GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

HEALTHCARE SCIENCE

PATHWAY: Biotechnology Research & Development

COURSE: Applications of Biotechnology

UNIT 1: Biotechnology Today

INTRODUCTION

Annotation:

This unit begins the third course in the biotechnology pathway. Students should already be familiar with biotechnology and some of the terms used in this science. This unit covers current events and trends in biotechnology and the different positions and career opportunities in the industry. During the course, students will discuss the economic effects biotechnology has on Georgia and the United States. They will also debate social and ethical issues that have developed from these new technologies. Students will be introduced to a project culminating in a class presentation. They will also begin a lab notebook, an essential and legal document which they will be expected to maintain throughout the term.

Grade(s):

- [ ] 9th
- [ ] 10th
- [X] 11th
- [X] 12th

Time:

Five 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 demonstrate the ability to use and apply mathematics and language arts skills.**

f) Apply English and language arts standards throughout the course using various forms of written and electronic communications.
g) Use biotechnology terminology appropriately.
h) Document projects in writing with emphasis on using the scientific format (abstract, introduction, methods, results, discussion, references, tables, and figures) and through oral presentations with electronic support.

HS-ABT-3 **Students will demonstrate deeper understanding of current trends and issues in biotechnology.**

a) Monitor current trends in biotechnology using a variety of information sources-i.e. Scientific American, Wall Street Journal, Discovery magazine, and scientific associations and federal web sites including USDA, NIH, FDA, CDC, NCBI, and BIO.
b) Examine the economic impact of biotechnology on quality of life to include the environment, agriculture, and medicine.

GPS Academic Standards:

ELA11W3 The student uses research and technology to support writing.
SCsh1 Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.
SSEF4 The student will compare and contrast different economic systems, and explain how they answer the three basic economic questions of what to produce, how to produce and for whom to produce.
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.
ELA9RC2 The student participates in discussions related to curricular learning in all subject areas.
ELA9LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.
ELA9RL5 The student understands and acquires new vocabulary and uses it correctly in reading and writing.
MM1A1 Students will explore and interpret the characteristics of functions, using graphs, tables, and simple algebraic techniques.
MM2D1 Using sample data, students will make formal inferences about population means and standard deviation.

UNDERSTANDINGS & GOALS

Enduring Understandings:

Biotechnology is changing our lives at a very fast pace, faster than our ethics can adjust and thus we are having problems reconciling moral and social issues with new technologies, including the controversies surrounding stem cells, cloning, growing tissues in laboratories, and using tissues or organs from transgenic animals to assist in human medicine. Georgia has a variety of biotechnology companies producing everything from bio-fuels to prosthesis equipment. Everyone who works in a biotechnology lab

must document all of their work in a laboratory notebook, which becomes a record of their work as well as a legal document.

Essential Questions:

- Why do people need to document everything they do in a lab?
- Where can information about the biotechnology industry be found?
- How does biotechnology affect the economies of Georgia and the United States?
- Who decides what is morally acceptable when it comes to using many of the technologies that biotechnology research has produced?
- What kinds of jobs are available in the biotechnology industry?

Knowledge from this Unit:

Students will be able to:

- Identify specific biotechnology companies and products in Georgia and the United States
- Discuss jobs available in the biotechnology industry
- Explain the affects of biotechnology on national and local economies
- Describe how laboratory notebooks are set-up and used

Skills from this Unit:

Students will be able to:

- Research current trends in biotechnology, both locally and nationally
- Demonstrate the skills necessary to keep a clear and legible laboratory notebook
- Debate the pros and cons of controversial biotechnology products

ASSESSMENTS

Assessment Method Type:

____ Pre-test
X Objective assessment - multiple-choice, true- false, etc.
__ Quizzes/Tests
__ Unit test
X Group project
X Individual project
____ Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
__ Self-check rubrics
__ Self-check during writing/planning process
__ Journal reflections on concepts, personal experiences and impact on one's life
__ 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
X 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

_____
__ 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
_X_ Post-test

Assessment Attachments and / or Directions:

- **Quiz 1 General Biotechnology Terms**
- **Quiz 2 Biotechnology Companies and Organizations**
- **Quiz 3 Biotechnology Products and Techniques**

LESSON PLANS

• LESSON 1: THE LAB NOTEBOOK

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

HS-ABT-1 **Students will demonstrate the ability to use and apply mathematics and language arts skills.**
f) Apply English and language arts standards throughout the course using various forms of written and electronic communications.
g) Use biotechnology terminology appropriately.
h) Document projects in writing with emphasis on using the scientific format (abstract, introduction, methods, results, discussion, references, tables, and figures) and through oral presentations with electronic support.

HS-ABT-3 **Students will demonstrate deeper understanding of current trends and issues in biotechnology.**
a) Monitor current trends in biotechnology using a variety of information sources-i.e. Scientific American, Wall Street Journal, Discovery magazine, and scientific associations and federal web sites including USDA, NIH, FDA, CDC, NCBI, and BIO.
b) Examine the economic impact of biotechnology on quality of life to include the environment, agriculture, and medicine.

ELA11W3 The student uses research and technology to support writing.

SCsh1 Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

SSEF4 The student will compare and contrast different economic systems, and explain how they answer the three basic economic questions of what to produce, how to produce and for whom to produce.

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.

ELA9RC2 The student participates in discussions related to curricular learning in all subject areas.

ELA9LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

ELA9RL5 The student understands and acquires new vocabulary and uses it correctly in reading and writing.

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

MM2D1 Using sample data, students will make formal inferences about population means and standard deviation.

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

   - Why do people need to document everything they do in a lab?
   - Where can information about the biotechnology industry be found?
   - How does biotechnology affect the economies of Georgia and the United States?
   - Who decides what is morally acceptable when it comes to using many of the technologies that biotechnology research has produced?
   - What kinds of jobs are available in the biotechnology industry?

3. Identify and review the unit vocabulary. Terms may be posted on a word wall or modified Frayer diagram.

Bioengineering	Efficacy	Plasmid
Biofuel	Food and Drug Administration	QC
Bioinformatics	Gene	Recombinant DNA
Biotechnology	Genentech	R&D
Bt Corn	Gene Therapy	Round-UP Ready Crops
Centers for Disease Control and Prevention	Genetically Modified Organism	Stem Cell
Clinical Trial	Human Genome Project	Transgenic
Cloning	Monsanto	Vaccine
DNA	National Institutes of Health	
DNA Fingerprinting	Patent	

4. Explain to students it is important to document everything in lab because under United States law, a patent is granted to the first to conceive the idea for an invention, not the first person to apply for a patent.
   - This means laboratory notebooks are essential evidence of the date of conception.

5. Keeping a Proper Notebook
   - Give each student a copy of the **Notebook Check Guidelines** information.
     - See attached supplementary files
   - Make sure students understand the following guidelines regarding their laboratory notebooks.
     - Lab notebooks must be permanently bound pages, not spiral or comb bound
     - Only write in blue ink
     - You can tape or staple diagrams and pictures into the notebook if you need to
     - Pages, pictures, and diagrams must be signed or initialed and dated
     - There should be no blank areas. Draw an X in any blank area.
     - Must be co-signed by another lab partner
     - Erasing is not allowed. Draw an X over mistakes and immediately sign that you have corrected the error.
   - **Note:** Additional guidelines for laboratory notebooks may be found at **www.snco.com/guidelines.html**.

6. Have students complete **Quiz 1 General Biotechnology Terms.**
   - See attached supplementary files
   - **Note:** The key is attached to the same document

• LESSON 2: CURRENT TRENDS IN BIOTECHNOLOGY

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

- Where can information about the biotechnology industry be found?

2. Interest Approach – Mental Set
   - Ask students, "What are some biotechnology products recently developed?"
   - Have any new innovations come out in the past year?
   - What kinds of research are involved in biotechnology?
   - How is biotechnology different from other sciences, such as chemistry and biology?

3. Research Activity
   - Give students a copy of the **Biotechnology Companies** worksheet and have them access **www.GABio.org**.
     - See attached supplementary files
     - When the homepage comes up, instruct students to click on "Georgia Companies," then "Georgia Company Listing."
     - Instruct students to complete the worksheet by answering the questions about five of the companies on the website.
   - Once students have completed research on the companies, have them research other publications to learn about biotechnology products.
     - **Examples:**
       - Cancer treatments
       - New crop varieties
       - Transgenic animals
       - Solar energy

4. Discuss findings of the research activities.

• LESSON 3: THE ECONOMIC AFFECTS OF BIOTECHNOLOGY

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

   - How does biotechnology affect the economies of Georgia and the United States?

2. Biotechnology and the Economy Project
   - Divide the class into small groups.
   - Instruct the groups to visit **www.biotechinstitute.org** and click on "Institute Membership" and then "Current Membership," which will bring up a list of national companies. They should also choose one of the companies researched in Lesson 1 to further research.
   - Have each group choose two companies — one national, and one in Georgia — to profile for this project. Make sure each student has a copy of the **Biotechnology and the Economy** worksheet to fill out during their research.
     - See attached supplementary files
   - Students should present their research to the class, making sure to compare and contrast the national companies with those specific to Georgia.

3. Lead a discussion following the presentations.
   - Ask students, "After seeing all these different companies, what major differences are there between national and Georgia companies?'
   - Why do you think products are more well-known if they are produced by a national company?
   - Would you rather work for a state or national company?

- There are many different fields of biotechnology. Which of these fields appears to be the most profitable?
- What do you think would happen to our economies if biotechnology companies ceased to exist?

4. Biotechnology in Georgia
    - Show students the **Georgia Biosciences 2008** PDF file.
        - See attached supplementary files
    - Review the various employment and economy-based charts.
        - As you go along in the presentation, ask students why they think some fields have many more employees than others.
5. Summary
    - The summary in this lesson can be accomplished several ways. It is suggested that students or groups present a summary of their findings to the class.

6. Have students complete **Quiz 2 Biotechnology Companies and Organizations.**
    - See attached supplementary files
    - **Note:** The key is attached to the same document

• LESSON 4: MORAL ISSUES RELATED TO BIOTECHNOLOGY

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

    - Who decides what is morally acceptable when it comes to using many of the technologies that biotechnology research has produced?

2. Moral Issues Activity
    - Have the class research and describe some of the main moral and social issues about biotechnologies that are surfacing in the media today.
        - **Examples:**
            - Gene therapy research
            - Genetically modified foods
            - Cloning
            - Seed patenting
    - Lead a discussion about the issues students discovered.
        - Ask students, "What seems to frighten the public the most about biotechnology?"
        - Is there anything about biotechnology which frightens you?
        - Do you think science can work these problems out? How?
        - Which of these issues is an example of science gone wrong?
        - Europeans ban GMO crops. Do you think the United States should too?
        - What do activists say about immunizations, GMOs, and transgenic animals?
        - How do biotechnology companies respond to the backlash?
        - Where is the middle of the road concerning biotechnology?

3. Summary: Moral Activities Paper
    - It is suggested that a summary of this lesson be given by having students write at least a one-page paper covering some of the issues discussed in class.
    - The paper should include the following:
        - **Title:** Moral Issues Related to Biotechnology
        - **Introduction**
        - **Body**
        - **Conclusion**
    - **Note:** This paper can be done in-class or as a take-home assignment.

4. Have students complete **Quiz 3 Biotechnology Products and Techniques.**
    - See attached supplementary files
    - **Note:** The key is attached to the same document.

• LESSON 5: BIOTECHNOLOGY CAREERS AND JOB RESPONSIBILITIES

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

    - What kinds of jobs are available in the biotechnology industry?

2. Lead a brief discussion about biotechnology jobs.
    - Ask students, "After learning about some of the biotechnology companies in the United States, which one would you most like to work for?"
    - Are there any non-scientific jobs in the biotechnology industry?
        - **Examples:**
            - Patent lawyers
            - Purchasing agents
            - Salespeople
    - Would you rather have a scientific job or a non scientific job? Why?

3. Job Search Activity
    - Give students a copy of the **Career Exploration** worksheet and have them access www.Monster.com.
    - Instruct students to search "biotechnology" and "Georgia" in the green job search menu on the homepage.
    - Have students answer the questions on the worksheet.
    - Allow students to choose one of the jobs they found to present to the class. Ask students to record one interesting fact about each job in their lab notebooks.

• ATTACHMENTS FOR LESSON PLANS

Notebook Check Guidelines
Quiz 1 General Biotechnology Terms
Biotechnology Companies
Biotechnology and the Economy
Georgia Biosciences 2008
Quiz 2 Biotechnology Companies and Organizations
Quiz 3 Biotechnology Products and Techniques
Career Exploration
Vocabulary Glossary
Stem Cell Writing Prompt
Stem Cell Rubric
Stem Cell Resources
Stem Cell Peer Critique

• NOTES & REFLECTION:

Teachers may use the laboratory notebooks as a way to keep track of students' progress and participation throughout the pathway.

CULMINATING PERFORMANCE TASK

Culminating Unit Performance Task Title:

Stem Cell Writing Project

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Students will write a mock letter to the Georgia governor either in support of using embryonic stem cells in biotechnology research, or in support of banning the use of embryonic stem cells and using adult stem cells instead. They will research on their own and using the sources provided to best analyze their position. Students will turn in both the letter and a works cited page, and will present their letter to the class for both peer and instructor review.

Attachments for Culminating Performance Task:

Stem Cell Writing Prompt
Stem Cell Rubric
Stem Cell Resources
Stem Cell Peer Critique

UNIT RESOURCES

Web Resources:

www.biotechinstitute.org
www.GABio.org
www.Monster.com

Materials & Equipment:

21st Century Technology Used:

☐ 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	