Lesson Plan

MODULE TOPIC: *Introduction to Scientific and Engineering Practices: Uncovering Ways to Increase Bioavailability of Drugs*

STANDARD(S) & INDICATOR(S):

- NGSS: Science and Engineering Practices, NGSS: 9-12, Practice 3. Planning and carrying out investigations
  - Plan an investigation collaboratively to produce data to serve as the basis for evidence as part of testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.
  - Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.
  - Select appropriate tools to collect, record, analyze, and evaluate data.
- NJCCCS Math:
  - 4.5.E.1: Create and use representations to organize, record, and communicate mathematical ideas.
  - 4.5.E.3. Use representations to model and interpret physical, social, and mathematical phenomena.

OBJECTIVE(S): Students will be able to:

- Discuss ways of increasing the bioavailability of a tablet.
- Design a complete experiment increasing the bioavailability of a tablet.
- Collect, organize, and analyze data.
- Explain the implications of increasing bioavailability on human health and the health of other organisms in the environment.

MATERIALS:

- Alka-Seltzer tablets
- Hot plate
- Temperature
- Mortar and pestle
- Stirring rods

LIST OF HANDOUTS (attach original copies of each handout - teacher & student edition)

- Bioavailability Worksheet
- Lab Skills Rubric
- "How to Write a Lab Report"
- "How to Write a Lab Report " Rubric

BACKGROUND INFORMATION:
Currently, pharmaceutical researchers are hard at work trying to figure out how to increase bioavailability of medications. Bioavailability is a measure of how much and how quickly a particular drug can get into the blood stream and into the target cells.

CLASSROOM ACTIVITY DESCRIPTION (LABORATORY/EXERCISES/PROBLEMS) including detailed procedures:

- Students will be presented with a real-world problem that scientists are currently trying to resolve (How can we increase bioavailability of drugs?)
- Students will work in collaborative groups to design experiments to increase the bioavailability of a tablet
- Students will then come up with a way to test whether or not they have increased the bioavailability of the tablet
- Students will record and analyze data collected from their experiment using tables and graphs generated by Microsoft Excel.
- Students will write a lab report (including data tables and graphs) on their experiment with a justification of the importance of increasing bioavailability.

SAMPLE QUESTIONS TO ELICIT CLASS DISCUSSION:

- What do you think bioavailability is?
- Why is bioavailability a concern for pharmaceutical scientists?
- Why might scientists want to increase bioavailability?
- What are the implications of increasing bioavailability?
- Why might bioavailability be a concern for environmental scientists?

HOMEWORK ACTIVITY/EXERCISES/PROBLEMS:

- Completed draft of experimental procedure prior to starting the experiment
- Lab report with:
    - Should include properly represented/analyzed data.
    - Should discuss implications of increasing bioavailability.

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:
Assess the quality of the students' ideas generated during discussion.
Assess success of experiment to increase the bioavailability of a tablet.
Assess student's explanation of the implications of increasing bioavailability on human health and the health of other organisms in the environment.

REFERENCES:

- Flinn Scientific
- Drug Bioavailability
    - http://www.merckmanuals.com/professional/clinical-pharmacology/pharmacokinetics/drug-bioavailability

Name: _____ Group Members: _____

BIOAVAILABILITY

BACKGROUND INFORMATION
Currently, pharmaceutical researchers are hard at work trying to figure out how to increase bioavailability of medications. Bioavailability is a measure of how much and how quickly a particular drug can get into the blood stream and into the target cells.

OBJECTIVES: Students will be able to:
Design a method to increase the bioavailability of an Alka-Seltzer tablet.
Design an experiment to test your method of increasing the rate of bioavailability.

Part I. Background on Drug Delivery in Humans
Generally, how do medications work? (Class discussion)

Part II. Brainstorming
With your group, brainstorm ideas on how you can increase the bioavailability of an Alka-Seltzer tablet. You may organize your thoughts any way that you would like (list, chart, concept map, etc.)

Part III. Experimental Design
Design an experiment that will allow you to test your method of increasing bioavailability. You and your group members must generate a complete and detailed procedure as well as a list of materials that will be used during your experiment. When you are finished, you must hand this in to your teacher to get the procedure approved.

Part IV. Experimental Procedure and Data Collection
Before you start your experiment, make sure that every member of your group will be an active participant. If this means assigning roles, please do so before you start.

Throughout the experiment you must adhere to all lab safety rules.

Your data should be collected in a properly formatted data table. Please make sure to collect data as accurately as possible. If you make any observations, you should write them down in your lab notebook.

Part V. Data Analysis and Reporting Results
You must generate your data tables and graphs on the computer. Please use Microsoft Excel to create your graphs. We will go over how to do this. After creating your representations, you must analyze your data and report your conclusions in a well-organized, comprehensive lab

report. Please follow the "How to Write a Lab Report" template. In your report, please make sure to include the importance of increasing bioavailability and the implications of increasing bioavailability on human health and the environment.

PARAMETERS TO EVALUATE STUDENT WORK PRODUCTS:
Assess whether your method actually affected the rate of bioavailability.

	0 Points (Needs drastic improvement)	**1 Points** (Needs major improvement)	**2 Points** (Needs some improvement)	**3 Points** (Needs minor improvement)	**4 Points** (Satisfactory)
Experimental Design	Demonstrates no understanding of biological concepts	Demonstrates minimal understanding of biological concepts	Demonstrates mediocre understanding of biological concepts	Demonstrates sufficient understanding of biological concepts	Demonstrates a strong understanding of biological concepts
	More than 3 steps are missing or hypothesis is not testable	Missing 3 steps	Missing 2 steps	Missing 1 step	Complete with steps that will allow for the hypothesis to be accurately tested.
Scientific Discussion	Lacks all of the standards	Lacks 3 of the 4 standards	Lacks 2 of the 4 standards	Lacks 1 of the 4 standards	1. Student articulates ideas clearly with justification 2. Student shows willingness to collaborate and refine ideas 3. Student shows respect for others and their ideas 4. Students collectively produce a viable experiment
Scientific Tools and Lab Equipment	More than 3 materials are not appropriate or are used incorrectly	3 materials are not appropriate or are used incorrectly	2 materials are not appropriate or are used incorrectly	1 material is not appropriate or is used incorrectly	All appropriate for the experiment and handled correctly
Data Collection	Data was not collected, data was falsely recorded (includes if data was not collected in a timely fashion and student tried to remember/guess what happened)	Lacks 3 out of the 4 standards	Lacks 2 of the 4 standards	Lacks 1 of the 4 standards	1. In a data table 2. Neat 3. Accurate 4. Table has a title and headings are labeled
Data Representation (Graphs)	Lacks all of the standards	Lacks 3 of the 4 standards	Lacks 2 of the 4 standards	Lacks 1 of the 4 standards	1. Appropriate type of graph is used 2. Titles are present and on correct axes with metric system units in parenthesis and axis labeled 3. Descriptive head title

					4. Tick marks are evenly spaced and go up by the same factor
Performance	Lacks all of the standards	Lacks 3 of the 4 standards	Lacks 2 of the 4 standards	Lacks 1 of the 4 standards	1. Students stayed on task 2. Safety rules followed 3. Lab table and equipment cleaned and put back correctly 4. Was able to work with minimal help from the teacher

HOW TO WRITE A LAB REPORT
ADVANCED BIOLOGY

Please follow the General Formatting guidelines for the entirety of your paper. Font type and size should be consistent throughout the entire paper. The only place that should not be 1.5 spaced is the Works Cited section. Do not use contractions in formal writing!

General Formatting (APA Formatting):
- 1-inch margins
- 12 pt. Times New Roman font
- 1.5 line spacing (no double-spacing!)

Cover Page:
Everything should be centered.
- Title of your experiment
- Your name

- Your School
- Your course (Advanced Biology)
- Your school year

On every page <u>but</u> the Cover Page, you should insert a Header with your last name on the left. Also, every page but the Cover Page should have Page Numbers inserted at the bottom right.

First Page:
You must rewrite your title and your name on the first page. Please center both at the top. Then, you may proceed to split the sections of your paper according to the guidelines.

Problem:
Question you are trying to answer

Introduction:
Everything you write should be in paragraph format (no bullets or numbers). It is required that you have internal citations (parenthetical citations) to avoid plagiarism. This section requires research; you must give credit to the ideas that you use from this research.

1. Background Information
   - <u>Paragraph 1</u>: General Information about the topic you are studying
   - <u>Paragraph 2</u>:General information about the test subjects in your study
   - <u>Paragraph 3</u>:
     - Statement of Study
       - "For this experiment, I will test the effects of…on…by…"
     - Hypothesis
       - This should be right after your Statement of Study

        - "I predict that if…then…because…"
    - Your hypothesis should make sense given your background information.
    - Why is your study worthy of pursuing? Why will your results be important? How could your results help people or other scientists in the future?

Materials

Please bullet all of the materials that are critical to your study

Procedure

- Please number all of the steps that you took to complete your study. This should be detailed enough so that other people can repeat your experiment the same exact way that you did.
- When you record your data, you should be recording in a pre-constructed data table. It is important that you stay organized throughout.

Results

- You should record all of your data in metric system units. You will always get points off for using measurements in inches, feet, gallons, etc.

- You will almost always need <u>both</u> a data table and a graph. Both must contain:
    - No colors other than black and white!
    - Appropriate Head Title
    - Subtitles (column/row titles for data tables and axes titles for graphs)
        - These should have the units that you are measuring in.
        - Do not put the units in every cell of the data table.
    - Captions
        - Under each data table, you must label it "Table 1, 2, 3, etc."
        - Under each graph, you must label it "Figure 1, 2, 3, etc."
        - Next to each label, you must provide a brief description of what the table shows you and the procedure.
            - E.g. "Heights of various plants when exposed to different pH levels. Data was recorded in Glen Rock, NJ between June 1st and August 1st.

- At the end of the results section, there should be a paragraph summarizing your raw results in paragraph form (no analysis or explanation here!).
    - E.g. "Over the course of 2 months, Plant 3, which was grown in soil with a pH of 4.5 grew the tallest. Plant 6 grew the least." Etc.

Discussion (Conclusion)

1. Refer back to your tables and figures to discuss your results. Was your hypothesis supported or rejected by your results? Does this make sense? Why or why not? In your justification, you must cite to a source (internal citation)

2. Experimental Errors
    - Explain what the experimental errors were and how they could have tampered with your results.

3. Suggestions for Future
    - How would you perform this experiment differently next time?
    - What are some new experiments that can be done based off of your research

Works Cited (APA Format)

- Need at least 1 book, 1 scientific article, and 3 other sources of your choice
- "Works Cited" section title should be centered
- Alphabetical order
- All <u>but</u> 1st line are indented (if you need help with this, let me know)
- No paragraph spacing

Criteria	Points Earned
General Formatting (3) • 1-inch margins • 12 pt. Times New Roman font • 1.5 line spacing (no double-spacing!)	
Cover Page (6) • Everything centered • Title of your experiment • Your name • Your School • Your course (Advanced Biology) • Your school year	
Title (5)	
Problem (5)	

Introduction: (35)
• Background information of general topic being studied (10)
  o Parenthetical citation (2.5)
• Background information about test subjects or materials (10)
  o Parenthetical citation (2.5)
• Statement of study (2.5)
• Hypothesis (Testable) (5)
• Importance of study (2.5)	

Materials (10)	
Procedure (10)	

Results (30)
• Data Table
  o Title (2.5)
  o Subtitles (2.5)
  o Units (2.5)
  o Set-Up (2.5)
  o Caption (2.5)
• Graph
  o Title (2.5)
  o Subtitles (2.5)
  o Units (2.5)
  o Set-Up (2.5)
  o Caption (2.5)
• Summary (5)	

Discussion (37)
• Hypothesis supported or rejected? (2.5)
• Do results make sense? (2)
  o Explanation (10)
  ▪ Parenthetical citation (2.5)
• Experimental Errors (5)
  o Explanation of how errors could have tampered with results (5)
• Suggestions for future
  o How to change same experiment (5)
  o Studies that can build off of yours (5)	

Works Cited (9) • 1 book, 1 scientific article, and 3 other sources (5) • "Works Cited" section title centered (1) • Alphabetical order (1) • All <u>but</u> 1st line are indented (1) • No paragraph spacing (1)	

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