

Name: \_\_\_\_\_

Period: \_\_\_\_\_

# Buoyancy—Why Things Float



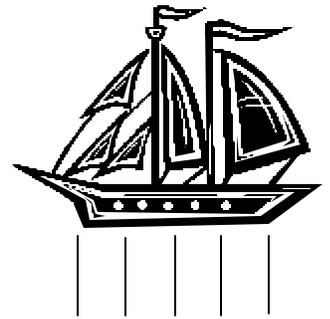
A warning buoy

A buoy floats on water to show boaters where to avoid underwater objects.

A buoy floats because of **buoyancy**—the upward force of water on an object.

Objects can float in more than just water. Balloons float in air; your fluids in your density column floated on honey, corn syrup, etc.

So how do things float?



A boat floats because the water pushes UP on it.

## How does a steel ship float?

### Is It Density?

You know about density.

If an object is denser than the liquid it's in it will sink.

If it is less dense than the liquid, it will float.

Here are three materials and their densities:

water, 1 g/mL; cork, 0.25 g/mL; steel, 7.86 g/mL.

In water a cork will float or sink? \_\_\_\_\_

In water a steel will float or sink? \_\_\_\_\_

## So, how does a steel ship float?

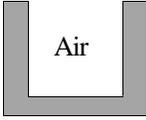
### It's About Buoyancy

*Archimedes' Principle: An object in a fluid will float when the weight of the displaced fluid equals the weight of the object.*

*Ex. A 50 newton object will float if it displaces 50 newtons of water. If it displaces less than that, it will sink!*



Steel block; higher density; sinks.



Steel ship; lower density (same mass, more volume); floats.

A steel ship can float because of its shape! A block of steel does not displace (push aside) enough water to keep it afloat, but a ship is mostly air in between its sides! This shape allows it to displace enough water to float.

Another way to think about this is that the ship is less dense than a block of steel because it has air inside!



Remember:  
*Noah's Ark floated because of Archimedes' Principle.*

Newtons—the metric unit of weight (we use pounds). We will use newtons more in Physics, but Archimedes Principle works just fine if you use MASS in place of newtons.

Remember: 1 mL of water = 1 gram of water

If a piece of rubber has a mass of 45 grams, how much water will it have to displace in order to float?

If a boat weighs 100 newtons and it displaces 250 newtons of water, how heavy a cargo can it carry?

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Buoyancy Lab—Archimedes' Principle

- 1) Find the initial mass of the balloon system (balloon with 20 pennies and the binder clip). *Record in data table below.*
- 2) How much water will have to be displaced for the balloon system to float? *Record below.*
- 3) Level the overflow tank this way:  
From the large beaker pour water into the displacement tank until it pours out into the small beaker.  
When the water stops flowing into the small beaker, empty the small beaker into the large beaker.
- 4) Seal the uninflated balloon system with the clip. Put it into the displacement tank and let the water flow into the small beaker.
- 5) With the graduated cylinder, determine how much water mass the balloon system displaced. *Record below.*
- 6) Did the balloon system float or sink? *Record below.*
- 7) Retrieve the balloon system. Relevel the overflow tank as in procedure 3).
- 8) Inflate the balloon just smaller than a tennis ball; seal with the clip; find the water mass displaced. *Record below.*
- 9) Relevel the overflow tank as in procedure 3).
- 10) Inflate the balloon to the size of a baseball (but smaller than the displacement tank). *Record the water mass displaced:*  
*QUESTION: Archimedes' Principle states that the balloon will float if the water it displaces equals the mass of the object.*  
*Did this happen? Record below.*
- 11) Find the volume of the film canister. *Record below.*
- 12) Using Archimedes' Principle determine what the maximum mass the canister can hold and still float. *Record below.*
- 13) Measure the mass of one penny: *Record below.*
- 14) Predict how many pennies will float in the canister? *Record below.*
- 15) Test your hypothesis. *Record your data below.*

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DATA TABLE		
1)	Initial balloon system mass	
2)	Water mass predicted	
5)	Water mass 1	
6)	Float or sink?	
8)	Water mass 2	
10)	Water mass 3	
Q:	Archimedes' Principle	
11)	Film canister volume	
12)	Maximum mass	
13)	Mass of one penny	
14)	Predict how many pennies	
15)	How many pennies did float.	