

## Course **Syllabus**

What you will learn in this course

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### **Biotechnology 1a: Introduction**

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There are so many mysteries that need unraveling in the world today that can help us grow better crops, cure diseases, combat pollution, solve crimes, and so much more. If you love the idea of solving problems to make the world a better place, a career as a biotechnician may be for you. In this course, you'll learn the basics of lab safety, how to perform tasks crucial to experimentation, biological basics, and about the exciting careers available in the field of biotechnology. Not all heroes wear capes. Some wear lab coats. Grab yours and let's get started!

### **Unit 1: Introduction to Biotechnology**

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What do cloned pets, cancer-seeking nanorobots, drug-producing produce, spider goats, lab-grown organs, meatless meat, and explosive-eating microbes all have in common? They are all produced through biotechnology! You will be amazed at all the ways that biotechnology has impacted your life and the world around you. Let's take some time to learn what biotechnology

is, how it developed, and where it might take us in the future. After considering an overview of the many fields and careers available in biotechnology, you'll be able to make some informed choices about which area interests you most.

## What will you learn in this unit?

1. Define biotechnology and explain applications of biotechnology to your life
2. Identify important historical milestones and advancements in the field of biotechnology
3. List the different fields of biotechnology and give examples of significant advancements in each area
4. Explain the bioethical issues related to biotechnology and identify potential societal impacts of advancements in this field of science
5. Explore a career of interest in the biotechnology field

<b>UNIT 1 Assignments</b>	
<b>Assignment</b>	<b>Type</b>
Unit 1 Critical Thinking Questions	Homework
Unit 1 Activity 1	Homework
Unit 1 Activity 2	Homework
Unit 1 Activity 3	Homework
Unit 1 Discussion 1	Discussion
Unit 1 Discussion 2	Discussion
Unit 1 Quiz	Quiz

## Unit 2: Biotechnology Laboratory Safety

What do virus hunters, biological weapons manufacturers, and biotechnicians all have in common? Unfortunately, they share the risk of potentially contracting a deadly disease when they go to work. Sound scary? Well, if you are well trained and commit to following proper laboratory safety guidelines and regulations, working in a biological laboratory – even one with harmful or deadly organisms – should be perfectly safe. So, what are important safety guidelines, regulations, practices, and procedures you need to know? Let's jump in and find out.

## What will you learn in this unit?

1. Explain the importance of understanding laboratory safety and describe the main steps to follow to prevent laboratory accidents
2. Identify the hazard posed by a chemical or biological agent using a safety sign or symbol
3. Describe the most important safety equipment and personal protective equipment (PPE) to use when working with different types of hazardous materials
4. Analyze a safety data sheet to determine the safety hazards associated with a particular chemical, the most appropriate PPE and safety equipment to use, as well as the best method to safely handle, store, and dispose of the chemical

<b>UNIT 2 Assignments</b>	
<b>Assignment</b>	<b>Type</b>
Unit 2 Critical Thinking Questions	Homework
Unit 2 Activity 1	Homework
Unit 2 Activity 2	Homework
Unit 2 Discussion 1	Discussion
Unit 2 Discussion 2	Discussion
Unit 2 Quiz	Quiz

## Unit 3: Biosafety and Sterility

Pathogens, disease, germs, bugs, microorganisms, viruses, fungus, bacteria . . . no matter what you call these organisms, biotechnologists work with them, study them, and even try to prevent them from contaminating their experiments. How do they do this safely? How can they mitigate the harm microorganisms can cause in research? Following important protocols and techniques while performing their work is key. But, what protocols and techniques must they follow? Here, we'll take a closer look to find out.

## What will you learn in this unit?

1. Compare and contrast the four biosafety levels, determine the biosafety level of biological organisms and materials, and identify the PPE, lab, and facility requirements, at each level
2. Explain the importance of following aseptic techniques and protocols in biological laboratories

3. Determine the correct method or tool that should be used to sterilize or disinfect laboratory equipment, workspaces, and materials
4. Differentiate between proper and poor aseptic technique when performing basic laboratory procedures

<b>UNIT 3 Assignments</b>	
<b>Assignment</b>	<b>Type</b>
Unit 3 Critical Thinking Questions	Homework
Unit 3 Activity 1	Homework
Unit 3 Activity 2	Homework
Unit 3 Discussion 1	Discussion
Unit 3 Discussion 2	Discussion
Unit 3 Quiz	Quiz

## **Unit 4: Biotechnology By The Numbers**

How big, or rather small, is biotechnology? How big is a strand of DNA, an enzyme, or an antibody? How do you work with the raw materials of biotechnology at such a small scale? Here, you will learn how to use the standard equipment and units found in nearly every biotechnology-based laboratory; you will also be able to perform important calculations and accurately use that equipment when you step into a research laboratory for the first time.

### **What will you learn in this unit?**

1. Clearly convert, calculate, and report measurements and calculations used when working in the lab
2. Prepare molar, % concentration, and mass/volume solutions
3. Demonstrate correct use of a micropipette
4. Identify and describe the proper use of basic equipment found in a biotechnology laboratory

## **UNIT 4 Assignments**

Assignment	Type
Unit 4 Critical Thinking Questions	Homework
Unit 4 Activity 1	Homework
Unit 4 Activity 2	Homework
Unit 4 Discussion 1	Discussion
Unit 4 Discussion 2	Discussion
Unit 4 Quiz	Quiz

## Biotechnology 1a Midterm Exam

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- Review information acquired and mastered from this course up to this point.
- 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.)

<b>MIDTERM</b> Assignments	
Assignment	Type
Midterm Exam	Exam
Midterm Discussion	Discussion

## Unit 5: The Molecule of Life

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Think for a moment about all the different types of life that exist on our planet. It might be surprising to know that the basic blueprint for this life is found in a tiny molecule, DNA. Here, you will learn how mankind discovered DNA, how it is structured, and how this new knowledge was applied in science. You'll get a chance to zero in on this amazing molecule, learning how to identify some of the specific information it uncovers.

### What will you learn in this unit?

1. Summarize the experiments that led to our understanding that DNA, not protein, is the molecule of hereditary
2. Describe the structure of DNA in detail and explain how this new information was applied in

science

3. Understand and interpret a DNA profile
4. Make a DNA profile
5. Identify and label the steps of DNA replication
6. Compare and contrast PCR with DNA replication

<b>UNIT 5 Assignments</b>	
<b>Assignment</b>	<b>Type</b>
Unit 5 Critical Thinking Questions	Homework
Unit 5 Activity 1	Homework
Unit 5 Activity 2	Homework
Unit 5 Activity 3	Homework
Unit 5 Discussion 1	Discussion
Unit 5 Discussion 2	Discussion
Unit 5 Quiz	Quiz

## Unit 6: Gene Expression

Our bodies must constantly respond to changing conditions. Something as simple as eating a meal poses a potentially dangerous condition if blood glucose concentrations are not returned to normal shortly thereafter with the help of the protein, insulin. In fact, proteins are involved in nearly every cell process in the body. They give us our traits, serve as a source of energy, perform cellular repair, form blood cells, allow for healthy growth and development, and even play a role in our immune system. Here, we'll learn how proteins are made by the cell, the structure and function of these proteins, and how scientists study and use them in research.

### What will you learn in this unit?

1. Describe the process in which proteins are produced through transcription and translation
2. Discuss the process in which proteins are developed through translation.
3. Understand the role of protein structure on its function and identify the primary, secondary, tertiary, and quaternary structure of proteins

4. Outline the steps scientists use to study protein structure as well as purify and separate proteins in the lab
5. Analyze the impacts of enzyme action on the rate of a chemical reaction using graphical data

<b>UNIT 6 Assignments</b>	
<b>Assignment</b>	<b>Type</b>
Unit 6 Critical Thinking Questions	Homework
Unit 6 Activity 1	Homework
Unit 6 Activity 2	Homework
Unit 6 Activity 3	Homework
Unit 6 Activity 4	Homework
Unit 6 Discussion 1	Discussion
Unit 6 Discussion 2	Discussion
Unit 6 Quiz	Quiz

## **Unit 7: Genomics and Precision Medicine**

Are you interested in the past? Have you ever wondered where your ancestors came from? How about the future? Do you wonder if you will live for 100 years or develop a fatal disease right in the prime of your life? The answers to some of these questions can be found within your own DNA. Once scientists discovered the important function of DNA, they set about dissecting and decoding it. What could this hidden cache of information reveal to us? How could we use the information to understand our own health and improve the way we treat disease? Let's find out.

### **What will you learn in this unit?**

1. Describe what your genome is and why studying your genome (genomics) is important
2. Discuss the impact genomics can have on you
3. List applications of precision medicine and types of genetic testing
4. Understand the benefits and challenges of direct-to-consumer testing
5. Compare and contrast different types of DNA sequencing technologies
6. Identify the best method to use to perform DNA isolation and extraction and compare the benefits and drawbacks of each type

<b>UNIT 7 Assignments</b>	
<b>Assignment</b>	<b>Type</b>
Unit 7 Critical Thinking Questions	Homework
Unit 7 Activity 1	Homework
Unit 7 Activity 2	Homework
Unit 7 Discussion 1	Discussion
Unit 7 Discussion 2	Discussion
Unit 7 Quiz	Quiz

## **Unit 8: Experimental Design**

Experimental design is at the heart of all scientific disciplines. The field of biotechnology has made so many advancements and great strides due to scientists asking important questions, setting up sound experimental designs to test their questions, and making sense of the data they collect. Here, you will learn about and practice the scientific method as you ask and use bioinformatics to answer a meaningful question related to DNA barcoding technology.

### **What will you learn in this unit?**

1. Ask a meaningful research question, write a testable hypothesis, and design an experiment to test the hypothesis
2. Document your work in a legal laboratory notebook according to industry standards and guidelines
3. Compare and contrast traditional taxonomy with DNA barcoding in the methods followed to perform each, the advantages and disadvantages of each, and the applications
4. Use a bioinformatics database to analyze DNA sequence data

<b>UNIT 8 Assignments</b>	
<b>Assignment</b>	<b>Type</b>
Unit 8 Critical Thinking Questions	Homework



Unit 8 Activity 1	Homework
Unit 8 Activity 2	Homework
Unit 8 Activity 3	Homework
Unit 8 Discussion 1	Discussion
Unit 8 Discussion 2	Discussion
Unit 8 Quiz	Quiz

## Biotechnology 1a Final Exam

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- Review information acquired and mastered from this course up to this point.
- 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.)

<b>FINAL Assignments</b>	
<b>Assignment</b>	<b>Type</b>
Final Exam	Exam
Class Reflection Discussion	Discussion