

## Product Improvement Lesson Plan: A Redesign of the Beverage Container

### Purpose

How are engineered products improved in industry? Engineers often use market research to improve a product's performance, appearance, and function. In this lesson, students will use the market research they have generated themselves to brainstorm and develop possible solutions to redesign an everyday product, such the beverage container. Some of the main ideas are:

- Big datasets are useful gain a variety of reliable information.
- In order to analyze big datasets effectively, questions are formed and hypotheses are tested.
- The shotgun approach of brainstorming different conclusions has its own strengths and weaknesses
- End-users provide useful information to designers
- Prototyping a design is a useful visual to present their ideas to other people and allow constructive feedback.

### Overview

This activity is designed to give an introduction to product design and market-oriented data analysis. The lesson is split into three parts for preparation, project time, and presentations. First, students will brainstorm market research questions to understand features their peers would like in a beverage container. Then, students will gather data from their peers and input responses into an online document. After the data has been collected, students will split into groups to interpret the class dataset. From their dataset, they will form three conclusions about the people surveyed. For each of their conclusions, the group will brainstorm and sketch at minimum three different designs for each of the conclusions brainstormed. Students will then analyze the sketches and develop one design to prototype that incorporates all three conclusions.

The lesson concludes with presentations in which each group will describe their product improvement to the beverage container and provide evidence for their design choices based on the market research. After each presentation, the audience will be asked to discuss in their groups and find one strength and one area of improvement about the design.

At the end of the class, students will compile a packet with four items: a sheet with their initial ideas (the nine different ideas from three conclusions), a concept drawing of their final idea, a prototype for each group, and a reflection worksheet.

**Student Outcomes**

- Students will generate data by surveying peers
- Students will be able to utilize the Excel interface to input, sort, and filter data
- Students will be able to construct explanations based on data, and use these explanations to influence design decisions
- Students will create multiple brainstorming solutions based on criteria
- Students will present a possible solution to the product improvement supported by research

**Standards:**

**Below are standards from AAAS. Note that the standards are interdisciplinary – coming from not just science, but language and social sciences.**

- S3-Plan and carry out an investigation
- S4-Analyze and interpret data
- S6-Construct explanations and design solutions
- E5-Read, write, and speak grounded in evidence
- M3 and E4-Construct viable arguments and critique reasoning of others
- E6- Use digital media and technology strategically and capably

**Below are standards from the Illinois Learning Standards.**

- 11.B.4b – Develop working visualization of the proposed solution designs.
- 11.B.5a – Identify a design problem that has practical applications and propose possible solutions, considering such constraints as available tools materials, time and costs.
- 11.A.5a – Formulate hypotheses reference prior research and knowledge.

**Time***Preparation*

- Day 1:
  - Ask students to brainstorm questions in class (5-10 minutes).
  - Teacher compiles questions, selects 5 questions and creates a market research sheet with the questions and demographic information (prep).
- Day 2: Students are given the compiled market research questions for homework. Students must gather data from at least 3 peers.
- Day 3: Survey answers are inputted in class through Google Docs (5-10 minutes)

*Project time*

- Day 4: Students will be given the class dataset and will be asked to analyze the data, draw 3 conclusions from the set, and start developing solutions based on the conclusions. Students will prototype one of their designs for the class. (1.5 class period)

- Break into groups: give them a card when they walk into the door. Card contains design challenge criteria.
- Intro: ask them to log in to website.
  - Explain the dataset. Give them an introduction to basic functions in excel (sorting and counting, different levels of sorting)
  - Example of how to pose a question and test a hypothesis about a target group (IE “I hypothesize freshman boys will like the color blue”, sort, then count the number of freshman boys that like blue and those that like other colors to gain evidence for the hypothesis)
- 45 minutes to pose a question, test a hypothesis, in groups of 3, and formulate 3 things they learned from the dataset (see worksheet with conclusions)
- Lightning design rounds for menu approach
  - Give student groups 9 post-it notes of 3 colors
  - Give student groups 3 minutes to come up with 3 possible designs about conclusion #1
  - Repeat this round 3 times so that each group has 9 post it notes with 9 different designs
  - *Stress that designs just need to encompass an idea, and do not need to be perfect.*
  - Perform round 4 of concept sketching: students will have time to create an ultimate design encompassing their best ideas.
- Rapid prototyping:
  - This round is probably the hardest part of the project. To bring their ideas to completion, and to better visualize their ideas for the class, groups will create a 10-minute prototype using available materials to represent their final design.

### *Presentations*

- Day 5: Students will present their best solution to the class. (30 minutes)
  - Ask students to present their target market, the qualities of their market, and their final design

### **Level**

9-12 Engineering Design course

### **Materials and Tools**

- styrofoam cup
- graph paper
- post-it notes (a different color for each of the three conclusions)

- disposable cups of different sizes
- miscellaneous prototyping materials (pipe cleaners, construction paper, foil, etc)

### Preparations:

- [Initial Question Form \(online\)](#): Students will be asked to brainstorm one question to submit. Teachers will select 5 questions from this pool of questions to create the market research form.
  - **Create student form for market research (print-out)**  
**Create market research google form (online)**: Students from all classes will submit their survey results to this form.
  - **Compile and organize aggregated dataset (online or print-out)**: Students will receive an aggregated dataset containing demographic information and responses of the students that they surveyed.
  - **Create reflections worksheet**
  - **Create “Design Challenges”**
  - **Assemble materials for prototyping**: Pipe cleaners, paper cups, construction paper, tin foil, rubber bands, scissors, paper tubes
- See Supplemental Materials to download worksheets*

### Prerequisites

- Students have practiced basic concept drawing.

### Background

Cell phones, fashion bags, cameras, cars, and watches are popular consumer products. Who do you know that owns these items? What are the qualities of these products that makes you want to buy these items? How do we best find out people’s interests? How would a computer help in this task? Would you rather design a product that appeals to many people, or target a smaller but very specific audience?

For dataset analysis: Explain the excel interface, what a cell is, what the “Sort” button does, and how to view “counts” on the bottom right. Encourage students to explore the interface and ask questions. Review how to copy and paste information. Encourage students to delete irrelevant information or move it to another worksheet (filtering step).

### Teaching Notes

When analyzing the dataset, teachers will first illustrate how to formulate a hypothesis or question using an example. For example, one question you could ask is: what colors do freshman girls prefer? To formulate a hypothesis from the question “freshman girls

prefer the color blue,” then test the hypothesis by counting the number of freshman girls that prefer blue and number of freshman girls that prefer other colors.

Students may struggle at analyzing many entries. The worksheet guides them to first formulate a question about the dataset to narrow down the number of entries they will look at. Introduce the “sort” button which sorts entries by a certain column. **Encourage students to delete irrelevant information or move the information to a separate worksheet**, so they may separate the signal from the noise.

Before the presentations begin, emphasize that students should project their voice and try to sell their best product design to the audience. During the presentations, encourage constructive feedback. Finally, encourage them to look at everyday objects in their daily lives with the perspective of a product designer. How can I improve the objects I use everyday?

In the debrief, explain how the activity ties into computational thinking. When would scientists or engineers analyze big datasets? GK-12 fellow would give an example or a quick demo on how he/she would analyze the class dataset or a dataset from his/her research

Concept	1	2	3
Extract information from a large dataset	Group identifies 1 characteristic	Group identifies 2 characteristics	Group identifies 3 characteristics using the question/hypothesis approach
Utilize the menu approach to concept sketching	No designs are created	At least 3 different designs are created	9 detailed designs based on the requirements are created
Concept Sketching	The combined sketch is not created.	The combined sketch is completed.	The combined sketch is completed and detailed.
Communication/Pre presentation Skills	Lacking presentation. Student did not introduce their target market or aspects of design.	Good presentation. Student introduced their target market, and their final design.	Great presentation (voices projected, professional quality, everyone speaks). Student introduces their target market, the qualities of their target market, and unique aspects of their final design.
Constructive audience feedback	Each group does not come up with a strength or weakness	Each group comes up with one strength or weakness per group	Each group comes up with at least one strength and weakness for each group, gives feedback for at least one presentation
Reflection	Students are confused and the lesson is a failure	Students find the lesson boring but gain experience in the design process presented.	Students understand a can implement a systematic approach to formulate data. Students find the

			lesson exciting and useful.
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## Beverage Container Re-design: Reflection

Do you think the conclusions made in the dataset reflect the overall population?

What design did you think was the best? How did you evaluate your different designs?

What was the most challenging aspect of this activity?

How was your design received by the other group?

How would your design be different?