GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

HEALTHCARE SCIENCE

PATHWAY: Biotechnology Research & Development
COURSE: Applications of Biotechnology
UNIT 2: Safety in Biotechnology

INTRODUCTION

Annotation:

In this unit students will evaluate cases of safety violations in biotechnology and draw conclusions about how they could have been prevented. They will demonstrate how to safely handle dangerous substances. The final learning activity will be a situation in which students will apply the knowledge gained from the case studies and their research of a particular issue to a risk management investigation of a company in which there has been a significant breakdown in safety practices. They will provide a fluent rendition of a safety issue with appropriate props or simulated props and corrective safety management.

Grade(s):

	9th
	10th
X	11th
X	12th

Time:

Fifteen 50-minute class periods

Author:

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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-2 **Students will incorporate required safety practices and procedures in performing tasks related to biotechnology.**

a) Analyze case studies of lab accidents and biohazards in various settings. (Examples include dangers of gases, explosions, electrical shock, biohazards, infectious disease, and genetically modified organisms; also other topics as suggested by current events.)

b) Demonstrate ways to prevent or manage lab accidents and biohazards in various workplace settings.

c) Understand and apply safe methods for transporting chemicals, grounding electrical equipment, sharps disposal, monitoring gas pressures (pressurized tanks), and using secondary containment systems for transport (safe shipping methods).

GPS Academic Standards:

SCSh2 Students will use standard safety practices for all classroom laboratory and workplace investigations.

UNDERSTANDINGS & GOALS

Enduring Understandings:

Students will understand the importance of consistently maintaining a safe workplace and the potential risks of failure if a lab is unsafe. They will also understand the potential affects and dangers of gases, explosions, electrical shock, biohazards, infectious disease, and genetically modified organisms and how they should be managed.

Essential Questions:

- How can required safety practices and procedures be maintained in biotechnology?
- How have incidents in biotechnology affected OSHA safety regulations?
- How should procedures such as safe chemical transport, electrical equipment handling, sharps management, gas pressure monitoring, and secondary containment systems for transport be managed in biotechnology?
- What can be done to prepare for and prevent lab accidents?
- How can lab explosions be prevented?
- What potential biohazards should laboratories be prepared for?

Knowledge from this Unit:

Students should be able to:

- List potential consequences of a breakdown in safety procedures
- Identify ways to prevent or manage lab accidents and biohazards
- Describe how chemicals should be transported
- Explain how secondary containment systems work for transport
- Describe how to research safety violation cases
- Discuss the issues related to infectious diseases and genetically modified organisms

Skills from this Unit:

Students should be able to:

- Demonstrate safe handling of dangerous gases
- Prevent electrical shock
- Handle biohazards safely

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
__ 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
_X_ 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
____ 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:

Assessment Safety in Biotech
Unit 2 Exam & Key

LESSON PLANS

- **LESSON 1: SAFETY OVERVIEW**

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

HS-ABT-2 **Students will incorporate required safety practices and procedures in performing tasks related to biotechnology.**

a) Analyze case studies of lab accidents and biohazards in various settings. (Examples include dangers of gases, explosions, electrical shock, biohazards, infectious disease, and genetically modified organisms; also other topics as suggested by current events.)
b) Demonstrate ways to prevent or manage lab accidents and biohazards in various workplace settings.
c) Understand and apply safe methods for transporting chemicals, grounding electrical equipment, sharps disposal, monitoring gas pressures (pressurized tanks), and using secondary containment systems for transport (safe shipping methods).

SCSh2 Students will use standard safety practices for all classroom laboratory and workplace investigations.

2. Review Essential Question(s). Post Essential Questions in the classroom.

- How can required safety practices and procedures be maintained in biotechnology?
- How have incidents in biotechnology affected OSHA safety regulations?
- How should procedures such as safe chemical transport, electrical equipment handling, sharps management, gas pressure monitoring, and secondary containment systems for transport be managed in biotechnology?
- What can be done to prepare for and prevent lab accidents?
- How can lab explosions be prevented?
- What potential biohazards should laboratories be prepared for?

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

APHIS	Gauge Pressure	PASS
Compressed Gas	High Pressure Gas	Pressure Regulator
Cylinder Valve	High Toxic Gas	RACE
Flammable Gas	Liquefied Gas	Sharps

4. Interest approach – Mental set
   - Find some current event articles related to biotechnology to share with students.
   - For each issue, ask students, “What do you think is the problem here?”
   - Could all of these situations be related to safety issues in biotechnology?
   - What do you think it means to practice safety in biotechnology?
     - Examples:
       - Not passing germs
       - Keeping the lab clean
       - Not using broken equipment
5. Safety Contracts
   - Review the **Biotech Safety Contract** and the **Lab Safety Commitment Poster** with students and have them sign to signify they have read them.
     - See attached supplementary files
   - Instruct students to take the contract and poster home so their parents or guardians may sign them as well.

6. Biotechnology Case Studies
   - **Note:** Before teaching this lesson, find some examples of case studies related to biotechnology.
   - Divide students into small groups and give each group a copy of the **Tuberculosis Case Study** handout.

    - See attached supplementary files
- As a class, read aloud and discuss the issues surrounding the TB cases.
- Have the groups answer the discussion questions on the handout.

• LESSON 2: CASE STUDIES

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

    - How should procedures such as safe chemical transport, electrical equipment handling, sharps management, gas pressure monitoring, and secondary containment systems for transport be managed in biotechnology?

2. Lab Safety Case Studies
    - **Note:** This may take time during several class periods, or may be assigned as an out-of-class homework project. Research case studies beforehand so they can be assigned to groups. Case studies can be graded using the **Oral Presentation Rubric**.
        - See attached supplementary files.
    - Break the class into small groups and give each group a case study about one of the following incidents:
        - Lab fire accidents
        - Exposure to a biohazard
        - Electrical shock
        - Infectious disease outbreak
        - Genetically modified organism
        - Chemical spill
    - Have the groups research their case study and present their findings to the class. In their presentation, they should include answers to the following questions:
        - What happened?
        - When and where did the incident occur?
        - What substance(s) were involved?
        - What was the affect of the incident?
        - What emergency steps were taken to handle the situation?
        - What can be done to prevent this situation from happening again?

3. Case Study Role-Play
    - Split the class into three groups and give each group a 3x5 index card with one of the following scenarios written on it:
        - A foreign country has released a pathogen to kill all America's corn
        - Foot and Mouth Disease outbreak in the U.S.
        - A train carrying chemicals crashes and leaks chlorine gas into the surrounding area
    - Have students role-play that they are a biotechnology company assigned to solve the problem and prevent against it happening in the future.
    - Allow the groups to present their scenarios to the rest of the class.
    - Once each group has presented, lead a class discussion about whether the preventative measures and solutions would be feasible in the real world.

• LESSON 3: FIRES AND EXPLOSIONS IN THE LAB

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

- What can be done to prepare for and prevent against lab accidents?
- How can lab explosions be prevented?

2. Lab Explosion Case Study
   - Access the lab explosion case study at **http://www.ehs.uci.edu/salerts/sep2000_lab_explosion.pdf**.
   - Spend a few minutes discussing different fire safety equipment in the lab, such as the fire extinguisher and fire blanket.
   - Explain to students the proper place they should go if there is a fire in their classroom laboratory.

3. Lead a brief discussion about fire safety.
   - Ask students, "How would you determine which fire extinguisher to use in case of a fire?
   - How would you alert others to the fact there is a fire?
   - What do the acronyms RACE and PASS mean in terms of a fire?
     - **RACE:** Rescue anyone in danger, Activate the fire alarm, Contain the fire by shutting a door, Extinguish the fire
     - **PASS:** Pull the pin, Aim the nozzle, Squeeze the handle, Sweep the spray at the base of the fire
   - Have you ever witnessed any type of explosion in person or on TV?
   - What did you notice about the explosion?
   - If you had been there, how would you have handled the situation?
   - What causes explosions in the lab?
   - Do you think explosions are serious?
   - How can explosions be prevented?
   - Why is it important to be prepared and have management practices established in case of an emergency?
   - Why is it important to have safety drills?
   - Have students volunteer to demonstrate the RACE and PASS procedures.
   - Discuss possible steps to take if there was an explosion in your lab.

• LESSON 4: HAZARDS IN THE LABORATORY

1. Review Essential Questions. Post Essential Questions in the classroom.
   - What can be done to prepare for and prevent lab accidents?
   - What potential biohazards should laboratories be prepared for?

2. Lead a discussion about hazards in the laboratory.
   - Ask students, "What would you do if you witnessed someone receive an electrical shock?"
   - Why is time of the essence in emergencies like these?
   - What would be a safe way to respond to this emergency?
   - What issues are there when handling gases and pressurized tanks?
   - How can we be prepared to handle gas leaks and shocks?
   - What additional biohazards could be issues in the workplace?
   - What agencies would be involved in the case of a chemical spill or gas leak?

3. Electrical Safety
   - Review with students how to handle an electric shock if it occurs in the classroom.
   - Ask for volunteers to demonstrate the response techniques.

4. Personal Protective Equipment

- Explain to students that when technicians are handling a toxic waste or other dangerous material, they should wear PPE.
- Tell students PPE can include:
    - Clothing appropriate for chemical operations
    - Eye protection
    - Respirators
- If possible, have a professional come in to the classroom to model PPE.

• ATTACHMENTS FOR LESSON PLANS

Biotech Safety Contract
Lab Safety Commitment Poster
Tuberculosis Case Study
Oral Presentation Rubric
Assessment Safety in Biotech
Unit 2 Exam & Key

• NOTES & REFLECTION:

If possible, have some safety professionals come to the class to demonstrate how to handle electrical shocks, explosions, and PPE.

CULMINATING PERFORMANCE TASK

Culminating Unit Performance Task Title:

Unit 2 Written Assessment

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Administer the Assessment Safety in Biotech assignment. Grade and discuss any questions students might have.

Attachments for Culminating Performance Task:

Assessment Safety in Biotech

UNIT RESOURCES

Web Resources:

http://www.ehs.uci.edu/salerts/sep2000_lab_explosion.pdf
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10106
http://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf
http://ublib.buffalo.edu/libraries/projects/cases/ubcase.htm
Note: To have access to the answers to the case studies, you must sign up in advance at the website
http://www.aphis.usda.gov/emergency_response/downloads/APHIS%20Emergency%20Mobilization%20Guide.pdf
http://www.aphis.usda.gov/biotechnology/regulations.shtml
http://programs.ifpri.org/pbs/pdf/pbscommbriefmaize.pdf

http://www.calstatela.edu/univ/ehs/docs/chemlab/lab_safety_jun_09.pdf
http://ehs.virginia.edu/biosafety/bio.documents/InspectionChecklist_BSL2.pdf
http://www.ascp.org/pdf/5701.aspx
http://library.thinkquest.org/03oct/00738/labincidents.html
ehs.virginia.edu/biosafety/bio.documents/biosafety_manual.doc
http://www.aphis.usda.gov/biotechnology/compliance_history.shtml

Materials & Equipment:

- 3x5 cards
- PPE
- Materials to simulate hazards in the laboratory
- Lab safety 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		