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National Postal Museum

Handle with Care!

A Postal Engineering and Design Challenge

Grade Level: 5th-8th grade.

Duration: 60 minutes.

Essential Questions

- How has the United States Postal Service used engineering and problem solving to move the mail?
- What is the engineering design process and how is it used?

Learning Objectives

- In the early 20th century, because of increased efficiency, reliability, and security of parcel post, farm produce was able to travel long distances through the mail to reach markets that were previously unavailable to farmers.
- The engineering design process is a series of steps that can be used to solve a variety of problems. This process is used by people and industries every day.

Learning Standards

Next Generation Science Standards (NGSS)

- **3-5-ETS1-1.** Define a simple design problem reflecting a need or want that includes specified criteria for success and constraints on materials, time, or cost.
- **3-5-ETS1-2.** Generate a compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- **3-5-ETS1-3.** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- **MS-ETS 1-1**. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- **MS-ETS 1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Common Core State Standards, ELA/Literacy

- **RI.5.1** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
- **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.
- **W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
- **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work and provide a list of sources.
- **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts.
- **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- **WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Materials

- Long rope or cable with enough length to be affixed to a point near the ceiling on one side of the room and affixed to a point near the floor, close or at the other side of the room.
- Miscellaneous construction materials. The construction materials for this activity are flexible. It is encouraged to reuse and recycle materials as much as possible. Use what you have available. Recommendations include:
    - Tape
    - Scrap paper.
    - Tin foil
    - Popsicle sticks
    - Bubble wrap.
    - Paper clips
    - Rubber bands
    - String
- Eggs
- Stopwatch
- Digital or printed copies of Object Spotlight: Egg Crate
- Student worksheet: *Handle with Care!*

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Set up

- Attach one end of the rope to a fixed point near the ceiling on one side of the room. Attach the other end to a fixed point near the floor on the opposite side of the room.
- If using printed copies, make enough copies *Handle with Care!* and *Object Spotlight: Egg Crate,* for each student to have their own.

Procedure

1. Warm Up: ask students to think about the source of the food they had already consumed that day and/or the day before. For example, where did the milk in their cereal come from? What about the fruit at lunch? The tomato on their sandwich? Facilitate a discussion, hypothesizing how far and in what ways products had to travel, to reach the students tables.
2. Distribute the *Handle with Care!* worksheet to students. Have students read the lesson introduction.
3. Tell students that during the lesson, they will be working as engineers to design, construct, and test a package design that will protect a single egg in the mail but first, they need to learn about the engineering design process.
4. Introduce the *Engineering Design Process*, from the *Handle with Care!* worksheet. Explain that the engineer design process is something that all engineers use, regardless of their specific discipline. In this design challenge, students are asked to work as engineers to design, construct, and test a device that can safely and quickly deliver an egg from one side of the room to another. Along with identifying the problem, engineers must consider any additional constraints like a budget or schedule. The constraints for this challenge are time and the materials available.
    a. Optional extension: consider attaching a cost to each of the materials that you are offering to the students and give students a budget. For example:

Total budget: $100

Item	Cost
1 foot of tape	$25
Scrap paper	$10/piece
Tin foil	$50/piece
Popsicle sticks	$5/stick

    b. Optional extension: discuss the benefits and drawbacks of some of the more environmentally friendly packaging materials that are available.

5. Divide students into groups of 3-4. Instruct students to follow the engineer design process on their worksheet to design, build, and test a solution. Emphasize the importance of communication. The *Communicate Solutions and Redesign* questions should be completed at the end of the lesson.
6. When it is time to test, each group brings their design to the end of the rope attached near the ceiling. Give students an egg to insert into their design. Providing support as needed, have students send their design down the rope. Use the stopwatch to time each trial. Keep track of each group's time stats and whether their egg broke or not.
    a. Optional extension: have students graph the class results. Students can also practice math skills by calculating the mean of the times, any outliers, etc.
7. Have students read Object Spotlight: Egg Crate to learn more about the specific engineering solution and design that the Postal Department used to ship eggs across the country.
    a. Optional Extension: Have students read *1936 Chapter: Sending Eggs to Alaska!* from the National Postal Museum.
8. Have students complete the *Communicate Solutions and Redesign* questions. Students can be provided with additional time and resources to redesign their device at the teacher's discretion.

See more educational resources from the National Postal Museum.

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Name _____ Student Worksheet

Handle with Care!

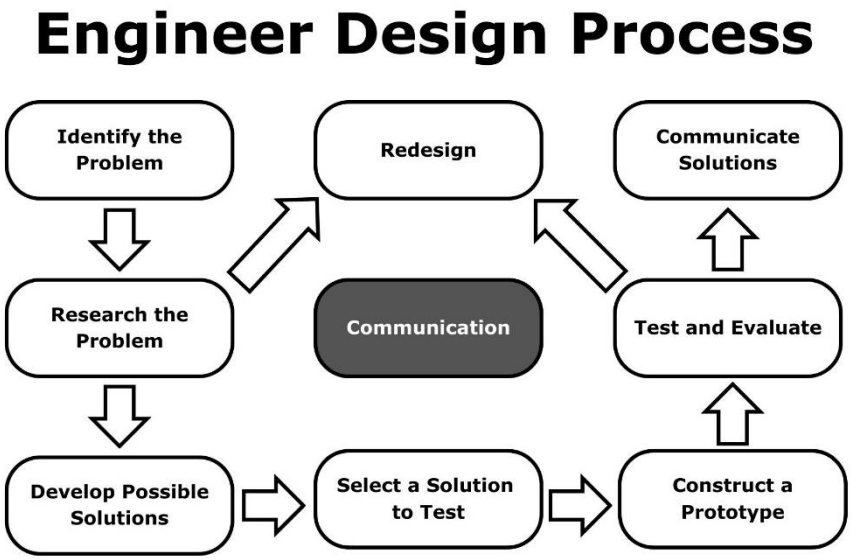
Explore Engineering and Parcel Post

Have you ever wondered where your food comes from? Most people get theirs from the grocery store. But imagine living in a place where fresh food is hard to find. Or, what if you were a farmer and needed to send your food to the city quickly and cheaply?

Before 1913, sending big packages was really expensive. But on January 1, 1913, the U.S. Postal Service started the Parcel Post Service. With Parcel Post Service, people could send packages up to 11 pounds, like candy, eggs, butter, and groceries, right from their mailbox!

But this couldn't have happened without the hard work of postal workers and engineers.

Today, you'll get to think like an engineer, solving problems and practicing your design skills through your own parcel post challenge.



<u>Identify the Problem</u>

1. What problem are you being asked to solve?

2. What are your constraints for this challenge?

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Research the Problem

1. What are some common shipping materials that used to protect fragile items? Describe or draw pictures of them below.

Develop Possible Solutions

1. Brainstorm some ideas for how you can safely transport your egg. Describe or draw pictures of possible solutions below.

Select a Solution to Test

1. Which solution will your group test? Name your design.

Construct a Prototype

1. Using the materials provided, construct your prototype.

Test and Evaluate

Design Name	Did the egg arrive safely?	Time (in seconds)

Communicate Solutions and Redesign

1. What worked well about your design? If you could do this activity again with the same materials, what would you do differently and why?

2. If you could do this activity again using different materials, what would you use?

3. How was the Post Office Department's egg crate design similar to your groups package design? How was it different?