thinking

### **Effective Communicators**

- Demonstrate awareness and sensitivity to tone and voice in multiple forms of communication
- Express concepts and ideas in a variety of forms
- Enhance communication skills through the use of media rich or other technology resources

**Global Citizens**

- Appreciate the value of diversity
- Understand the range of local and international issues facing today's global community
- Demonstrate awareness of the importance of cultural sensitivity and social responsibility in the 21st century