Harmless Holder

GOAL

Students use the engineering process to solve a challenge and understand the difference between product design and process design.

GRADE LEVEL

Middle through high school

MATERIALS *(per team)*

- 6 full cans of soda, seltzer, or juice
- Cardboard (approx. 8.5x11 in.)
- Copier paper
- Duct tape
- Wax paper
- String
- 4 paint stirrers
- 6 rubber bands
- Have additional materials on hand for Process Design activity

PRODUCT DESIGN STEPS

1. **Identify the problem.** Students are challenged to invent a holder for six cans that's animal-safe, sturdy, convenient, and easy to carry.
2. **Research problem.** Plastic rings are great for carrying cans, but can be a problem when they become trash that animals can get tangled in. To demonstrate, have each student slip a rubber band around their right wrist, then try to remove it using only their right hand. No fair using teeth, left hand, etc. Discuss with students the new holder criteria (conditions that the design must satisfy— holds 6 cans, easy to carry, safe for animals, etc.) and constraints (limitations with material, low environmental impact, etc.).

Divide class into teams of 3-4 students. Ask each team to:

3. **Develop possible solutions:** brainstorm.
4. **Select best possible solution** incorporating the criteria and constraints.
5. **Construct prototype** using the materials given.

TIP: Have extra cans available in case some break open during construction or testing.

6. **Test & evaluate the prototype.** Did they satisfy the criteria and constraints? If not, then…

7. **Redesign.** Brainstorm a new design, build and test it until they have successfully solved the problem. NOTE: If the holder is bending and twisting, that's FORCE at work, pushing and pulling on the parts. They will need to reinforce things to resist the ***force***.

At each step in the process the students must communicate with their team members and others outside their team to get feedback on their design. Communication is at the core of the engineering design process.

BRAINSTORMING TIPS. If students have difficulty getting started, ask these questions:

- You need to be able to carry the cans easily. What are some different kinds of handles used to pick up objects?
- How can you hold six cans together?
- Should you arrange the cans on end? On their sides? Stack them?
- How will you remove the cans easily?
- How will you carry the holder?
- If an animal were to eat some of the materials you use today, it might still cause problems. Can you balance convenience with an acceptable level of risk?

PROCESS DESIGN

If time is limited, you might need to just design the assembly line and eliminate the comparison test.

Choose one holder design that best meets the criteria and constraints. With the entire class, design an assembly line.

When the line is running at speed (tested, redesigned, retested) divide the class into two teams. Each member of Team One will assemble complete holders. Team Two operates the assembly line. *TIP: to involve more students, consider a double-sided line if the holder design is simple.* Set a timer to about 10-15 minutes. Explain to students that you will be the Senior Quality Control Officer and will be checking to make sure their holders meet the criteria. Afterwards, compare the differences.

REAL WORLD CONNECTION

Engineers look for ways to improve packaging systems to reduce litter and the need for raw materials, and eliminate dangers to animals and the environment, while at the same time keeping the production process cost effective. To learn about an idea's strengths and weaknesses, engineers build a series of prototypes before going into actual production. Students might enjoy the movie or book Cheaper By the Dozen, a real-family story of industrial and time management engineering connections.

Activity adapted from Design Squad Nation.

Design Squad Nation is produced by WGBH Boston. Major funding is provided by the National Science Foundation. Project funding is provided by Northrop Grumman Foundation and S.D. Bechtel, Jr. Foundation.

Additional funding is provided by United Engineering Foundation (ASCE, ASME, AIChE, IEEE, AIME). This DESIGN SQUAD NATION material is based upon work supported by the National Science Foundation under Grant No. EEC-1129342. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.