EDUCATIONAL OUTREACH
FLORIDA POLYTECHNIC UNIVERSITY

BOAT CHALLENGE

Design the most efficient vessel

Overview

Building boats involves mechanical, electrical, electronic, software and safety engineering. Engineers not only build boats. They design, build, and maintain ships, from aircraft carriers to submarines and from sailboats to tankers. Boat design goes beyond aesthetics, or the way the boat looks. Engineers are responsible for the ship design, including the form, structure, and stability of hulls. Material scientists and engineers work with metals, ceramics, and plastics to create new materials to develop, process, and test materials used to create a range of products includes boats that are cost effective and function efficiently.

Activity

Your work for Elite Engineering Corporation. The Mississippi Cookies Company has contacted the CEO of Elite Engineering Corporation and is in need of a new vessel (boat) to transport cookies from their factory to their distribution center. Your CEO has guaranteed the Mississippi Cookie Company that each of the research and development (R&D) teams (*that's you!*) at Elite Engineering Corporation will present your best designs. The vessel design that is the most cost effective **and** efficient will be purchased and built by the Mississippi Cookie Company. This will be determined by a dollar amount.
Video overview: https://www.powtoon.com/m/drxNYvM2l6Y/1/m

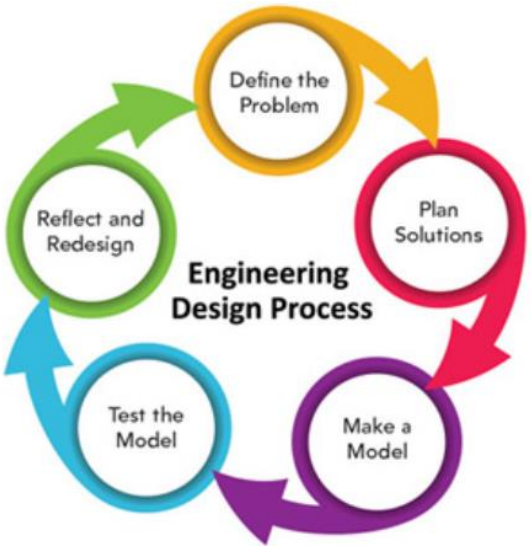
The Problem

The Mississippi Cookie Company transports their cookies from their factory in Minneapolis, MN to their distribution center in New Orleans, LA. Since the route is over 1,400 miles on the Mississippi River. It is important to ship as many cookies as possible each trip to make the most profit. The most efficient boat was damaged in a recent storm. She needs to replace it with a watercraft that will support the weight of thousands of boxes of cookies.

The Challenge

As one of the R&D Teams at Elite Engineering Corporation, you have been tasked to design a craft that can float, travel a route of over 1,400 miles and carry as many cookies possible in one trip, maximizing profits. Using the engineering design process, you will need to plan, create, design and test a model of the boat you would like to sell to the Mississippi Cookie Company.

Remember, everything has a cost including the materials to build the boat, the fuel, the employees, the cookies, the packaging and more. Profit is a financial gain, especially the difference between the amount earned and the amount spent in buying, operating, or producing something.
Each team will design, create and test a model of a boat that will support the weight of the cookies but is also the most economical design.



You can only construct your model boat using materials provided. Example materials include: popsicle sticks, aluminum foil, glue, straws, cork, foam and other materials that may be "on sale" that day.
*Remember– a big part of this challenge is to create a model that will support weight and be economical to build. The more Mother Goose has to spend on her boats, the less profit she makes off of her cookies.
You have a budget of $400 to build your boat.

Materials

Assorted school supplies (popsicle sticks, aluminum foil, cardboard, tape, foam, straws, cork, etc.)
Container that can hold at least 8 inches of water
Weights (pennies, dice, tinker toys, etc. Identical small items that are the same weight and can fit into the boat)
Paper for planning and record keeping
Pen/Pencil

Plan

10 minutes

As a group, discuss features that you would like your boat to have. Make sure you write all of your ideas down.

Make a list of the materials you think you will need including quantity.

Design and Shop

15 minutes

Sketch the model of your boat. Be sure to label what materials are being used for the parts of your model. Your model is a representation of your boat and cannot be bigger than 1ft x 1ft x 1 ft.

Using the material list provided (see example), create a shopping list and calculate the cost of your materials.

Once approved, "purchase" your materials from the store and begin building

Material	Cost	Qty	Total $
Lumber (popsicle sticks)	= $50 each		
Sheet Metal (aluminum foil)	= $25/sheet		
Welding materials (glue)	= $50 bottle		
Reinforcements (plastic straws)	= $25 each		
Buoys (corks)	= $50 each		
Cable/rope (masking tape)	= $10/inch		

Add the cost of all materials purchased for Total Spent →

ITEM	How Many?	X Cost (each)	= Total cost

Build

30 minutes

Construct your model using the plan and design your team created. You may not return or exchange any materials *with the store.*

Test

Time to test. A pool, wash tub or storage container able to fill with at least 8 inches of water
First, predict how many weights you think your boat will hold _____
Place your boat in the water. Does it float? Yes _____ No _____
Start testing your boat. To be fair, one person from your team will place weights in the model boat one at a time. If the bottom of the model touches the bottom of the container or takes on water, subtract the last weight placed in the boat to calculate the number of weights the model holds. This represents the number of cookies your boat would hold.
How many weights did you model hold? _____

Calculate

Calculate how efficient your design is.
First calculate how much you spent.

Material	Cost	Qty	Total $
Lumber (popsicle sticks)	= $50 each		
Sheet Metal (aluminum foil)	= $25/sheet		
Welding materials (glue)	= $50 bottle		
Reinforcements (plastic straws)	= $25 each		
Buoys (corks)	= $50 each		
Cable/rope (masking tape)	= $10/inch		
Add the cost of all materials purchased for Total Spent →			

Then determine how much you have left from your original budget. This will be your balance.
$400– Total Spent _____ = _____ balance

Calculate the profit of the weights
Number of weights your model held_____ x $10 (profit per weight)= _____ profit

Calculate the overall gain
Balance_____ + Profit _____ = _____ overall gain

The team with the highest overall gain is the model that will be chosen by the Mississippi Cookie Company to build to transport their cookies.

Assess and Redesign

1. How do you think your team did in regards to planning and designing?

2. Explain anything that your team would do differently.

3. What modifications would you make to your design?

Extension

If time permits, make modifications to your model and re-test
Purchase additional materials, given an additional budget of $200

ITEM	How Many?	X Cost (each)	= Total cost

Construct/Test Model:
You will have 15 minutes to re-build your model
How many weights do you think your model will hold? Predict _____
Test your model
How many weights did it hold? _____

Calculate your new balance

Material	Cost	Qty	Total $
Lumber (popsicle sticks)	= $50 each		
Sheet Metal (aluminum foil)	= $25/sheet		
Welding materials (glue)	= $50 bottle		
Reinforcements (plastic straws)	= $25 each		
Buoys (corks)	= $50 each		
Cable/rope (masking tape)	= $10/inch		
Add the cost of all materials purchased for Total Spent →			

Overall gain from first test_____ +200 – Total Spent _____ = _____ balance #2

Calculate the profit #2 of the weights
Number of weights your model held_____ x $10 (profit per weight)= _____ profit

Calculate the overall gain #2
Balance #2_____ + Profit #2 _____ = _____ overall gain #2

Reflect:

1. Compare/Contrast your first model with the second

2. Did you learn anything from watching your classmates testing their models in the first round?

3. Why do we test, re-design and retest?

4. What do you think the next step is after you've made the most cost effective and efficient model?

Thank you for downloading this lesson, please take a moment to complete our survey