# National Postal Museum – Systems at Work Exhibit
# Lesson 1 – Handle with Care
# Teacher Guide

## *Essential Questions*

What is engineering? How does engineering affect us in our everyday lives? How did the U.S. parcel post system change the way goods were distributed throughout the country?

## *Desired Outcomes*

Students will understand that engineering is an essential component to the way work and play. Students will understand that in the mid-1930s, because of the increased efficiency, reliability, and security of the parcel post, farm produce was able to travel long distances via the mail to reach markets that were currently unavailable to farmers.

## *In This Lesson*

Students will develop a method for safely "shipping" an egg from one side of the classroom to the other. Students will learn how to utilize the engineering design process.

## *National Standards of Learning*

NS.5-8.1 Science as Inquiry: Abilities necessary to do scientific inquiry
NS.5-8.2 Physical Science: Motion and forces
NS.5-8.2 Physical Science: Transfer of energy
NS.5-8.5 Science and Technology: Abilities of technological design
NS.5-8.6 Personal and Social Perspectives: Science and technology in society
NS.5-8.7 History and Nature of Science: History of Science

## *Instructional Notes*

Use this lesson to guide a discussion of how the postal service has changed the way goods are transported across the country and how this has influenced markets. Additionally, this lesson can be used as a way to introduce students to the engineering design process. The lesson can be used alone, or in conjunction with Station 5 (Handle With Care, 1936) of the Systems at Work exhibit of the National Postal Museum.

## *Materials and Resources*

- Fishing Line (one end must be attached to a fixed point near the ceiling of one side of the room, and the other end must be attached to a fixed point near the floor of the other side of the room)
- Miscellaneous Construction Materials (plastic drinking straws, toothpicks, cardboard, masking tape, paperclips, index cards, aluminum foil, etc.)
- Eggs

- Stopwatches
- Worksheet: Handle with Care!
- Presentation: Handle with Care!

## *Supporting Materials for Teachers*

### Background

By the mid-1930's, the U.S. parcel post system was more than 20 years old. It had opened a new world to rural Americans. Businesses depended on the efficiency, reliability, and security of the parcel post. Products that rarely left cities only a few years earlier now appeared at their doorsteps. And farm produce traveled to far off markets by mail. One such produce item was the egg.

Chickens can have a hard time wintering in Alaska. So, in the spring, an Alaskan farmer ordered eggs from Seattle in time for them to hatch into chicks after they reached Alaska. The eggs traveled from an eastern Washington farm to Seattle by rail, and on the way they were sorted into a sack for a boat route to Alaska. At the Seattle post office, the pouches awaited the next ship headed north, and were carried aboard on the day the ship set sail.

Four days later, the ship would dock in Seward, Alaska. The pouch holding the eggs was taken to the post office, and its contents were sorted again, and any number of vehicles—another ship, a small plane, or dogsled—might deliver the eggs to their final destination.

### Engineering

Engineering is commonly referred to as a way to use science and mathematics to solve problems. According to the National Engineers Week Foundation, "Engineers use their imagination and analytical skills to invent, design, and build things that matter. They are team players with independent minds who turn ideas into reality. By dreaming up creative and practical solutions, engineers are changing the world all the time."[1]

There are a multitude of different fields of engineering, including: aerospace engineering, agricultural and biological engineering, audio engineering, bioengineering and biomechanical engineering, biomedical engineering, ceramics and materials engineering, chemical engineering, civil engineering, computer engineering, electrical engineering, environmental engineering, geological and geophysical engineering, industrial engineering, manufacturing engineering, marine and ocean engineering, mechanical engineering, mining engineering, nuclear engineering, petroleum engineering, software engineering, and systems engineering.[2] Everything around us and everything that we do or use has been influenced by one or more of these professionals.

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[1] National Engineers Week Foundation (2008). *All About Engineering*. Retrieved from http://www.eweek.org/AboutEngineering/AboutEngineering.aspx.
[2] Discover Engineering (n.d.). *Career Profiles.* Retrieved from http://www.discoverengineering.org/.

**Suggested Activities and Lesson Sequence**

Activity 1: Lesson Introduction (Slide 2). Facilitate a discussion related to the source of the food that students ate that morning (i.e. perhaps the grains for their breakfast cereal came from Iowa, the milk came from Wisconsin, and the banana came from somewhere in South America). Discuss the lesson objective.

> Possible extension: discuss the environmental ramifications of the shipping and transportation required.

Activity 2: Engineer Word Web (Slides 3-4). Facilitate a discussion on the many types of engineers that are working today. The word web can be performed using the Think-Pair-Share strategy to illicit individual thoughts, as well as provide an opportunity for student collaboration. Provide examples of some of the more obscure fields:

- *audio engineering*: creating the sounds that you hear when playing a video game or watching a television show
- *biomedical engineering*: a rapidly growing field involving the design of artificial organs, joint replacement parts, and prosthetic devices
- *petroleum engineer*: designing everything from oil wells, storage tanks, transportation systems, and researching technologies to yield the most amount of energy from Earth's available oil reserves

Activity 3: Design Challenge (Slides 5-8). Introduce the Engineering Design Process. This is a protocol that all engineers use, regardless of their specific discipline. The process begins by identifying a problem. In this case, the students are being asked to design, construct, and test a device that can safely deliver an egg from one side of the classroom to another. Along with identifying the problem, engineers must consider any constraints that have been imposed upon them, like a budget or a schedule. Your students will be constrained by a schedule (perhaps one class period), as well as the materials that will be available for them to complete the challenge.

> Possible extension: consider attaching a cost to each of the materials that you are offering to students, and give students a budget. For example:
>
> Total Budget: 25¢

| Item | Cost |
|---|---|
| Plastic Straw | 5¢ |
| 30 cm masking tape | 10¢ |
| Index card | 2¢ |
| 30 $cm^2$ sheet of aluminum foil | 15¢ |

Activity 4: Research (Slides 9-10). Guide your students to identify some of the more common packing materials that are used to protect fragile goods, such as crumpled paper, packing peanuts, bubble wrap, etc.

Possible extension: discuss the benefits and drawbacks to some of the more environmentally friendly packaging materials that are available:

- corn-based packing peanuts: not made of petroleum-based products, but are susceptible to damage if wet
- dried grasses (common in the early 20th century): renewable resource, but can contribute to the spread of invasive plant species

Activity 5: Design (Slides 11-12). Have students work in groups to develop solutions to the design challenge. Emphasize the importance of communication, which is displayed in the center of the engineering design process. Communication is an essential component during each phase of the engineering design process. Engineers are in constant communication with all other stakeholders. Have students collectively decide upon which solution to use, and name their design.

Activity 6: Build (Slides 13-14). Students will gather their materials and begin construction of their prototypes. Set a reasonable time limit on this construction phase.

Activity 7: Test (Slides 15-16). Send each design down the fishing line. Have students use stopwatches to time each trial.

At this point, the challenge has ended. However, the design process has two more steps: redesign, and communicate solutions. At the instructor's discretion, students can be provided with additional time and resources to redesign their device. Additionally, students can be asked to communicate their results by creating a sales pitch or brochure for their device.

Possible extension: mathematics curriculum connections:

- have students graph their results
- have three students time each run, and calculate the mean of the times

Activity 8: Analysis (Slide 17). Have students answer the analysis questions, which are geared toward understanding the engineering design process.

Possible extension:

- Relate this challenge back to the story of the egg being shipped from Washington to Alaska.
- Relate this discussion back to students' breakfast choices. How do their decisions impact the environment? How do they affect the freshness of the food they eat?