# Shipping for Survival

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## Lesson Focus

Lesson focuses on how packaging engineers develop customized shipping and packaging containers to meet the needs of many different industries. Students learn about different packages that have been engineered to transport hearts for surgery, blood for analysis, and foods to retain freshness. Students then work in teams to build a container that will allow a flower to be shipped without damage and with water using everyday items. Flowers must remain fresh and not wilted for 24 hours after being sealed in the box.

## Lesson Synopsis

The "Shipping for Survival" activity explores packaging engineering and how many products, from eggs to organs intended for transplant require special packaging to assure they arrive at their destination in perfect condition. Students work in teams to design a shipping container and system to safely ship a flower with water so that the flower is still alive and fresh upon delivery. They present their new designs to the class, execute their plans, and evaluation the effectiveness of different designs.

## Age Levels

8-18.

## Objectives

- Learn about package engineering.
- Learn about engineering design and redesign.
- Learn how engineering can help solve society's challenges.
- Learn about teamwork and problem solving.

## Anticipated Learner Outcomes

As a result of this activity, students should develop an understanding of:

- packaging engineering
- engineering design
- teamwork

## Lesson Activities

Students learn about how important packaging design and engineering can be, especially when the item being shipped is an organ ready for transplant, or other living items. Students work in teams to design, build, and test a packaging system that will allow a fresh flower to be safely shipped and arrive alive and not wilted after 24 hours. Student teams with the smallest package to achieve the goal receive extra points in the activity.

## Resources/Materials

- Teacher Resource Documents (attached)
- Student Resource Sheet (attached)
- Student Worksheet (attached)

## Alignment to Curriculum Frameworks

See attached curriculum alignment sheet.

## Internet Connections

- TryEngineering (www.tryengineering.org)
- Federal Express Shipping Guide (www.fedex.com/en-us/service-guide/packing-express-ground/get-guides.html)

## Recommended Reading

- Structural Package Designs (ISBN: 9057680440)
- Successful Food Packaging Design (ISBN: 2940361339)
- Special Packaging Designs (ISBN: 9057680548)

## Optional Writing Activity

- Write an essay or a paragraph about how organs are shipped for transplant operations. What conditions do the engineers have to ensure will be consistent during transportation of the organ? Has the procedure for shipping this item changed over the past ten years?

## For Teachers: Teacher Resource

### Lesson Goal

The "Shipping for Survival" activity explores packaging engineering and how many products, from eggs to organs intended for transplant require special packaging to assure they arrive at their destination in perfect condition. Students work in teams to design a shipping container and system to safely ship a flower so that the flower is still alive and fresh upon delivery. They present their new designs to their class, execute their plans, and evaluation the effectiveness of different designs.

### Lesson Objectives

- Learn about package engineering.
- Learn about engineering design and redesign.
- Learn how engineering can help solve society's challenges.
- Learn about teamwork and problem solving.

### Materials

- Student Resource Sheets
- Student Worksheets
- A fresh flower with a stem cut to about 7cm (must be consistent between all student teams – select a type of flower that is readily available in your area and does require a continual water supply).
- Building materials – water, cotton balls, plastic, paper towels, rubber band, string, paper clips, cardboard, tape, newspaper, plastic wrap, foil, wooden dowels, other everyday materials readily available to you

### Procedure

1. Show students the student reference sheets. These may be read in class or provided as reading material for the prior night's homework.
2. To introduce the lesson, discuss how engineers design packaging differently for different items and that when the items must remain fresh (such as flowers) or alive (such as an organ scheduled for transplant) the packaging requires planning and engineering to make sure the product survives.
3. Divide your class into teams of 2-3 engineers. Explain that they need to develop a packaging system that will allow a fresh flower to be shipped safely and arrive at a destination still fresh and not wilted. Student teams with the smallest package to achieve the goal receive extra points in the activity. Note, you can either keep the sealed boxes in your classroom for 24 hours, or could bring all boxes to your local post office and ship them back to the school.
4. Teams consider their challenge, develop a plan on paper, then present their designs to the class. They may adjust their designs after receiving class feedback.
5. Teams next build their design, wait 24 hours (or ship to school from post office) and open the packages to evaluate the success of the design.
6. Teams complete a reflection sheet, evaluating their experience with the lesson.

### Time Needed

One to two 45 minute sessions.

## Student Resource:
## Packaging Engineering and Care of Flowers

Many items, from eggs in the local market, to organs rushed to a hospital, require special packaging to ensure they arrive safely and in good condition at their destination.

### ◆ Packaging Options

Engineers often work with marketing, sales, and perhaps a creative department when recommending packaging requirement for a product. Good packaging must protect the product, eliminate any damage while moving, shipping, or storing the products, and also make the product attractive if it is to be displayed in a consumer environment such as a grocery store, hardware store, or department store. For this reason, packaging is a critical part of a product's design and engineering process, and engineers must take many factors into consideration including appearance, function, and costs.

### ◆ Material Selection

Engineers have to consider the durability, cost, and performance of different materials when designing products and the package they will ship or be displayed in. Many factors will help determine which materials to use, such as how long the package will be on the product, how fragile or expensive the product is, and whether exposure to temperature or humidity would impact the performance of the product.

### ◆ Caring for Flowers

Flowers usually need a continuous source of water to remain fresh and hydrated. Cutting the stem of a flower at an angle instead of straight across increases the surface area exposed to the water and therefore boosts the flowers ability to absorb water. Removing leaves that are close to the cut on the stem can help the flower because water absorbed by the cut stem can go to the flower instead of to the leaves. Warm water can be absorbed more quickly by flowers than cold water. There is an exception to the warm water rule: Cold weather flowers like daffodils and tulips should be kept in cold water. Some people believe you can extend the life of a flower by using a mixture instead of just water. Recipes vary, but some say to combine 1 quart of warm water, 1 tsp. sugar, and 2 tbsp. of lemon or lime juice and mix well. Some florists believe that before selling or shipping flowers, that one inch of stem should be cut off under water. When flower stems are exposed to air – even for a short period of time -- they will begin to seal up which prevents or slows the absorption of much needed nutrients.

## *Student Worksheet:*

### ◆ Engineering Teamwork and Planning

You are a team of manufacturing engineers given the challenge of designing a package that can safely ship a fresh flower. The flower must be sealed in a box with access to water -- and not be reopened for 24 hours. Your teacher may elect to ship the class packages to the school from your local post office, or simply put them away for a day. Either way, when you reopen your package, the flower must still be alive, fresh, and not wilted. In addition, any water included in the box must only be exposed to the flower stem – upon opening the box, the rest of the contents should be dry not wet or moist. Student teams with the smallest package to achieve the goal receive extra points in the activity.

### ◆ Planning and Design Phase

Your team has been provided with a set of materials. Review these as a group and draw your packaging design in the box below or use another page. Think about how you will ensure that your flower has enough water to survive in the box for a day. Also, think about what might happen to the flower if the box were tossed about at the post office, or was stacked with heavier boxes above it.

## Student Worksheet:

### ◆ Construction Phase

Build your package, and be sure to put your team's name or number on the box for easy identification. Then, answer the questions below:

1. How similar was your design to the actual package you built.

2. If you found you needed to make changes during the construction phase, describe why your team decided to make revisions.

3. Do you think that packaging engineers often change their original plans during the manufacturing or construction process?

### ◆ Shipping Phase

Your teacher will devise a shipping system for all the packages created in your classroom. This may entail simply storing the boxes for 24 hours, or shipping them to your school from a local post office.

### ◆ Evaluation Phase

Once all packages have arrived at your school, you will work in teams to evaluate the packages and determine the condition of the arriving flower.

### ◆ Scoring

The following scores must be made for each incoming package. The box with the smallest overall volume gains a bonus 2 points:

| Package Number | Availability of Water<br>0 - no water<br>1 – a little water<br>2 – lots of water | Freshness of Flower<br>0 – droopy<br>1 – a little wilted<br>2 – fresh as new | Dryness of Box Interior<br>0 – wet inside<br>1 – damp<br>2 - dry | Total Score |
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| | | | | |

## Student Worksheet (continued):

◆ **Evaluation**

Complete the evaluation questions below:

1. What aspect of the design of the package that had the best overall score do you think lead to its success?

2. If you had a chance to do this project again, what would your team have done differently?

3. How do you think your design would have worked if the package had to be shipped in 100 degree temperatures? Below zero temperatures?

4. Do you think that this activity was more rewarding to do as a team, or would you have preferred to work alone on it? Why?

5. What other considerations would you have had to factor into a design if instead of shipping a flower you were shipping a human heart for an emergency transplant operation?

6. What other considerations would you have had to factor into a design if instead of shipping a flower you were shipping food that must remain frozen?

## For Teachers: Alignment to Curriculum Frameworks

**Note:** Lesson plans in this series are aligned to one or more of the following sets of standards:

- U.S. Science Education Standards (http://www.nap.edu/catalog.php?record_id=4962)
- U.S. Next Generation Science Standards (http://www.nextgenscience.org/)
- International Technology Education Association's Standards for Technological Literacy (http://www.iteea.org/TAA/PDFs/xstnd.pdf)
- U.S. National Council of Teachers of Mathematics' Principles and Standards for School Mathematics (http://www.nctm.org/standards/content.aspx?id=16909)
- U.S. Common Core State Standards for Mathematics (http://www.corestandards.org/Math)
- Computer Science Teachers Association K-12 Computer Science Standards (http://csta.acm.org/Curriculum/sub/K12Standards.html)

### ◆National Science Education Standards Grades K-4 (ages 4-9)

**CONTENT STANDARD B: Physical Science**

As a result of the activities, all students should develop an understanding of

- Properties of objects and materials

**CONTENT STANDARD C: Life Science**

As a result of the activities, all students should develop understanding of

- The characteristics of organisms
- Organisms and environments

**CONTENT STANDARD E: Science and Technology**

As a result of activities, all students should develop

- Abilities of technological design
- Abilities to distinguish between natural objects and objects made by humans

**CONTENT STANDARD F: Science in Personal and Social Perspectives**

As a result of activities, all students should develop understanding of

- Science and technology in local challenges

**CONTENT STANDARD G: History and Nature of Science**

As a result of activities, all students should develop understanding of

- Science as a human endeavor

### ◆National Science Education Standards Grades 5-8 (ages 10-14)

**CONTENT STANDARD B: Physical Science**

As a result of their activities, all students should develop an understanding of

- Properties and changes of properties in matter

**CONTENT STANDARD C: Life Science**

As a result of their activities, all students should develop understanding of

- Structure and function in living systems

**CONTENT STANDARD E: Science and Technology**

As a result of activities in grades 5-8, all students should develop

- Abilities of technological design
- Understandings about science and technology

**CONTENT STANDARD F: Science in Personal and Social Perspectives**

As a result of activities, all students should develop understanding of

- Science and technology in society

**CONTENT STANDARD G: History and Nature of Science**

As a result of activities, all students should develop understanding of

- Science as a human endeavor

## *For Teachers: Alignment to Curriculum Frameworks*

### ◆National Science Education Standards Grades 9-12 (ages 14-18)

**CONTENT STANDARD A: Science as Inquiry**

As a result of activities, all students should develop

- Abilities necessary to do scientific inquiry

**CONTENT STANDARD C: Life Science**

As a result of their activities, all students should develop understanding of

- Behavior of organisms

**CONTENT STANDARD E: Science and Technology**

As a result of activities, all students should develop

- Abilities of technological design
- Understandings about science and technology

**CONTENT STANDARD F: Science in Personal and Social Perspectives**

As a result of activities, all students should develop understanding of

- Science and technology in local, national, and global challenges

### ◆Next Generation Science Standards Grades 2-5 (Ages 7-11)

**Matter and its Interactions**

Students who demonstrate understanding can:

- 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

**From Molecules to Organisms: Structures and Processes**

Students who demonstrate understanding can:

- 5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.

**Engineering Design**

Students who demonstrate understanding can:

- 3-5-ETS1-1.Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2.Generate and 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.

### ◆Next Generation Science Standards Grades 6-8 (Ages 11-14)

**Engineering Design**

Students who demonstrate understanding can:

- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

## *For Teachers: Alignment to Curriculum Frameworks*

**◆Standards for Technological Literacy - All Ages**

**The Nature of Technology**

- Standard 1: Students will develop an understanding of the characteristics and scope of technology.

**Technology and Society**

- Standard 5: Students will develop an understanding of the effects of technology on the environment.

**Design**

- Standard 8: Students will develop an understanding of the attributes of design.
- Standard 9: Students will develop an understanding of engineering design.
- Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

**The Designed World**

- Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.