

Will Your Diploma Stand the Test of Time?

Subject: Biology

Grade Level: High School (9th/10th Grade)

Case Summary

Will your high school diploma outlast you? Students will determine which type of paper would be best for their diploma.

Credits

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Learning Objectives

1. Design and conduct an experiment to test the stability of paper samples
2. Understand the structure/composition of the paper affect its stability
3. Determine the effect of pH on paper quality/deterioration
4. Predict environmental conditions that would ensure the longevity of a valuable document
5. Identify the role of cellulose in the manufacturing of paper

Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

- a. Exhibit the above traits in their own scientific activities.
- b. Recognize that different explanations often can be given for the same evidence.
- c. Explain that further understanding of scientific problems relies on the design and execution of new experiments, which may reinforce or weaken opposing explanations.

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

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate technique in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data
- d. Graphically compare and analyze data points and/or summary statistics.
- e. Develop reasonable conclusions based on data collected.
- f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

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

- a. Develop and use systematic procedures for recording and organizing information.
- b. Use technology to produce tables and graphs.
- c. Use technology to develop, test, and revise experimental or mathematical models.

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

- a. Trace the source on any large disparity between estimated and calculated answers to problems.
- b. Consider possible effects of measurement errors on calculations.
- c. Recognize the relationship between accuracy and precision.
- d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.
- e. Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.

SCSh6. Students will communicate scientific investigations and information clearly.

- a. Write clear, coherent laboratory reports related to scientific investigations.
- b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.
- c. Use data as evidence to support scientific arguments and claims in written or oral presentations.
- d. Participate in group discussions of scientific investigation and current scientific issues.

The Nature of Science

SCSh7. Students analyze how scientific knowledge is developed.

Students recognize that:

- a. The universe is a vast single system in which the basic principles are the same everywhere.
- b. Universal principles are discovered through observation and experimental verification.
- c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.
- d. Hypotheses often cause scientists to develop new experiments that produce additional data.
- e. Testing, revising, and occasionally rejecting new and old theories never ends.

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

Students will apply the following to inquiry learning practices:

- a. Scientific investigators control the conditions of their experiments in order to produce valuable data.
- b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations' hypotheses, observations, data analyses, and interpretations.
- c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.
- d. The merit of a new theory is judged by how well scientific data are explained by the new theory.
- e. The ultimate goal of science is to develop an understanding of the natural universe, which is free of biases.
- f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

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

- c. Identify the function of the four major macromolecules (i.e., carbohydrates, proteins, lipids, nucleic acids).
- d. Explain the impact of water on life processes (i.e., osmosis, diffusion).

Assessment

Students will be graded on

- Completion of Table 1
- Research into Questions from Table 1 (12 points)

Category	4	3	2	1
Table	Four or more observations and questions	Three observations and questions	Two observations and questions	Fewer than two observations and questions
Amount of Research	All questions are addressed	Three questions are addressed	Two questions are addressed	Fewer than two questions are addressed
Research Quality and Citations	All peer-reviewed articles and APA citation	Peer-reviewed articles and improper citation	Some peer-reviewed articles.	No peer-reviewed articles

- Completion of pH and Paper Activity including worksheets
- Creation of experiment to test aging factors on paper.
- Presentation of experiment to class and class participation

Implementation Strategy

Day 1:

- Introduction (10 Minutes)
Teacher will share an image of an old paper document that has deteriorated. <http://www.anythinganywhere.com/commerce/documents/usa-dipl-1.jpg> Students will be asked to read the document, which should cause difficulty.
 - a) Is the document easy to read?
 - b) Is this a new or old document?
 - c) How can you tell?
- Paper Comparison/pH Lab (45 minutes)

Day2/3:

- Inquiry Lab (110 minutes)
- Students will bring in samples of aged personal documents and have a class discussion on what may have caused the aging of those documents.

Day 3:

- Students will present their experimental results to classmates. (45 minutes)
- Class will discuss what is the best paper to use for their High School Diploma and why. (15 minutes)

Resources

History of Paper/Paper Making

<http://www.hqpapermaker.com/paper-history/>

<http://www.hrc.utexas.edu/educator/modules/gutenberg/invention/papermaking/>

<http://paper.lib.uiowa.edu/european.php>

History of Diplomas

<http://www.archives.upenn.edu/faids/upp/upp231.html>

<http://nyamcenterforhistory.org/tag/diplomas/>

Will Your Diploma Stand the Test of Time?: Scene 1

Look at the image of the diploma. Do you think your diploma will still be around in 100 years? If so, what will it look like? How will its appearance change?

Fill out the table below. You may continue on the back of the page if you need more space.

Table 1: Diploma Image

Observations	Questions
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.

Research the answers to your questions.

Scene 2: What type of paper would you want to use for your diploma?

Table 2: pH of Paper Using Acid Identification Pen

Paper Sample	pH

Table 3: pH of Paper Using pH Paper or Meters

Paper Sample	pH

Which of these papers would you want to use for your diploma? Why?

Scene 3: Inquiry Lab – Will the paper you chose age well?

Students will design/conduct an experiment to evaluate one factor affecting the aging of paper. The student-designed experiments may be conducted over several days/weeks depending on the variables the students have chosen. Your conclusion should be at least one page, written separately.

Vocabulary

Monomer	Disaccharide
Polymer	Polysaccharide
Condensation	Cellulose
Hydrolysis	pH
Macromolecule	Acids
Carbohydrate	Bases
Monosaccharide	

Problem: What is the effect of <u>IV</u> on <u>DV</u> as measured by _____?
Hypothesis:
Variables: Independent variable Dependent variable Controlled variable (s)
Experimental Design:
Results: Data