Lab: Which Paint is the most Cost-Effective?

FOR THE TEACHER

Summary
In this lab, students will practice implementing the scientific method in order to compare the properties of different paint samples through a variety of testing. Students will research consumer reports, hypothesize, and conduct specific tests in order to determine which brand of paint is the most cost effective.

Grade Level
Middle School

NGSS Alignment
This lab will help prepare your students to meet the performance expectations in the following standards:
- **MS-ETS1-2**: Evaluate competing design solutions using a systematic process to determine how well the solutions meet the criteria and constraints of the problem.
- **Scientific and Engineering Practices**:
  - Analyzing and Interpreting Data

Objectives
By the end of this lab, students should be able to
- Carry out an experimental test while considering parameters that need to be held constant in order for the test to be valid.
- Analyze and compare test results in order to collect data.
- Interpret data in order to make a justified conclusion.

Chemistry Topics
This lab supports students’ understanding of:
- Scientific Method
- Observations

Time
**Teacher Preparation**: 1 hour to shop and 1 hour to organize/set-up
**Lesson**: 3 days (45 minutes each day)

Materials (per group)
- 4 paint samples
  - Various brands of paint, same finish type (Ex: Behr, Sherwin Williams, Duran, Valspar)
- 4 pieces of Drywall/Sheetrock (Cut 6 inch by 6 inch squares)
- 4 Paint brushes
- Consumer Report/ Paint Quality Index for each paint sample used
- Corresponding color swatch for each paint sample used
- Container of soapy water
- Sponge
- Several of the following “stain” test items:
  - Crayons
  - Sharpies
  - Ketchup
  - Mustard
  - Dirt
  - Dirt
Safety
- Always wear safety goggles when handling chemicals in the lab.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.

Teacher Notes
- This lab is designed to be completed over a 3 day period (45 minutes per day). However, that may be modified depending on the length of your classes and the ability of your students.
- Prior to the lesson the teacher will need to go to a home improvement store such as Home Depot or Lowes to purchase drywall/sheetrock, four brands of paint, paint brushes, and color swatches.
  - It is important to note here that each brand of paint should be in the same type of finish: gloss, semi-gloss, satin or matte.
  - Be sure to tell the store that these materials are for school use, and they may supply you with left over paint samples at a discount or free of charge!
  - Depending on the number of students in your class a single sample size of paint should be sufficient for the entire class to share.
- The teacher can decide to print the consumer reports for each of the specific paint samples used in the class, or the teacher may choose to have students investigate online.
- For those unfamiliar with Consumer Reports or Paint Quality Index, these are resources for consumers that have professional reviews of the products.
- Teacher should review the scientific method in order to ensure all students comprehend the process.
- Prior to the lab, demonstrate how to conduct the various tests on the paint samples. Discuss the importance of consistency during testing.
- Teacher should group students strategically in order to have all students engaged and active.
  - Small groups of 2-3 students would be ideal.
- Reference for vocabulary terms: Nolan Painting

FOR THE STUDENT
Lesson

Which Paint is Most Cost Effective?

Vocabulary: Components of Paint

Binder: A binder is the material that remains in the paint after it dries – it’s what carries the pigment and creates the final film of color. The quality of binder in your paint determines how durable that final film is, and how well the film adheres to its surface.

Thinner: Thinner is the material that makes the paint fluid, or, you could say, “paintable.” It’s important to look at the quality of a thinner because this is what gives the paint a smooth finish and makes for easier application.

Pigment: Pigment is the color that is held within the binder. It plays a role in determining how well the paint covers the wall, giving it that bright, solid sheet of color. Pigment can also play a role in how well the paint holds up over time. A quality paint will stay bright while paint with a lesser quality pigment will lose its color over time.
Additives: This term refers to the extra materials in paint that make it easier to apply. Additives are actually what affect the thickness of the paint while you’re applying it, the amount of time it takes to dry, how evenly the color is spread throughout the paint (to avoid weird swirls and clumps), and how smoothly the final painted surface looks.

*Reference for vocabulary terms: Nolan Painting

Pre-lab Questions
1. List several everyday uses of paint:
2. List any questions that you have about paint.
3. What do you think will happen to the paint sample if the binder is weak?
4. Why is a high quality thinner important in a paint sample?
5. What do you think would happen if you used a paint with a low quality pigment to paint the outside of your house?
6. Are additives necessary in paint?

Objective
Students will apply their knowledge of the scientific method in order to carry out a controlled test. Students will analyze and interpret their results in order to determine which paint sample is the most cost effective.

Materials
- Four brands of paint
- 4 pre-cut pieces of dry wall
- 4 brushes
- Color swatches for each paint sample
- Container of soapy water
- Sponge
- Several of the following “stain” test items:
  - Crayons
  - Sharpies
  - Ketchup
  - Mustard
  - Dirt

Safety
- Always wear safety goggles when handling chemicals in the lab.
- Wash your hands thoroughly before leaving the lab.
- Follow the teacher’s instructions for cleanup of materials and disposal of chemicals.

Directions
Day One:
1. As a group you are going to conduct an investigation that compares four different brands of paints for different qualities:
   a. Coverability
   b. Scrubability
   c. Color accuracy
   After comparing those qualities, you are going to determine which paint brand would be the ‘best bang for your buck’, using your experimental data to support your conclusion.
2. Prior to testing, use the Consumer Guides Report and/or the Paint Quality Index provided, research the four different brands of paint that you will be using in your laboratory test. Collect information about each brand in order to help you hypothesize which paint type will be most cost-effective.

<table>
<thead>
<tr>
<th>Paint Brand</th>
<th>Notes/Information Collected</th>
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3. Examining the data you have gathered through research. Make a hypothesis as to which brand of paint will be the most cost effective one to purchase. Make sure to explain why you have chosen this brand of paint.

**Hypothesis:**

4. Next, collect 4 squares of sheet rock from your teacher. Label the back of each piece with your names and the brand of paint you are going to paint it with.

5. You are going to paint each square with a different paint in order to compare the types of paint. List the things that you should keep constant (do the exact same) when you paint each square in order to carry out a fair test:

**Constants:**

6. Following the constants you listed above as guidelines, carefully paint each square using the same method. Set the squares aside to dry overnight.

**Day Two:**

1. Collect your squares. Examine and compare them to determine which paint brand covered the square of sheet rock the best. Record your observations in the data table. Indicate a rating of 1 for the best paint coverage and 4 for the worst coverage.

2. Examine each square and compare the color on the sheetrock to the color it shows on the corresponding sample paint chip.

3. Record your results in your data table. Give the square that looks most like the paint sample a rating of 1 and the one that varies the most a rating of 4.
4. Mark each square in different places using the items you teacher has available for you. They might be: a dark crayon, a black Sharpie, a ‘squirt’ of ketchup, a ‘squirt’ of mustard, and a bit of dirt.

5. Allow the items to ‘set’ or dry for 5 minutes on the square.

6. While waiting, collect a container of soapy water and a sponge.

7. Attempt to clean the materials off of each square for 30 seconds.

8. Examine each square after cleaning. Give the brand that is the cleanest (least amount of stain remaining) a 1 in your data table and the square with the most visible stains remaining a 4.

9. Total the ratings for each paint type. The lowest total possible is a 3, while the largest total possible is a 12.

10. Clean up your area and materials according to your teacher’s directions.

### Results

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<tr>
<th>Test Type</th>
<th>Observations and Ratings</th>
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<td>Paint Brand A</td>
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<tr>
<td>Paint Coverage</td>
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<tr>
<td>Paint Color Chip Comparison</td>
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<tr>
<td>Staining</td>
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<td>Total Rating (add values from all tests)</td>
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### Analysis

**Day Three:**

1. Your teacher will provide you with the cost of each type of paint. Considering the cost, and the results of your testing, which brand would you recommend buying? Explain your choice in a written paragraph, providing specific details to support your recommendation.

2. 
   a. Look back at the hypothesis that you wrote on Day 1. Did the results of your testing support your hypothesis or not? Explain.
   b. What might be some reasons that the hypothesis wasn’t supported by test data?

3. During your testing, where might errors have occurred? List at least 2 possible errors.

4. Choose one of the testing errors listed above. How could this error be fixed in a future test?