GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

HEALTHCARE SCIENCE

PATHWAY: Biotechnology Research & Development

COURSE: Applications of Biotechnology

UNIT 5: Research and Data Analysis

INTRODUCTION

Annotation:

This unit includes lessons on following standard operating procedure, maintaining a laboratory notebook, documenting and analyzing data, and performing mathematical calculations using statistics.

Grade(s):

X	9th
X	10th
X	11th
X	12th

Time:

15 hours

Author:

Deborah Grimes

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-6 **Students will communicate effectively orally and in writing, applying academic knowledge in biotechnology communications.**

a) Understand how to follow a Standard Operating Procedure.
b) Utilize computer based applications in documenting and analyzing data.
c) Maintain a laboratory notebook using proper procedures and attention to the notebook as a legal document.
d) Apply technical writing format for reports, using common scientific formats.

HS-ABT-1 **Students will demonstrate the ability to use and apply mathematics and language arts skills.**

a) Perform mathematical calculations related to biotechnology including statistics.
b) Compare the standard deviation and the mean of efficacy testing data of two biotechnology products.
c) Illustrate a set of biotechnology data graphically.

GPS Academic Standards:

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.
ELA9LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.
ELA9RC2 The student participates in discussions related to curricular learning in all subject areas.
MM2P1 Students will solve problems (using appropriate technology).
MM2P3d Use the language of mathematics to express mathematical ideas precisely.
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.
ELA11W3 The student uses research and technology to support writing.
MM1A1 Students will explore and interpret the characteristics of functions, using graphs, tables, and simple algebraic techniques.
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.
MM2D1 Using sample data, students will make formal inferences about population means and standard deviation.

UNDERSTANDINGS & GOALS

Enduring Understandings:

- Working in a biotechnology laboratory requires one to follow standard laboratory protocol, to develop knowledge and skill necessary to perform those procedures, and to interpret the data / test results accurately.

Essential Questions:

- What is the benefit of following a standard operating procedure in a biotechnology laboratory?
- How and why must a laboratory notebook be developed and maintained?
- How is statistical data calculated and interpreted in the field of biotechnology?

Knowledge from this Unit:

Students will be able to:

- Discuss the standard operating procedure in a biotechnology laboratory.
- Describe the contents of a laboratory notebook.
- Define terms and explain procedures for performing statistical calculations in the laboratory.
- Compare and interpret data in the biotech laboratory setting.

Skills from this Unit:

Students will be able to:

- Maintain a laboratory notebook.
- Perform mathematical calculations using statistics.

ASSESSMENTS

Assessment Method Type:

_____ Pre-test
X Objective assessment - multiple-choice, true- false, etc.
__ Quizzes/Tests
_X_ Unit test
_____ Group project
_____ Individual project
X Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
__ Self-check rubrics
_X_ 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
_X_ 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
X Constructed Responses
__ Chart good reading/writing/listening/speaking habits
_X_ Application of skills to real-life situations/scenarios
X Post-test

Assessment Attachments and / or Directions:

Unit 5 Test - Research and Data Analysis
Unit 5 Test- key

LESSON PLANS

• LESSON 1: INTRODUCTION TO RESEARCH AND DATA ANALYSIS

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

HS-ABT-6 **Students will communicate effectively orally and in writing, applying academic knowledge in biotechnology communications.**

a) Understand how to follow a Standard Operating Procedure.
b) Utilize computer based applications in documenting and analyzing data.
c) Maintain a laboratory notebook using proper procedures and attention to the notebook as a legal document.
d) Apply technical writing format for reports, using common scientific formats.

HS-ABT-1 **Students will demonstrate the ability to use and apply mathematics and language arts skills.**

a) Perform mathematical calculations related to biotechnology including statistics.
b) Compare the standard deviation and the mean of efficacy testing data of two biotechnology products.
c) Illustrate a set of biotechnology data graphically.

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

- What is the benefit of following a standard operating procedure in a biotechnology laboratory?

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

Sample vs Population	Median	Mode
Standard Operating Procedure	Scientific Laboratory Notebook	Standard Deviation & Coefficient of Variation
Statistics	Average / Mean	Qualitative vs Quantitative

4. Interest approach – Mental set

- Ask students to recall what they know/remember about standard operating procedure in a laboratory.

5. Review the procedure by viewing the power point **Standard Operating Procedure** power point. Discuss and emphasize necessary steps or procedures that will be followed and expected for this class.

- See attached supplementary files

6. For review, complete standard operating procedure using the **Standard Operating Procedure Handout.** Use this as an opportunity to review a lab safety procedure. Choose a step-by-step Standard Operating Procedure or you may use the **SOP Activity** (see attachment). Examples will vary depending upon your own needs (i.e. washing hands, putting on and removing gloves, cleaning or disinfecting an instrument, or any basic routine procedure). Remind students of the importance of always following procedures with step by step accuracy.
    - See attached supplementary files

7. Summary Activity – In two sentences, define SOP and relate why it is important to have SOP in a biotechnology lab.

• LESSON 2: SCIENTIFIC LABORATORY NOTEBOOK

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

    - How and why must a laboratory notebook be developed and maintained?

2. View the Power Point **Scientific Notebook**. Lead a general discussion and review of the steps for maintaining a laboratory notebook. Make sure students learn the correct procedure for maintaining a Scientific Notebook. Give examples and demonstrate the correct procedure/rules for maintaining the notebook as you review the power point. You may adapt your own guidelines for the scientific notebook. Students should get a proper notebook to use for this activity.
    - See attached supplementary files

3. You may use a combination of peer check and/or teacher check of the individual student's notebook and its contents. Verify the students have correctly organized their notebook; all items have been properly documented and correctly recorded. Use the **Scientific Notebook Guidelines** to evaluate the activity. The notebook may be checked and graded as needed throughout the course as indicated by the teacher.
    - See attached supplementary files

4. Summary Activity – Give students a sample notebook entry and them record it in their own notebooks. Check for accuracy.

• LESSON 3: RESEARCH AND DATA ANALYSIS

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

    - How is statistical data calculated and interpreted in the field of biotechnology?

2. View the power point **Research and Data Analysis** as the students complete the worksheet below. Lead a general discussion and explanation of the terms associated with statistical procedures.
    - See attached supplementary files

3. Distribute copies of **Research and Data Analysis Worksheet** and have students complete as you view the power point above. Demonstrate the steps for performing specific statistical calculations as you view the power point. Provide adequate examples to allow students to practice mathematical calculations and to master statistical calculation procedures. Evaluate the worksheet using the **Research and Data Analysis Worksheet Key**.
    - See attached supplementary files

• LESSON 4: STATISTICAL WRITING PROJECT

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

    - How is statistical data calculated and interpreted in the field of biotechnology?

2. Lead a general discussion and review of the types of technical writing formats. View the PowerPoint **Scientific Writing** as you discuss and illustrate the correct format for writing and summarizing research data. Give examples as you review the power point.
    - See attached supplementary files

3. Aid the students in gathering scientific research writing sources. Use examples of scientific research from science and biotech libraries or websites, biotech periodicals, biotech laboratories, biotech research studies, and biotech organizations to compose their research evaluation. Use the guidelines **Scientific Writing Format** to read, analyze, discuss, and summarize the data in the research report. Give examples and describe situations when statistical data maybe used and the importance of correct interpretation and understanding of the data.
    - See attached supplementary files

4. Ask students how statistical data is calculated and interpreted. Record in a graphic organizer.

• LESSON 5: STATISTICAL MATHEMATICS CALCULATIONS

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

    - How is statistical data calculated and interpreted in the field of biotechnology?

2. Review the procedures for determining mean, mode, median, standard deviation, and coefficient of variation. After adequate practice, distribute copies of the **Statistical Mathematical Calculations Grade Sheet** and allow students to complete.
    - See attached supplementary files

3. Evaluate their understanding and competence in performing statistical calculations using the **Statistical Mathematical Calculations Grade Sheet Key**. Review as needed for total classroom/student understanding.
    - See attached supplementary files

• ATTACHMENTS FOR LESSON PLANS

Standard Operating Procedure PowerPoint
Standard Operating Procedure Handout
SOP Activity
Scientific Notebook PowerPoint
Scientific Notebook Guidelines
Research and Data Analysis PowerPoint
Research and Data Analysis Worksheet
Research and Data Analysis Worksheet - key
Scientific Writing
Scientific Writing Format

Statistical Mathematical Calculations Grade Sheet
Statistical Mathematical Calculations Grade Sheet – key
Unit 5 Test
Unit 5 Test Key

- **NOTES & REFLECTION:**

The Scientific Laboratory Notebook was first developed in the Introduction to Biotechnical (Unit 5) course. Verify the student understands the concept and is maintaining the laboratory notebook throughout this course as well. It is also important to stress to the students that every technique in the laboratory must be performed according to an established standard operating procedure and that science is about following each procedure precisely.

CULMINATING PERFORMANCE TASK

Culminating Unit Performance Task Title:

Students will complete statistical mathematical calculations accurately and demonstrate the data graphically.

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Perform Statistical Mathematical Calculations & Graph Data

Attachments for Culminating Performance Task:

Statistical Mathematical Calculations Grade Sheet
Statistical Mathematical Calculations Grade Sheet - Key

UNIT RESOURCES

Web Resources:

http://en.wikipedia.org
http://davidmlane.com/hyperstat/A16252.html

Materials & Equipment:

- Computer / internet access
- Projector / multimedia materials
- Worksheets for Mathematical Calculations
- Textbook(s) - Statistics

21st Century Technology Used:

X	Slide Show Software	X	Graphing Software		Audio File(s)
	Interactive Whiteboard	X	Calculator		Graphic Organizer
	Student Response System		Desktop Publishing		Image File(s)

☐	Web Design Software	☐	Blog	☐	Video
☐	Animation Software	X	Wiki	☐	Electronic Game or Puzzle Maker
☐	Email	X	Website		