Spaghetti Vessels

You and your team have the task of constructing a vessel made entirely of spaghetti, hot glue, and plastic wrap.

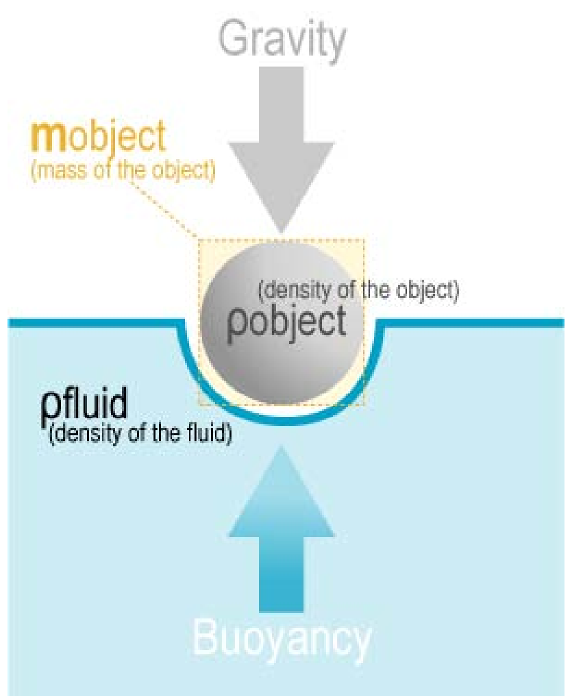
Objectives

- Understand and utilize the concept of buoyancy and Archimedes' Principle.
- Identify different forces that act upon structures in a fluid.
- Develop knowledge on the importance of structural integrity and balance to a vessel's design.
- Develop and construct a boat made entirely of spaghetti, hot glue, and plastic wrap capable of supporting the most weight.
- Determine the volume of different vessels, comparing the results of the test.

Key Aspects to a Boats Success

Buoyancy

In physics, buoyancy is the upward force on an object produced by the surrounding fluid (i.e., a liquid or a gas) in which it is fully or partially immersed, due to the pressure difference of the fluid between the top and bottom of the object. The net upward buoyancy force is equal to the magnitude of the weight of fluid displaced by the body. This force enables the object to float or at least to seem lighter. Buoyancy is important for many vehicles such as boats, ships, balloons, and airships.



Archimedes' Principle

- If the weight of the water displaced is less than the weight of the object, the object will sink.

- Otherwise the object will float, with the weight of the water displaced equal to the weight of the object.

Structural Integrity

In order for a boat to be successful it must be strong. This means that it can support its own weight in the water along with the load that a boat must carry without failure. The design of the vessel must also prove to be balanced and stable in the water.

Part one

Design and Construction

Goal: Create the boat that will support the most weight without sinking.

Materials: 30 strands of spaghetti (plus 3 emergency strands,) hot glue, and plastic wrap.

Before construction your team must design the vessel on paper. Remember – your materials are limited. After all group members have approved the design, begin construction of the boat. Strength of joints will play a crucial role in the overall structure of the boat. When the skeleton of the boat is complete, use the plastic wrap to cover the outside of the boat.
Careful: Hot Glue right out of the GUN will melt the plastic!

Testing/Results

The first step is determining the volume of your group's vessel. Utilizing the equations attached or others found online, take the correct measurements and roughly determine the volume of your boat. Record your results.

Use this website :
http://www.calculatoredge.com/enggcalc/volume.html

Volume of Vessel: __________in^3

According to Archimedes' Principle a vessel should float as long as it displaces more than its own weight in water. A stable boat will distribute its weight and sink evenly in the water. Knowing the volume of your boat and that water weighs 0.016 Kg/in^3 determine the theoretical mass that your boat should hold.

Theoretical mass: _________kg

Each boat will be placed in a large tub of water to determine initial stability and buoyancy of the vessel. Mass will slowly be added to the boat until the vessel sinks. Record your results.

Mass held: __________grams   Mass(g) x1000 = _________kilograms

Analysis/Discussion

Compare your vessel's design and carrying capacity with other groups in the class.

Group's Name	Mass Held	Rough Sketch of Design

Did one shape/design prove to be more efficient than others? Which one and why?

If your boat tipped over and sank rather than sinking evenly, how would this effect your buoyancy calculation?

What are some reasons your vessel didn't live up to your expectations?

After observing your results and those of your classmates, what do you think flawed your design?

How would you improve upon your design?

Did your group work efficiently and effectively together? What were some positive aspects and negative aspects of you group?

Part two

Now that your group has completed the first vessel you must take what you have learned and improve upon your initial design. Design and construct a second boat – one in which you believe will out perform your first boat. Using the same methods as part one, test your boat and record the necessary data in the included table.

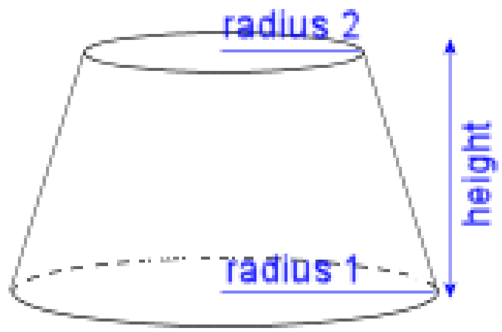
Final discussion

How did your second attempt compare to your first? Was it better/worse? Why or why not?

What changes did you make when designing your second boat? What aspect of vessel design (buoyancy, stability, structural integrity) did these changes address?

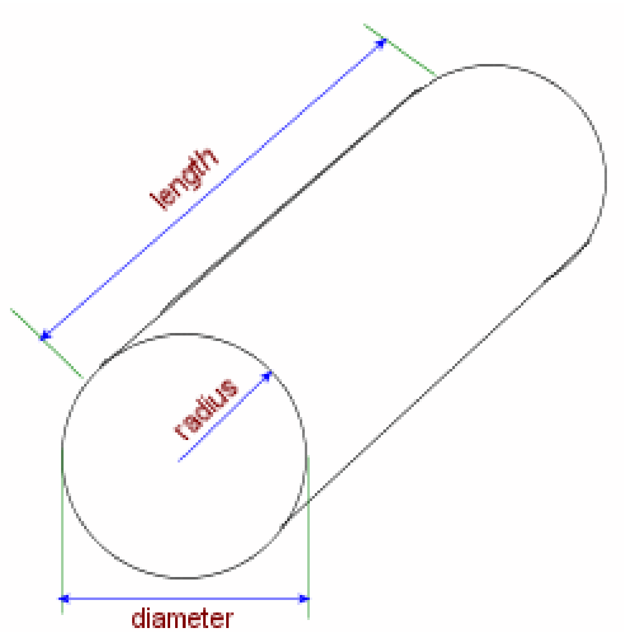
Do you believe your design would work well in a real world situation? Why or Why not?

Volume of a Cone



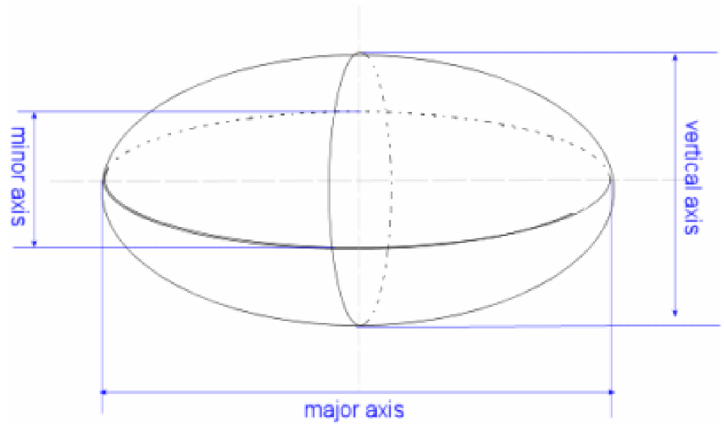
volume = Pi * h / 3 * (r1^2 + (r1 * r2) + r2^2)

Volume of a Cylinder



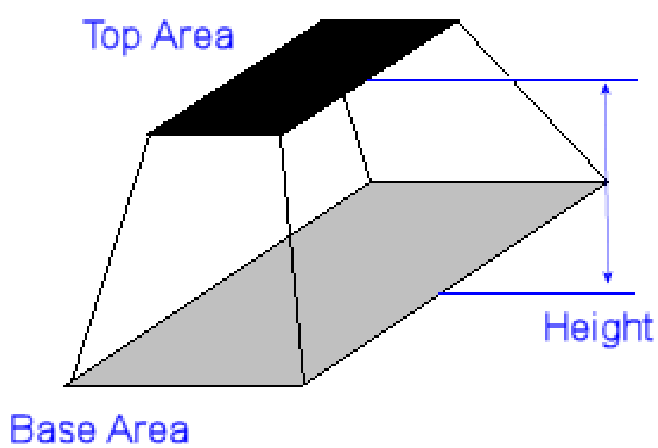
volume = Pi * radius^2 * length

Volume of an Ellipsoid



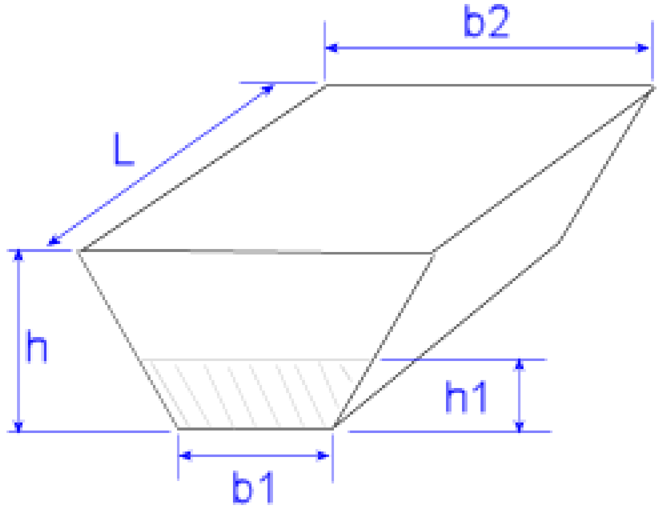
volume = Pi / 6 * (major * minor * vertical)

Volume of a Pyramid



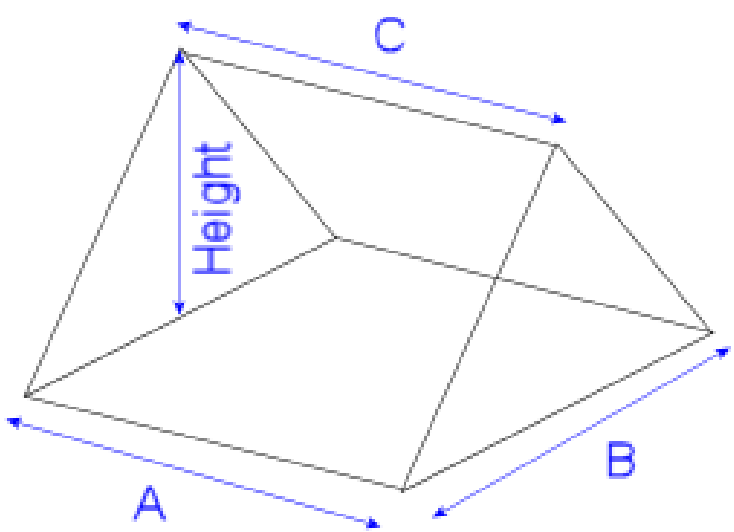
volume = (A1 + A2 + sqrt(A1 * A2)) * H / 3

Volume of a Trapezoid tank



volume = L * (b1 + (b2 - b1) * h1 / h + b1) * h1 / 2

Volume of a Wedge



volume = (2 * A + C) * B * H / 6

source: OnlineConversion.com