Design Thinking Lesson 1: *The Solve*
Student Guide

Welcome to Design Thinking Year 2!

Last year, you explored the design thinking process by creating the tallest tower and rescuing the sloth named Dulles from a tree. This year, you'll explore a new phenomenon to freshen up your Design Thinking skills.

I. The Phenomenon

Watch the video clip of the Marco Polo ship in the Savannah Port. As you watch the video, record your initial thoughts below.

Observe

Record your observations, reactions, and questions from the video.

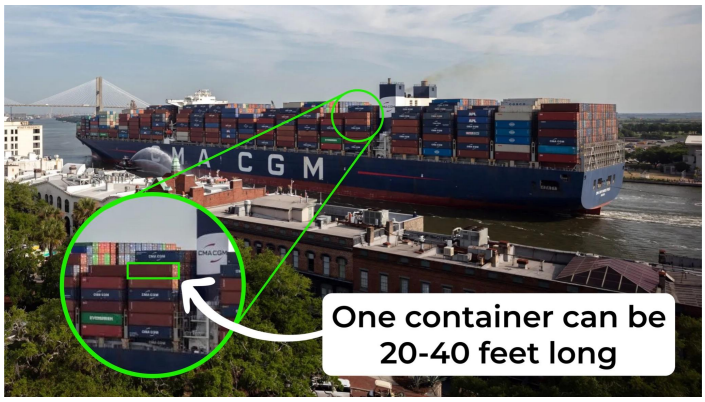
Watch the video again and answer the following questions.

1. How do you think it is possible for a ship to float while holding so much weight?

2. What challenges might engineers face when constructing a ship as long as the Empire State Building?

II. Think Like an Engineer

For remote instructions, click here.



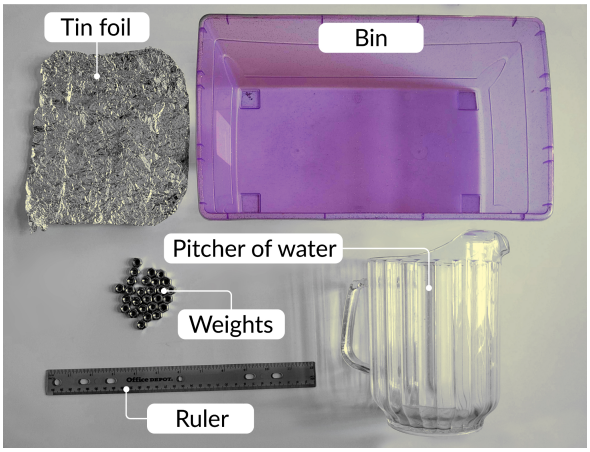
The Marco Polo is one of the largest vessels to ever dock on the East Coast. At full capacity, this container ship can carry roughly 16,000 containers that hold goods such as furniture, food, construction materials, and clothes for US customers. Ship delivery of this size helps consumers receive goods quickly and efficiently.

How do engineers design and construct a ship capable of holding as much weight as the Marco Polo?

In today's challenge, you'll work as an engineer to design a ship capable of floating the greatest amount of cargo containers without sinking. You will have 15 minutes to create your model ship from the materials provided. When time is up, you will present your final design to the class.

Materials:

- Aluminum foil: One 15 cm x 15 cm sheet
- A ruler
- A sink, tub, bucket, large bowl or dishpan
- Tap water to fill the tub
- 50 weights per ship to represent cargo containers (suggested weights include washers, bolts, marbles, or pennies)
- Balance (optional)
- Paper towels or rags for clean-up



Good luck, and let the design challenge begin!

Ship Design Challenge

Name of Ship: _____

Brainstorm Cargo Ship Design (capable of holding the most cargo)

Build and test your cargo ship from the provided materials. Add "cargo containers" to your ship until it reaches its maximum hold capacity without sinking. You may refine and retest it as necessary within the time limit.

Once your design is complete, add a sketch or photo of your ship, and document your observations below.

Final Ship Drawing or Photo	Observations
	1. Does your ship successfully support cargo containers without touching the bottom? 2. What observations and details did you notice when the cargo containers were placed on your ship? 3. What is the final number of cargo containers your ship could hold without sinking to the bottom? _____

Reflect

1. How did your team's ship compare with other ships in the classroom?
   Tip: Compare ship shape, length, size, height of the sides of the ship, and shape of the boat bottom (flat vs. v-shaped).

2. Study the ship that held the most cargo containers without sinking to the bottom. Describe the characteristics that made this design successful.

3. What were some of the obstacles that you/your group faced in this Ship Design Challenge?

4. When designing a prototype, why is it important to have access to all materials/variables that relate to the identified problem?

5. If given the opportunity to repeat this challenge, what would you do differently to create a better ship?

III: Create a Reference Guide

1. Think about the ship design challenge you just completed. On the Design Thinking Reference Guide below, list the actions you completed for each step of the Ship Design Challenge.

2. Next, cut out each of the Design Thinking Process Vocabulary Cards along the **solid blue lines**.

3. Match each vocabulary card to the correct step on the Design Thinking Reference Guide. Tape each matching vocabulary card over the corresponding box on the diagram. **You should be able to lift the flap to see the corresponding Design Thinking box underneath.**

4. Add color to your Reference Guide as desired.

MY DESIGN THINKING REFERENCE GUIDE

1 *Understand the Problem*

2 *Ideate/Brainstorm*

3 *Prototype*

4 *Test*

5 *Refine*

6 *Repeat*

DESIGN THINKING VOCABULARY CARDS

UNDERSTAND THE PROBLEM

Identify the key question being asked. Possibly ask questions and do background research as needed.

IDEATE/BRAINSTORM

Think up ideas/possible solutions by sketching, creating lists, having team conversations, etc.

PROTOTYPE

Construct the design solution with proportions similar to the real-life final product.

TEST

Conduct experiments with the prototype to test the design against identified variables in order to determine if flaws exist.

REFINE

Based on test data, update the original design to improve stability, buoyancy, maximum weight capacity, etc.

REPEAT

Retest the refined prototype to determine success/failure of design.

Name: _____ **Date: _____**

IV. Exit Ticket

Complete the exit ticket below *or* you can take the quiz online!

1. In order to brainstorm design solutions, one must be able to:
    a. Refine the design
    b. Retest the design
    c. Understand the problem needing to be solved
    d. Create a prototype

2. A prototype should be constructed:
    a. In order to test a model of the design solution
    b. With model proportions that are the exact same size as they are in real life
    c. Using precise details and color
    d. Answers a. and b.

3. True or false: If a prototype fails in a test run, the design should be refined and retested.
    a. True
    b. False

4. Thinking up ideas and sketching them out on a piece of paper would be part of what process?
    a. Identifying the problem
    b. Brainstorming
    c. Testing a design
    d. Collecting data

5. Which of the following would be an example of refining a ship design?
    a. Creating a proportional model of a ship
    b. Testing a model ship in a pool of water
    c. Adding a flat bottom and pontoons to an existing model ship to increase stability and buoyancy
    d. Floating a model ship in a pool of water with a fan blowing to provide wind current