GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

HEALTHCARE SCIENCE

PATHWAY: Biotechnology Research & Development

COURSE: Applications of Biotechnology

UNIT 9: Tissue & Cell Culture

INTRODUCTION

Annotation:

Cells and tissues from bacteria, yeast, plants and animals have been used for many years to produce products including bread, vaccines, biofuels, and medical products. Though it can take years to develop new species by conventional breeding, biotechnologists have found ways to use cultures and lab-grown populations to create novel organisms in a much shorter time frame. These technologies have led to changes in agricultural production and pharmaceutical use, and continue to do so today. This unit teaches the importance of these organisms in biotechnology and demonstrates to students proper ways to culture bacteria, plants, yeast, and animal cells in a laboratory setting.

Grade(s):

	9th
	10th
X	11th
X	12th

Time: Ten 50-minute class periods

Author: Mandy Latimer

Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation.

FOCUS STANDARDS

GPS Focus Standards:

HS-ABT-1 **Students will describe how characteristics of living organisms are integrated with advanced biotechnology techniques to lead to discovery or production.**

d) Apply the basic concepts of cell growth and homeostatsis to systems for culturing cells.

- Describe the different cell types and culture methods (*e.g.*, bacteria, yeast, animal and plant) as used in biotechnology.
- Review sterile culture technique and apply it to growing eukaryotic cells in culture (*e.g.*, plant cell culture).
- Distinguish between the culture environments needed for single-celled organisms and cells from multicellular organisms.

GPS Academic Standards:

SB1	Students will analyze the nature of the relationships between structures and functions in living cells.
SB2	Students will analyze how biological traits are passed on to successive generations.
SB3	Students will derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems.
SB4	Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.
SCSh3	Students will identify and investigate problems scientifically.
SCSh4	Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
SCSh5	Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.
SCSh6	Students will communicate scientific investigations and information clearly.
SC7	Students will characterize the properties that describe solutions and the nature of acids and bases.
SCSh8	Students will understand important features of the process of scientific inquiry.
SPS10	Students will investigate the properties of electricity and magnetism.
MM1A1	Students will explore and interpret the characteristics of functions, using graphs, tables, and simple algebraic techniques.
MM1D3	Students will relate samples to a population.
MM1P1	Students will solve problems (using appropriate technology).
MM1P4	Students will make connections among mathematical ideas and to other disciplines.
MM1P5	Students will represent mathematics in multiple ways.
MM2D2	Students will determine an algebraic model to quantify the association between two quantitative variables.

UNDERSTANDINGS & GOALS

Enduring Understandings:

Microorganisms, animals, and plants are important to biotechnology because of their variety of uses. It is important for students to understand how they are used, the public's concern regarding their use, and the proper way to grow these species for use in scientific research and development.

Essential Questions:

- What are some differences between bacteria, yeast and plant cells?

- Why is it important to use sterile technique?
- What are three ways that bacteria can be grown in a lab?
- How has biotechnology transformed some of our basic crops?
- What are some of the unique advantages of plants to genetic engineers?

Knowledge from this Unit:

Students should be able to:

- Describe how bacteria, yeast and plant cells can be grown in the lab
- Explain why plants are suitable for genetic engineering
- List some crops that have been improved by genetic engineering
- Describe the difference between eukaryotic & prokaryotic cells

Skills from this Unit:

Students will be able to:

- Demonstrate proper plant tissue culture techniques
- Perform sterile technique

ASSESSMENTS

Assessment Method Type:

X Pre-test
__ Objective assessment - multiple-choice, true- false, etc.
__ Quizzes/Tests
__ Unit test
X Group project
__ Individual project
X Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
__ Self-check rubrics
__ Self-check during writing/planning process
X__ Lab Book
__ Reflect on evaluations of work from teachers, business partners, and competition judges
__ Academic prompts
__ Practice quizzes/tests
__ Subjective assessment/Informal observations
__ Essay tests
__ Observe students working with partners
__ Observe students role playing
__ Peer-assessment
__ Peer editing & commentary of products/projects/presentations using rubrics
__ Peer editing and/or critiquing
X Dialogue and Discussion
__ Student/teacher conferences
__ Partner and small group discussions
_X_ Whole group discussions
__ Interaction with/feedback from community members/speakers and business partners
__ Constructed Responses
__ Chart good reading/writing/listening/speaking habits
__ Application of skills to real-life situations/scenarios
__ Post-test

Assessment Attachments and / or Directions:

Since biotechnology is mostly taught to students by doing lab work, it is usually easy to spot when a student is not following directions or doesn't understand basic lab techniques because the student's labs will not work.

LESSON PLANS

• LESSON 1: GROWING CELLS IN LAB

1. Identify the standards. Standards should be posted in the classroom.

HS-ABT-1 **Students will describe how characteristics of living organisms are integrated with advanced biotechnology techniques to lead to discovery or production.**

d) Apply the basic concepts of cell growth and homeostatsis to systems for culturing cells.

- Describe the different cell types and culture methods (*e.g.*, bacteria, yeast, animal and plant) as used in biotechnology.
- Review sterile culture technique and apply it to growing eukaryotic cells in culture (*e.g.*, plant cell culture).
- Distinguish between the culture environments needed for single-celled organisms and cells from multicellular organisms.

SB1 Students will analyze the nature of the relationships between structures and functions in living cells.

SB2 Students will analyze how biological traits are passed on to successive generations.

SB3 Students will derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems.

SB4 Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.

SCSh3 Students will identify and investigate problems scientifically.

SCSh4 Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SCSh6 Students will communicate scientific investigations and information clearly.

SC7 Students will characterize the properties that describe solutions and the nature of acids and bases.

SCSh8 Students will understand important features of the process of scientific inquiry.

SPS10 Students will investigate the properties of electricity and magnetism.

MM1A1 Students will explore and interpret the characteristics of functions, using graphs, tables, and simple algebraic techniques.

MM1D3 Students will relate samples to a population.

MM1P1 Students will solve problems (using appropriate technology).

MM1P4 Students will make connections among mathematical ideas and to other disciplines.

MM1P5 Students will represent mathematics in multiple ways.

MM2D2 Students will determine an algebraic model to quantify the association between two quantitative variables.

2. Review Essential Questions. Post Essential Questions in the classroom.
   - What are some differences between bacteria, yeast and plant cells?
   - What are three ways that bacteria can be grown in a lab?

- Why is it important to use sterile technique?
- How has biotechnology transformed some of our basic crops?
- What are some of the unique advantages of plants to genetic engineers?

3. Identify and review the unit vocabulary. Terms may be posted on word wall.

Aerobic	Bioterrorism	Gel Medium
Anaerobic	Buffer	Peptidoglycan
Antibiotics	Colony	Petri Dish
Antimicrobial	Culture Media	Plasmid
Archaea	Eukaryotic	Prokaryotic
Batch Process	Fermentation	Thermophiles
Bioluminescence	Fermenter	Yeast
Biomass	Fungi	

4. Interest approach – Mental set
   - Split the class into small groups.
   - Assign each group one of the following scenarios, and give each group the corresponding **Interest Approach Scenarios:**
     - See attached supplementary files
     - Yeast for Ethanol
     - Therapeutic *E. coli*
     - Animal Cells to Produce Rabies Vaccine
     - Algae as a Biofuel
   - Have the groups research their scenario and answer the questions on their worksheets.

5. Lead a discussion about the use of cell cultures in biotechnology.
   - Ask students, "What are the differences between bacteria, yeast, animal, and plant cells?"
   - Which one takes the longest to culture?
   - How is each of these used in biotechnology?
   - What is exponential growth?
   - Cryopreservation is a way to preserve cells for later use. Why might scientists want to do this?

• LESSON 2: STERILE TECHNIQUE

1. Review Essential Questions. Post Essential Questions in the classroom.

   - Why is it important to use sterile technique?

2. Lead a brief discussion about being sterile in the lab.
   - Ask students, "What does it mean to be 'sterile?'"
   - What are some laboratory techniques we can used to be sterile?
   - Where can contamination come from?
   - What kind of material can contaminate an experiment?
   - Why is sterility important?
   - What should you wear in the lab to prevent human contamination?

3. Sterile Technique Project
   - Break the class into small groups.
   - Have each group create a presentation about how to be sterile in the lab.

- Some topics to touch on include:
    - Working under a hood
    - Working with a pathogen
    - Surgery
    - Handling contaminated objects
    - Working in a clean room
    - Chemicals used to sterilize working surfaces
- Allow students to be creative and involve demonstrations of sterile technique, humor, and "what could go wrong" scenarios in addition to posters or slideshows.

4. Summary
    - Make sure students are well-acquainted with techniques and reasoning behind the need for sterile conditions and techniques.

• LESSON 3: PLANT BIOTECHNOLOGY

1. Review Essential Questions. Post Essential Questions in the classroom.

    - How has biotechnology transformed some of our basic crops?
    - What are some of the unique advantages of plants to genetic engineers?

2. Read the following to the class.
    - Agriculture is the world's biggest industry, but feeding an ever-increasing world population from a finite amount of land has become a major issue.
    - Biotechnology has helped by giving researchers a new set of tools to help them develop new and improved plants at an accelerated pace.
    - Plants that can produce their own pesticides, contain increased nutrients, and which can be used for pharmaceutical production have already been developed.

3. Lead a discussion about transgenic plants.
    - Ask students, "What is a transgenic plant?"
    - What are some examples of transgenic plants?
    - Do you think these plants have affected the economy?
    - Do you think transgenic crops should be labeled differently?
    - Why do you think people are concerned about eating transgenic foods?
    - Are there any limitations to conventional plant breeding?

4. Create-a-Plant
    - Instruct students to create a transgenic plant.
    - The plant may solve an existing problem in the food supply, or just be a new decorative species.
    - Have students draw and decorate their plants and present them to the class
    - Their presentations should include:
        - Problem solved by the plant
        - Where the plant can be grown
        - Color, flavor, texture, and other physical characteristics
        - How the plant is cultivated
        - Beneficial traits
        - Advantages and disadvantages of the plant

5. Summary

- Have students pick one of the following methods and write a short report on how the method can be used to create transgenic plants.
    - Conventional breeding
    - Growing plants from a single cell
    - Leaf fragment technique
    - Protoplast fusion
    - Gene guns
- Make sure the report includes the following:
    - Importance of this method to the economy
    - Plants produced by this method
    - Why people are concerned about transgenic plants
    - How plants produced by this method are used in biotechnology

• LESSON 4: CULTURING PLANT TISSUE

1. Review Essential Questions. Post Essential Questions in the classroom.

    - What are some of the unique advantages of plants to genetic engineers?

2. Lead a discussion about growing plants.
    - Ask students, "Why does it take so long to grow plants in the conventional way?"
    - How does culturing tissue in a lab make the same plants in a shorter time period?
    - Why must plant tissue culture be done under sterile conditions?
    - What are some plant hormones we use?

3. African Violet Culture
    - Have students visit **www.kitchenculturekit.com** and find a protocol for culturing African violets.
        - The procedure should be recorded in their lab notebooks.
    - Break the class into small groups and give each group an African violet.
    - Instruct the groups to perform their experiment and record all observations and photographs in their lab notebooks.
    - After the experiment, students should explain in a short paragraph why they needed to use sterile technique while propagating plants.

• ATTACHMENTS FOR LESSON PLANS:

Interest Approach Scenario
GBTI Bacteria Lab
Vocabulary Glossary

• NOTES & REFLECTION:

One of the most important steps in this unit is that the student be able to understand sterile technique. Students should also be able to discuss pros and cons pertaining to biotechnology's impact on our food supply, health and environment.

CULMINATING PERFORMANCE TASK

Culminating Unit Performance Task Title:

Bacterial Culture of *E. coli* and *S. epidermidis*

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Students will be cultivating *Escherichia coli* and *Staphylococcus epidermidis* bacteria. They should record all procedures, observations and data in their laboratory notebooks.

Attachments for Culminating Performance Task:

GBTI Bacteria Lab

UNIT RESOURCES

Web Resources:

www.kitchenculturekit.com
www.hudsonalpha.org/education
www.pbs.org/wgbh/harvest/

Materials & Equipment:

- Baby food jars
- Forceps
- Isopropyl alcohol
- Scissors
- Large plastic tubs for sterile hood
- Agar
- Spray bottles

21st Century Technology Used:

X	Slide Show Software		Graphing Software		Audio File(s)
	Interactive Whiteboard		Calculator		Graphic Organizer
	Student Response System		Desktop Publishing		Image File(s)
	Web Design Software		Blog		Video
	Animation Software		Wiki		Electronic Game or Puzzle Maker
	Email		Website		