



Critical Thinking

BIG IDEA(S):

- How can thinking critically help us solve complex problems?
- What is the engineering design process?

WHAT YOU WILL NEED:

- Design Process handout

OVERVIEW

In this sixth session, young people will explore a STEM challenge focused around manufacturing. As they collaborate to complete the challenge, they will apply the engineering design process to create prototypes of a new product and optimize their designs.

BEFORE YOU BEGIN

- Print and copy the handout listed in the *What You Will Need* section so there are enough copies for the participants to work in pairs.
- Read through the activity to make sure you understand the directions before the session begins.

ENGAGE

- Begin by asking the young people to form groups of three or four.
- Explain that today they will be tackling a challenge related to manufacturing. To help them prepare for this challenge, encourage the groups to discuss:
 - What is one product that you use or have used in the past that you were satisfied with? Why do you feel this way?
 - What is one product you use or have used in the past that you are not fully satisfied with? Why do you feel this way?
- Then bring everyone back together to share and discuss:
 - What are some of the key differences between products you are satisfied with and products you are not satisfied with?
 - Focusing on the products you like, what do you think happened before they were manufactured to ensure their success?

EXPLORE

1. After students share their thoughts, explain that product ideas are led through the engineering design process. This process takes an idea from conception to creation and beyond. It helps ensure that the product in development fulfills a need in society, meets certain constraints and criteria, is of high quality, and more!
2. Encourage the young people to pretend that they now work as Industrial Designers for a cell phone company interested in manufacturing innovative cell phone cases.
3. Ask everyone to find a partner and distribute a **Design Process handout** to each pair.
4. Read through the steps provided and explain that Step 1 has already been completed. Then encourage pairs to get started and continue through the design process.
5. When it seems like most pairs have completed Step 5, read Step 6 aloud together. Then guide groups in pairing up and completing this final step.
6. Once groups have edited their designs based on their peers' feedback, encourage them to place their completed designs around the classroom in easily-viewable locations so the young people can rotate around the classroom, view the work their peers created, and compare/contrast it with their own.
7. Conclude with a discussion around the following questions:
 - Can design problems have multiple possible solutions? Why or why not?
 - How did breaking the problem down into smaller steps (researching the problem, brainstorming solutions, creating a prototype, etc.) help your group develop a solution?
 - Could this approach to problem-solving be applied to other problem scenarios? Why or why not?

MAKE THE CONNECTION

The engineering design process is used across all STEM careers. Though the solutions will vary depending on the field, the process is consistently used to help problem-solvers better understand the design challenge, organize their ideas, and develop a successful solution. An understanding of how to implement the engineering design process is crucial for a STEM career!

EXTEND AND EVALUATE

Do you meet more than once a month? In an upcoming session, you could:

- Encourage young people to use the Internet to learn about one or more of the manufacturing careers listed below and consider: 1) What aspects of the career intrigues them, and 2) What role the career could play in the manufacturing of their phone case.
 - Manufacturing Careers:
 - Industrial Engineer
 - Mechanical Engineer
 - Machinist
 - Software Developer

- Industrial production manager
 - Manufacturing executive
 - Quality control inspector
 - Materials mover
 - Manufacturing sales representative
- Have groups use free online CAD software or modeling materials to build 3D versions of their designs.

Step 1—Define the problem

Customers have expressed the want and need for cell phone cases that do more than just protect their phones.

Step 2—Research the problem

Develop questions to help you understand what cell phone users would like in a phone case. Then pose these questions to your peers.

Question:

Question:

Question:

Step 3—Brainstorm solutions

Think about your peers' responses and jot ideas for new cell phone cases below.

Step 4—Select a solution

Circle the one cell phone case solution from above that you believe could be manufactured to best meet the needs of cell phone users.

