Activity: Designing a Procedure for Product Testing

FOR THE TEACHER

Summary
In this activity, students will take on the role of research engineers who work for a chemical company that sells coatings for different types of surfaces. Students are required to design a procedure for testing their common household coating to prove its durability to various types of stresses. Students will be required to create procedures that can collect both quantitative and qualitative data as well as an appropriate data table.

Grade Level
Middle School or High School

NGSS Alignment
This activity will help prepare your students to meet the performance expectations in the following standards:

- **HS-ETS1-1**: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **Scientific and Engineering Practices**:
  - Asking Questions and Defining Problems
  - Planning and Carrying Out Investigations

Objectives
By the end of this activity, students should be able to
- Design multiple procedures to test a product.
- Create a labeled data table.
- Provide examples of qualitative and quantitative data for designed experiments.

Chemistry Topics
This activity supports students’ understanding of
- Experimental Design
- Scientific Method
- Data Collection

Time:
**Teacher Preparation**: 5 minutes
**Lesson**: 50 minutes

Materials
- (Will vary) Teachers can ask students to produce output on a whiteboard, paper or on a computer program.

Safety
- No specific safety precautions need to be observed for this activity.

Teacher Notes
- Teachers may have students work individually, in pairs or in small groups.
- Students may be assigned all of the same coating or different coatings depending on the teacher’s preference.
- A possible list of coatings to choose from include:
  - Kitchen Pans
o Kitchen Counters
o Garage Floor paint
o Nail Polish
o Interior Wall Paint
o Exterior House Paint
o Road Paint
o Windshield glass coating
o Traffic sign paint
o Coating on inside of washing machine
o Coating on inside of stove
o Coating on inside of microwave
o Coating on inside of dryer
o Coating on floor of bathtub
o Other paints or coatings that students choose.

• There are a variety of ways that you could have the students do this activity. You can make it a short introductory activity or a longer activity that takes a couple days. The students could write their ideas on paper, or gain experience with computers by typing their lab procedures and data tables into Google Docs or other word processing programs. The students can turn in their labs to the teacher, or share with the class. They could use posters, whiteboards, or post their ideas to a class online message board. Teachers could even have their students make a short video describing how they are going to test the coating.

• A student example/answer key has been provided for teacher reference.

FOR THE STUDENT

Lesson

Designing a Procedure for Product Testing

Background
Your company prides itself on the idea that it creates the “best” coatings for common everyday items. Your job as the company’s research engineer is to be able to back up these claims by providing reasoning and evidence from the lab testing you perform in your lab.

As the lead researcher, you must create the detailed list of procedures required for your employees to complete. You must also create the data table for them to fill in to be able to compare the results from these different types of tests.

Pre-Activity Questions
For each of the following pieces of data, state whether it is qualitative or quantitative:

1. temperature of a glass of water
2. color of paint on a house
3. time it takes a person to run a mile
4. number of M&M’s in a bag
5. behavior of a bird in a tree
Procedure
1. Your teacher will assign you or your group a type of coating that you will have to create a list of stresses that would impact it.
2. Once the stresses have been identified, you are to create a detailed procedure for how to test that variable on your coating.
3. Your group must decide on at least 3 pieces of qualitative data and 3 pieces of quantitative data that can be collected to answer the question above.
4. You will need to develop a step-by-step, detailed procedure for testing each property, and create one comprehensive data table that could be used to record all your findings.

Detailed Procedure
Write your procedure below:

Data
Create your data table below:

Analysis
1. Which of your experimental procedures provided qualitative data?
2. Which of your experimental procedures provided quantitative data?
3. What challenges did your team face in creating your procedures?

Conclusion
Describe in one sentence how this activity reinforces what happens in the real world and in industries.