Boat Activity Instructions

Overview

Engineers are often required to design cost-effective and efficient designs while carrying out accurate calculations. Today, the members of your engineering team will design a boat that is low in cost in cost and high in performance: scores will be awarded based on accurate calculations, not on carrying the heaviest load.

Rules

- Teams must track their material “purchases” from the TWT Store. No real money will be used for these purchases but various items “cost” more so note every item that is used in your design.
- No returning of supplies that have been defaced, cut or broken. Items can be borrowed while in the design phase, but change of mind after using an item in your design is not a reason an item can be returned. Choose wisely.
- Tools will be provided for boat construction and the use of all other tools must be approved by Dr. Genalo.
- The design must allow for a cup to be added and removed. The design cannot cage the cup. The design cannot deface the cup. The design cannot build up the cup/make the cup taller.
- The design must be free-floating. It is a boat, not a bridge.
- Boats may be decorated, but only with permanent marker. No washable markers will be allowed. No glitter is to be used on the boats. (Keep in mind, decorations may change the density of the boat.)

Calculations

- Measurements needed
  - Total Mass = Boat mass + Cup mass
  - Total Volume = Boat volume + Cup volume
  - Water displaced
- Engineering Concepts
  - When bodies are partially or completely submerged in a liquid, the resulting force acting on the body is called the buoyant force. The buoyant force is equal to the weight of the fluid that the body displaces, expressed mathematically through Archimedes’ Principle: $F_B = V\gamma$
  - Archimedes’ Principle: $F_B = V\gamma$
    - $F_B = $ Buoyant Force
    - $V = $ Volume of Liquid Displaced
    - $\gamma = $ Specific Weight of the Displaced Liquid = $\rho g$
      - $\rho = $ Density of the Displaced Liquid
      - $g = $ Acceleration due to gravity
- Assuming no other forces are present, the buoyant force equals and opposes the force due to gravity.
- Stability is also important and determined by the center of gravity and center of buoyancy.
  - Center of gravity - $C_g$: Calculated focal point of an object’s total weight. This value changes only if weight is changed/redistributed.
  - Center of buoyancy - $C_B$: Theoretical center of an object’s submerged volume. Changes only if the amount or shape of the submerged volume changes. Always below the water line.
- Buoyant forces act through the center of mass of the displaced volume. Gravitational forces act through the center of gravity of the object. Before changing the weight or weight distribution of the boat, consider carefully how these changes will adjust the center of gravity: if the center of gravity is on either side of the centerline of the boat, the boat will tip to that side.