Topic 3

Viscosity & Density

Viscosity

- We know a key part of fluids is their ability to flow
- *How quickly* they flow is known as **viscosity**!

Fluid	Thicker	Thinner
Ex: Shampoo	Harder to get out of bottle	Would need more to wash your hair

- Your turn! Best answer gets a candy!

Viscosity Cont…

- So viscosity is a property that determines how quickly something flow … how?
- It is the fluids internal friction that keeps it from moving
  - The thicker a substance the more particles it tends to have so the slower it moves
  - High viscosity = slower moving → ketchup

  - Low viscosity = faster moving → rubbing alcohol

Changing Viscosity?

- Can you think of a way to alter the viscosity of a substance?
- Solid answer (*insert student name who answered the question but since you could not possibility know in advance then just keep this here*) good logic on that one!
- Temperature! Increasing or decreasing it!

Viscosity Ramp Test

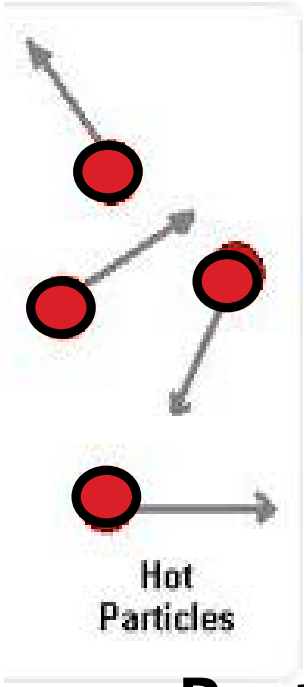
- To prove it you can do the ramp test!

Viscosity & Temperature

As….

The opposite is also true…

Temperature



Particle Movement Increases

Viscosity Decreases

Density – Here Comes Math!

- Explain this …

- Same object, different depths

Density

- Density, it in basic form, is how much stuff (*particles*) make up the fluid/object in question
- Also, it is a ratio of mass to volume
- More particles = heavier and vice versa
- Are solids always more dense than liquids and/or gases?
- You can even calculate it!

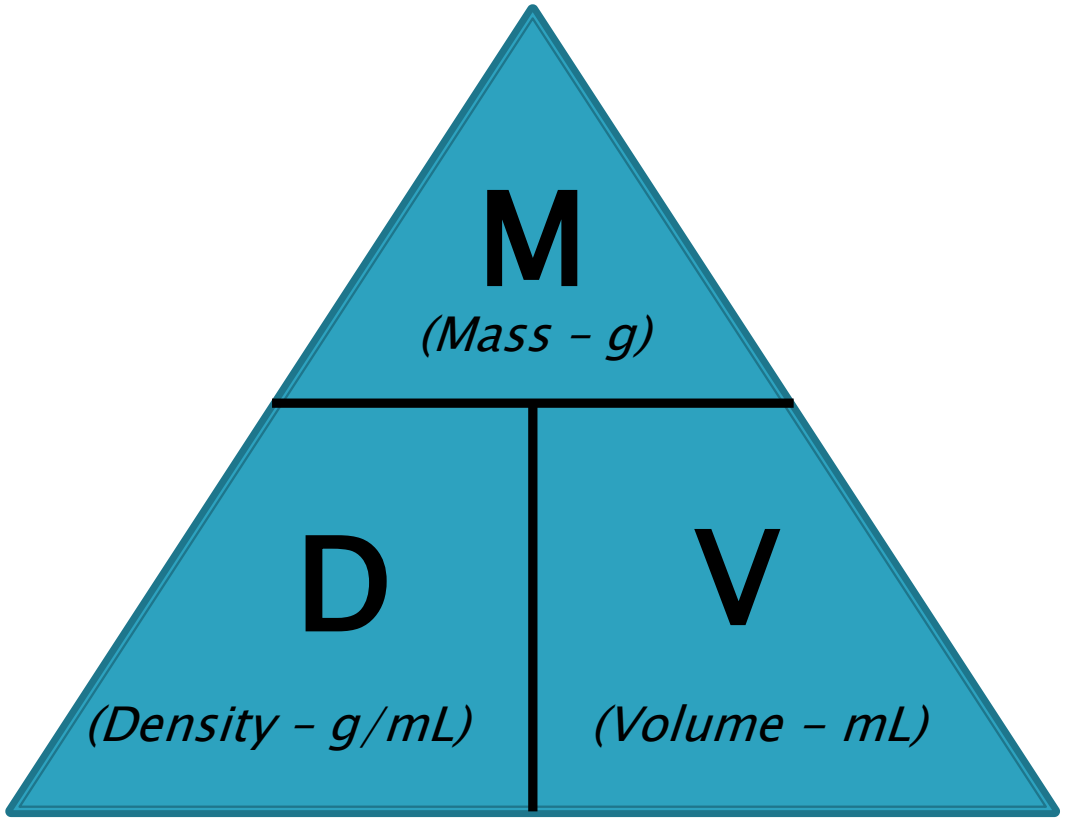
$$density = \frac{mass}{volume}$$

or, in short form:

$$d = \frac{m}{v}$$

Density – The $$ Slide

- The following is vital information …



Density + Math = Love Story

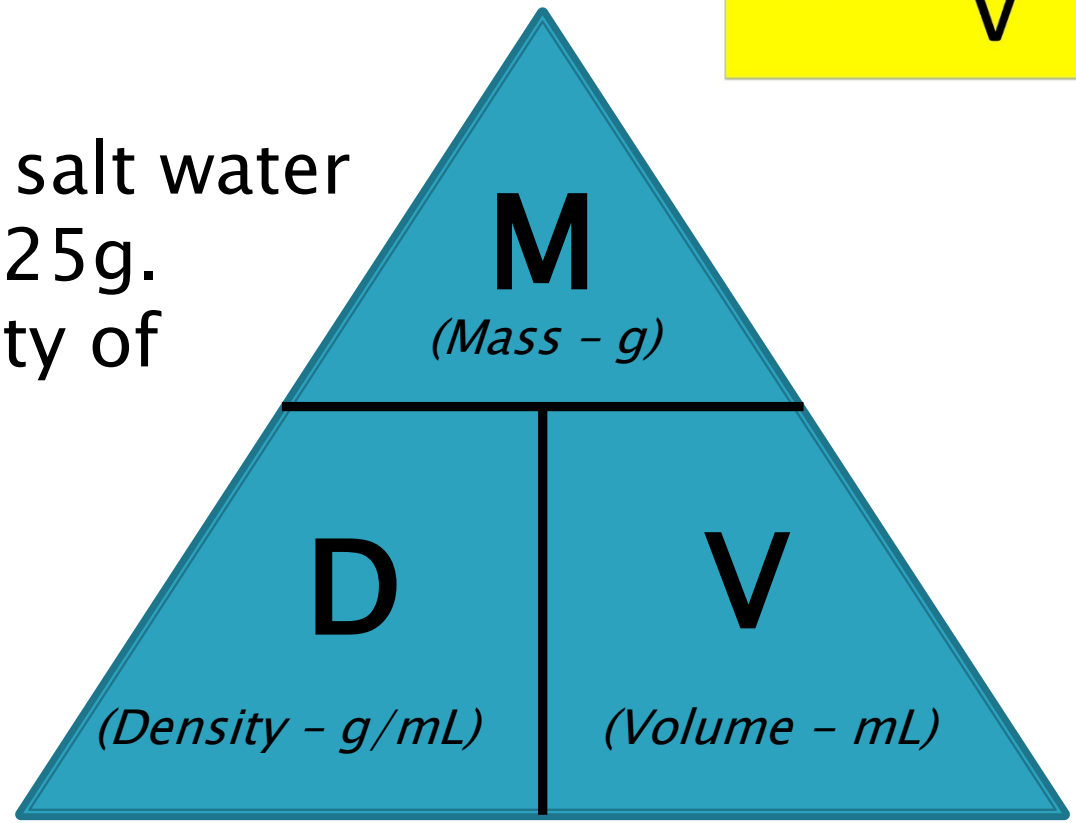
$$D = \frac{\heartsuit}{}$$

$$D = \frac{m}{V}$$

- Let's try to use this triangle
- You will love this!

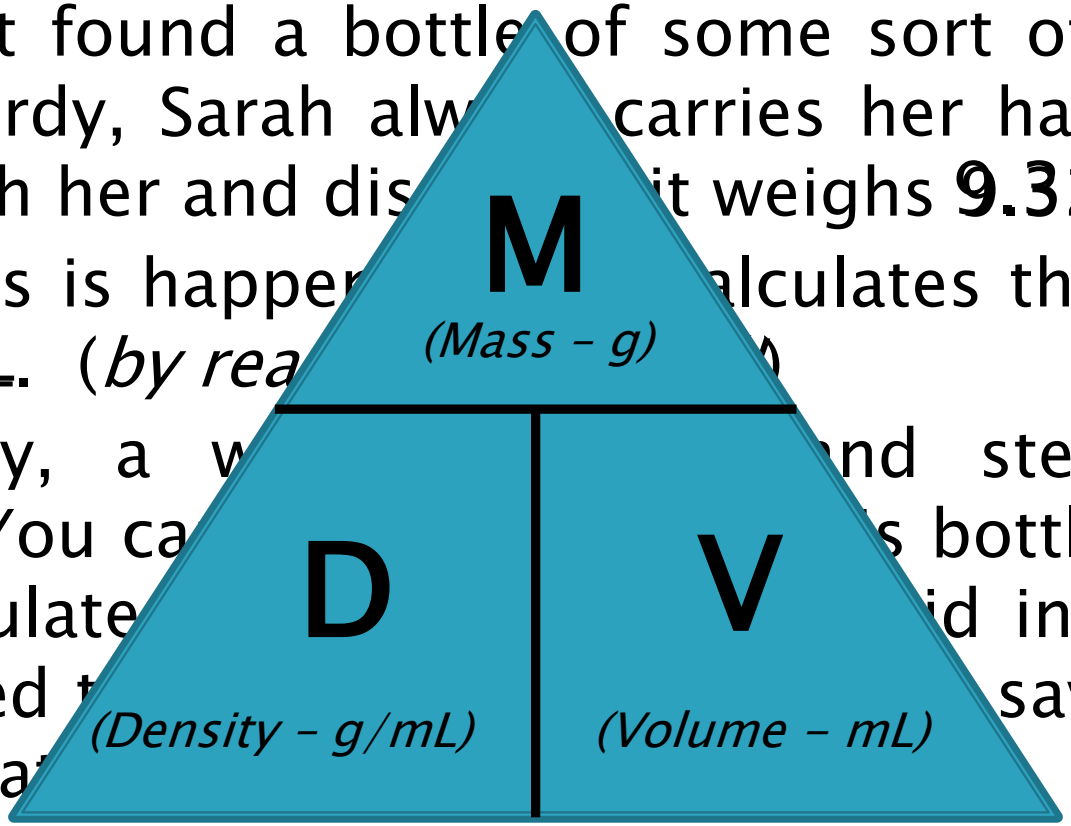
- I have 10.5mL of salt water with a mass of 2.25g. What is the density of my salt water?

- 4.66g/mL
  Did you get it?



More Practice

- Sarah & Lily are walking through a desert when they discover something shining in the distance. They sprint over to the object to discover they have just found a bottle of some sort of liquid. Being nerdy, Sarah alw carries her hand held scale with her and dis it weighs **9.32g**.
- While this is happe alculates the bottle is **750mL**. (*by rea*
- Randomly, a w nd steals the bottle. "You ca s bottle if you can calculate id inside it!" They need t save them by calcula



Solve!

Density & Temperature

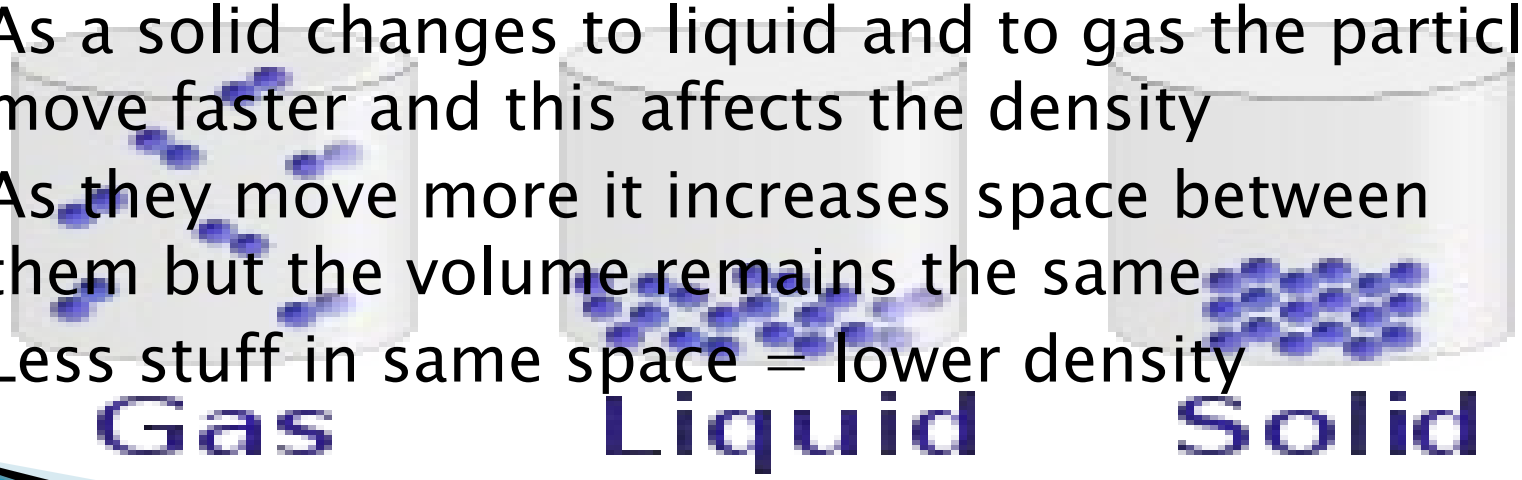
- What are the 3 states of matter?
  - Solid
  - Liquid
  - Gas

- Temperature heats or cools it changes states

Density & Temperature

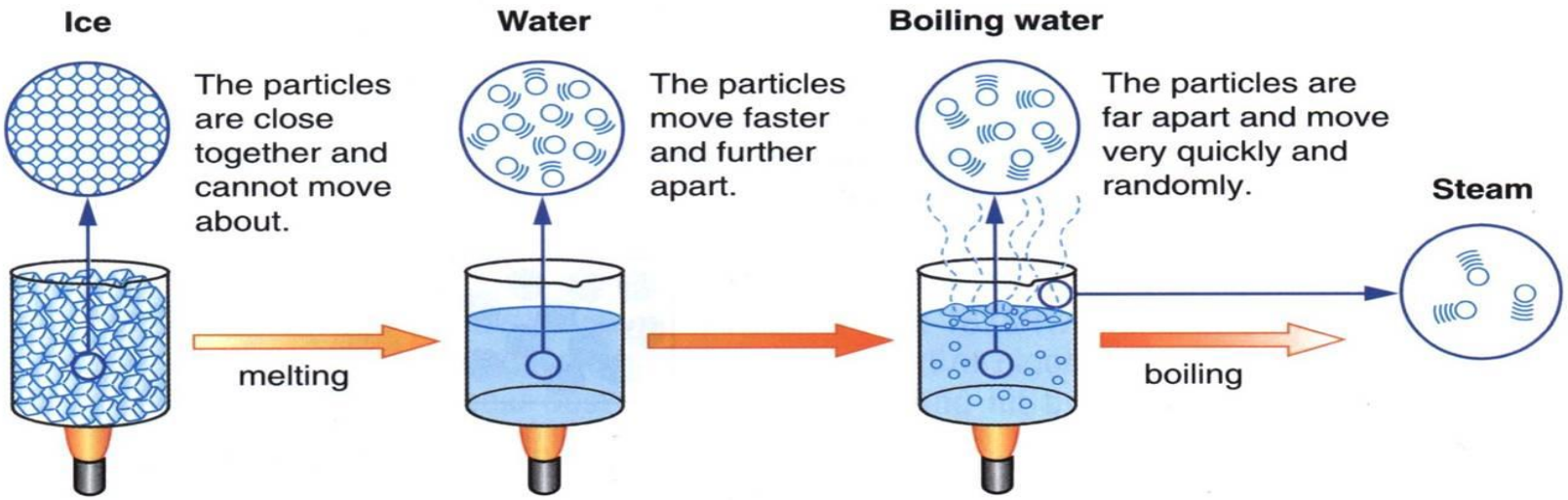
- What are the 3 states of matter?
  - Solid
  - Liquid
  - Gas

- Temperature heats or cools it changes states
- As a solid changes to liquid and to gas the particles move faster and this affects the density
- As they move more it increases space between them but the volume remains the same
- Less stuff in same space = lower density



States of Matter & Density

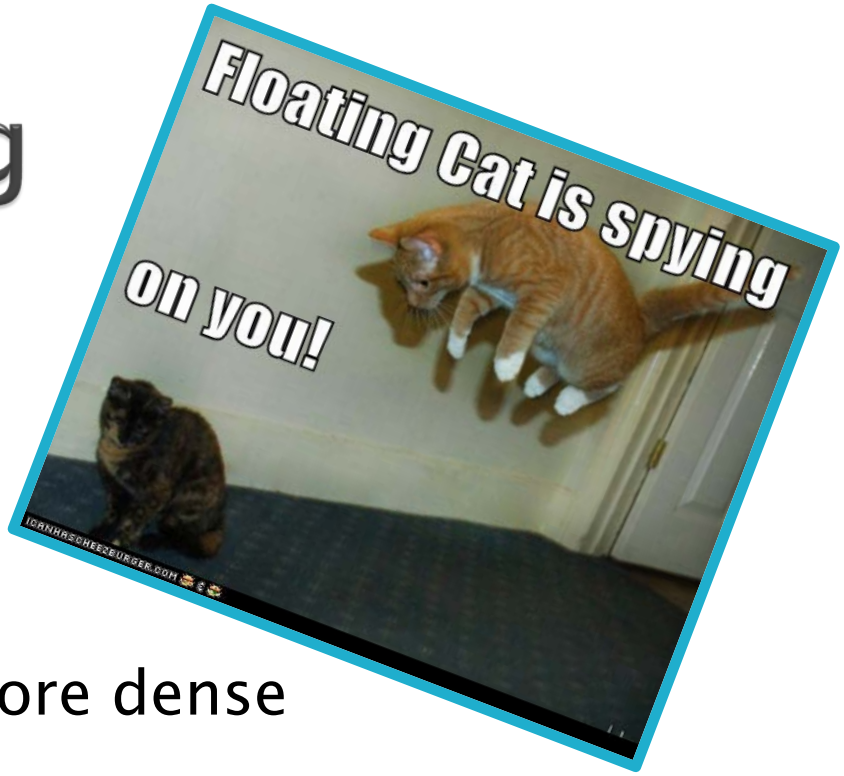
- A substance (*except water*) has a greater density in its solid state than it in liquid or gas state



▲ Changes of state in matter.

The Dead Sea – Israel

Density & Floating



- What have you learned?
- Density determines if 1 object can float in another
  - Less dense will float in a more dense

- So if gravity plays a role in that … is that the only force that acts on us?

Buoyancy

- Objects ***pulled down*** by _____Gravity ☺_____?

- Objects in water face the same force but also an opposite force …

- Objects ***pushed upward*** by _____Buoyant Force ☺_____?

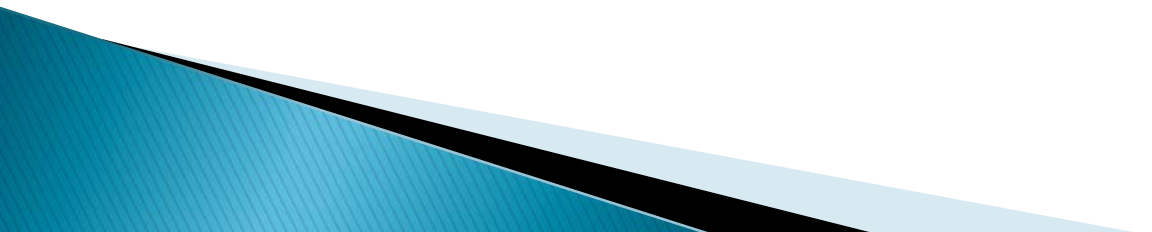
Fighting Forces

- So what happens when the density of the liquid is greater than the density of the object…?

Sinks

Floats

Floats



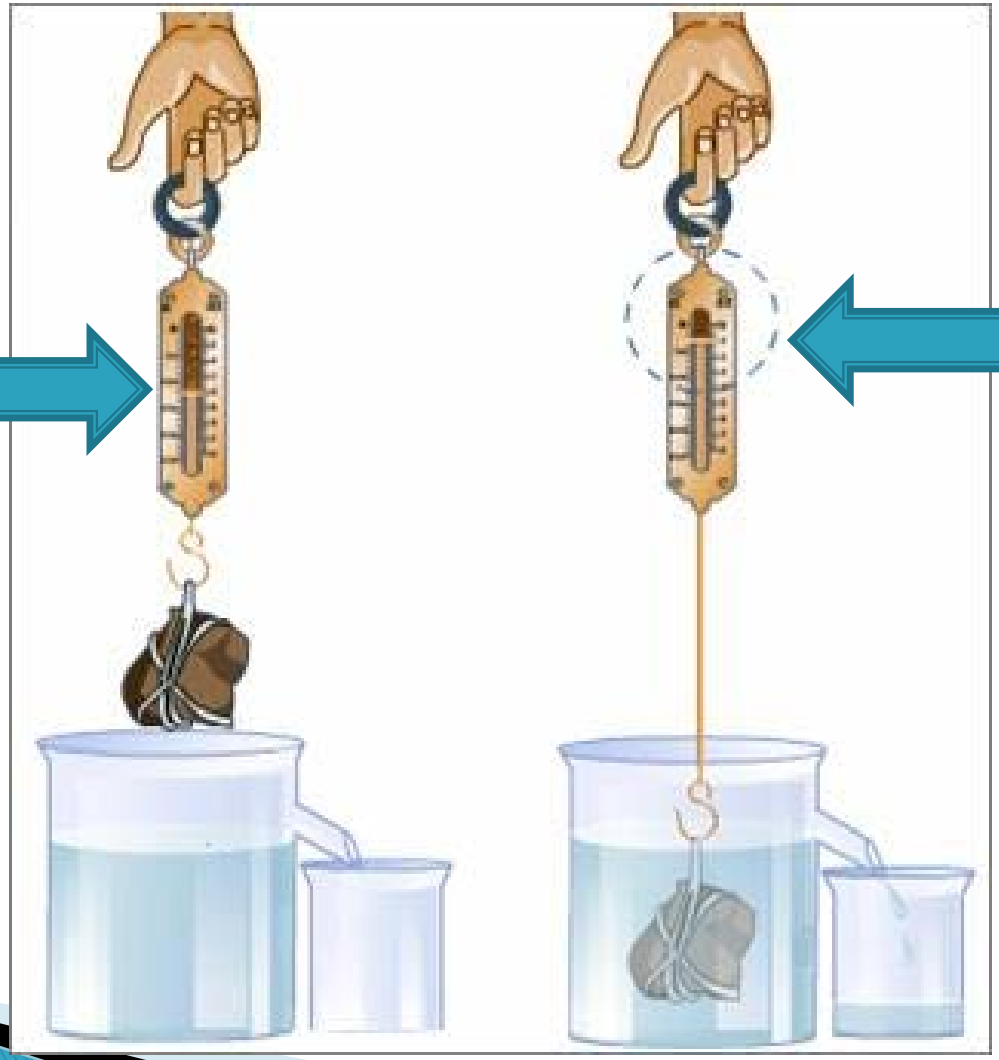
So what is Buoyancy?

- The tendency of an object to float when placed in a fluid (liquid)

Mind … Explosion …

How much is the buoyant force?

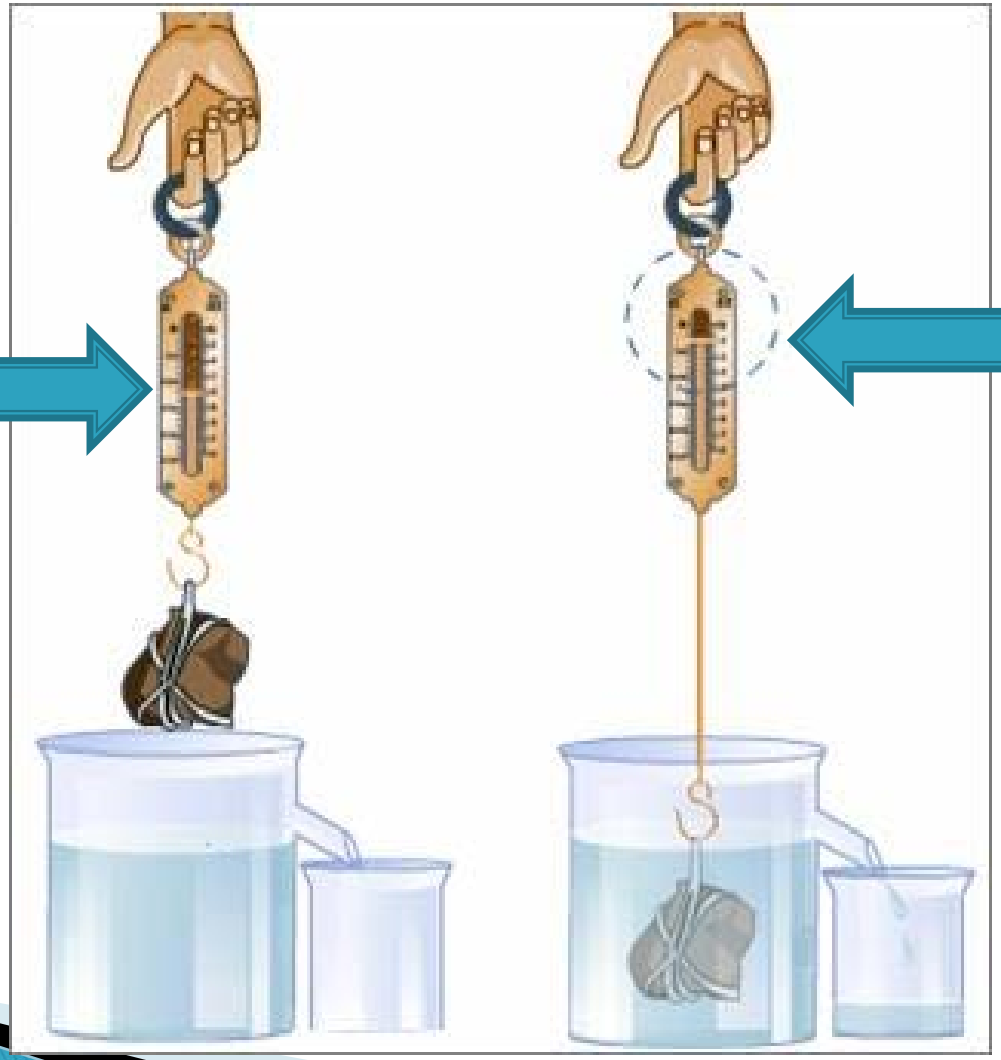
80N



30N

How much is the buoyant force?

60N

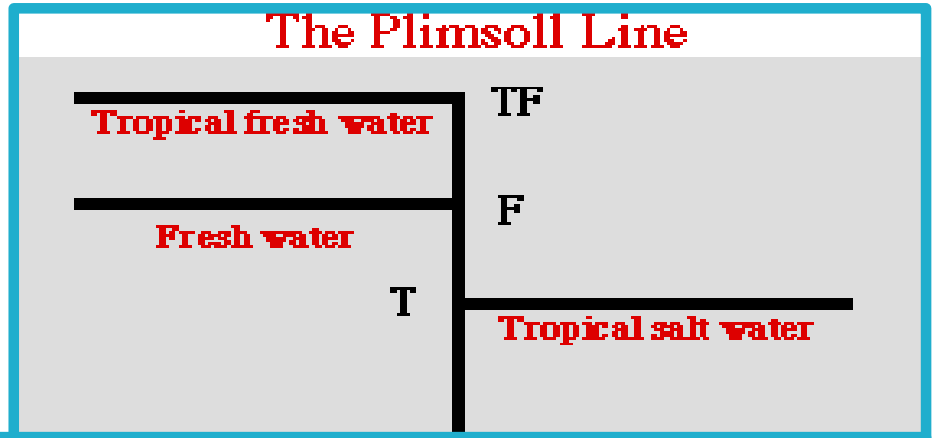


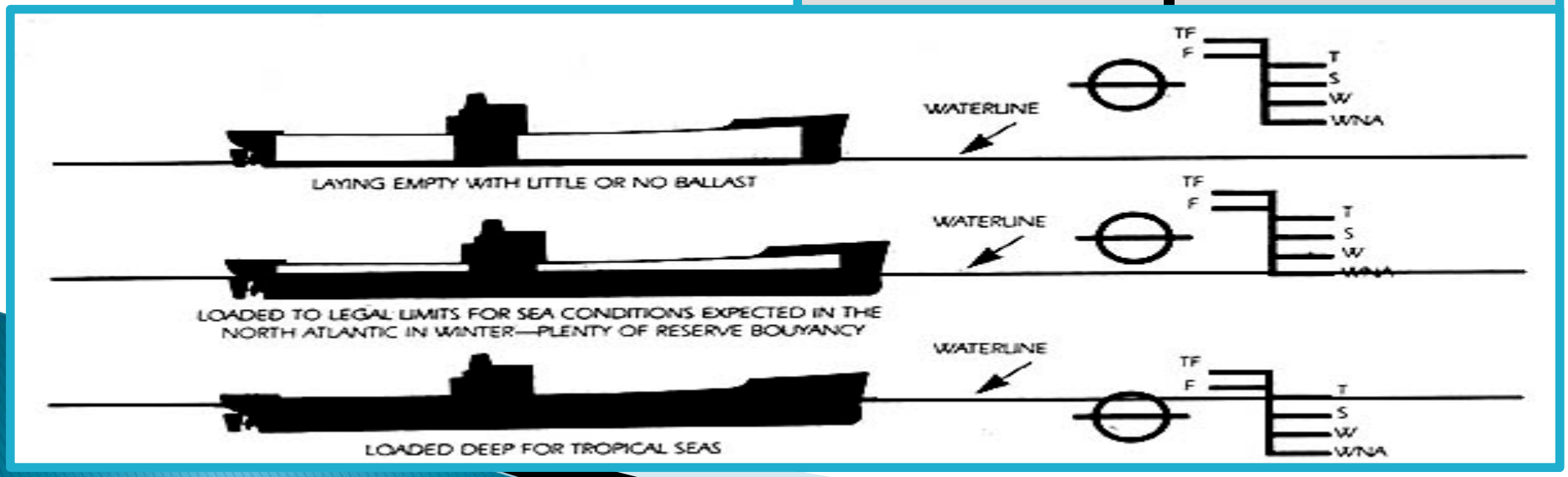
50N

Plimsoll Line

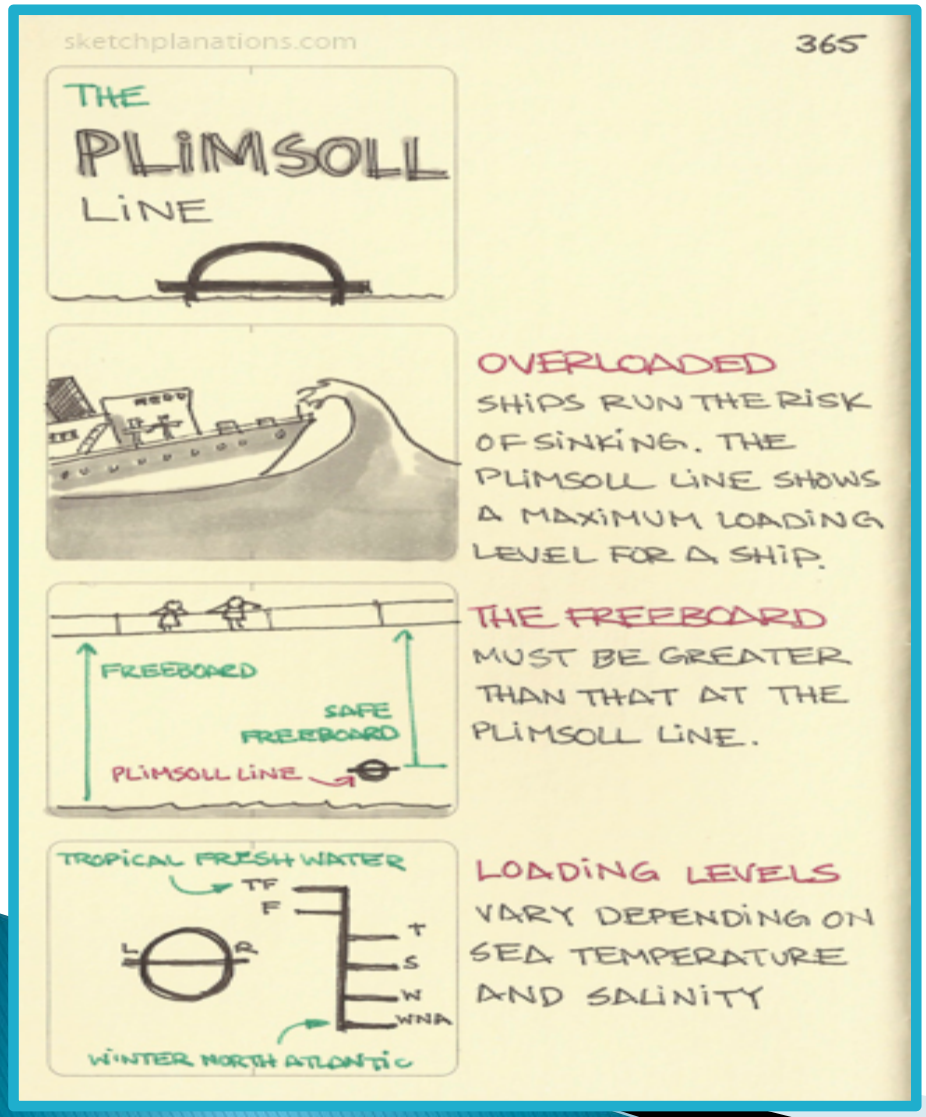
- Anyone know what this is…?

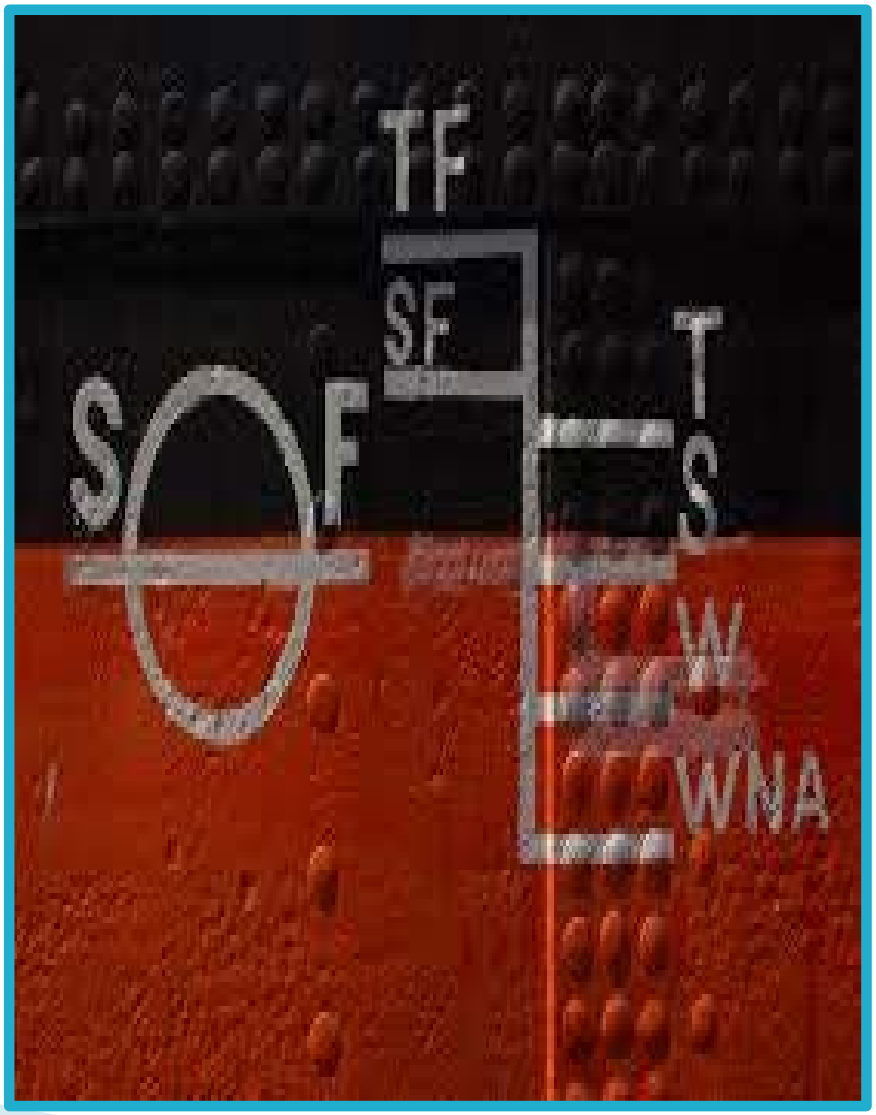
- How heavily a ship can be safely loaded in different water conditions



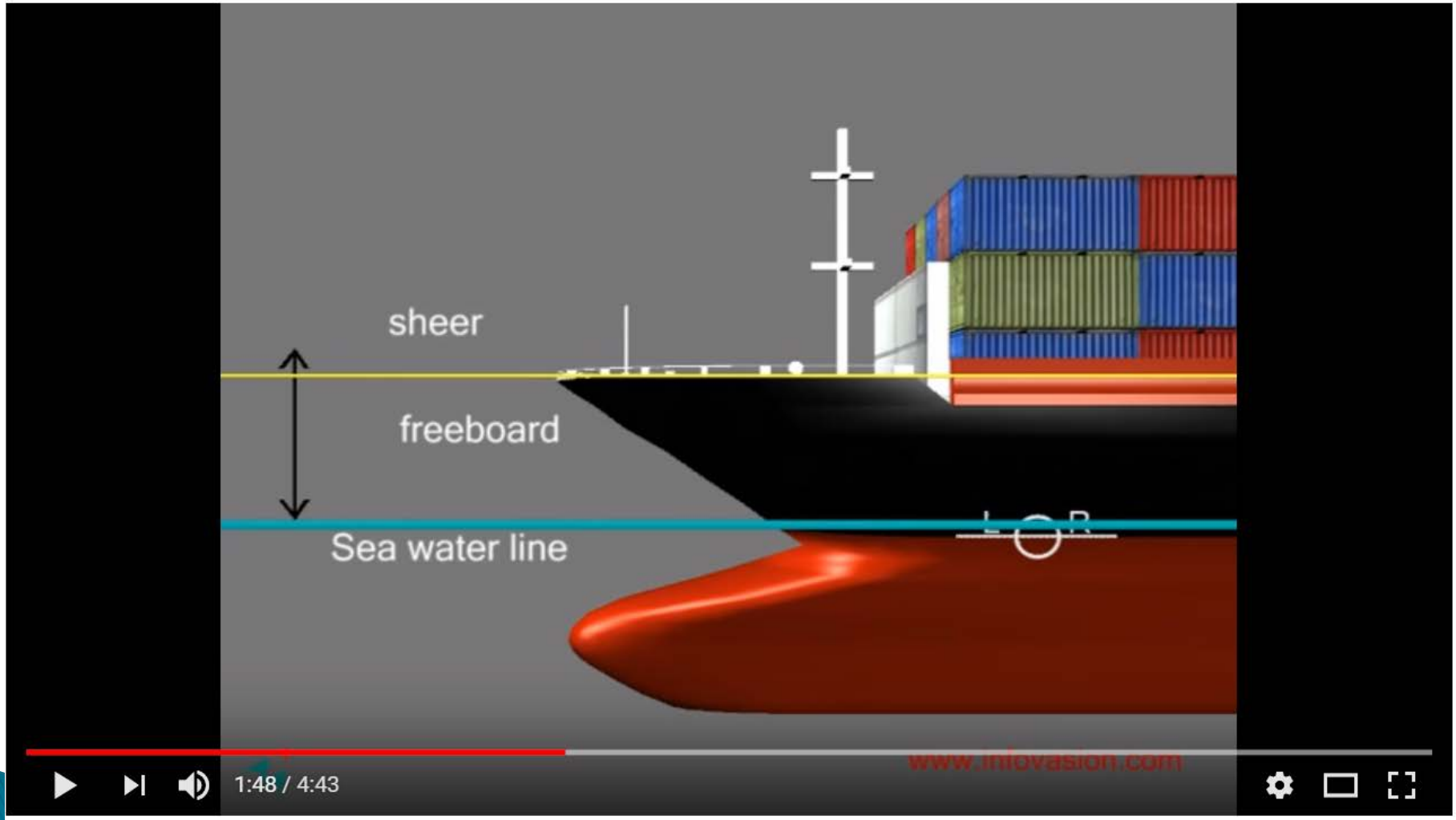


Plimsoll Line Cont…





Plimsoll Lines Save Lives



Compressibility

- Extent to which an object can be compressed

Compressibility ... In Action

Plastic Bottle Demonstration

- Liquids vs. Gases
- Which is more easily compressed?

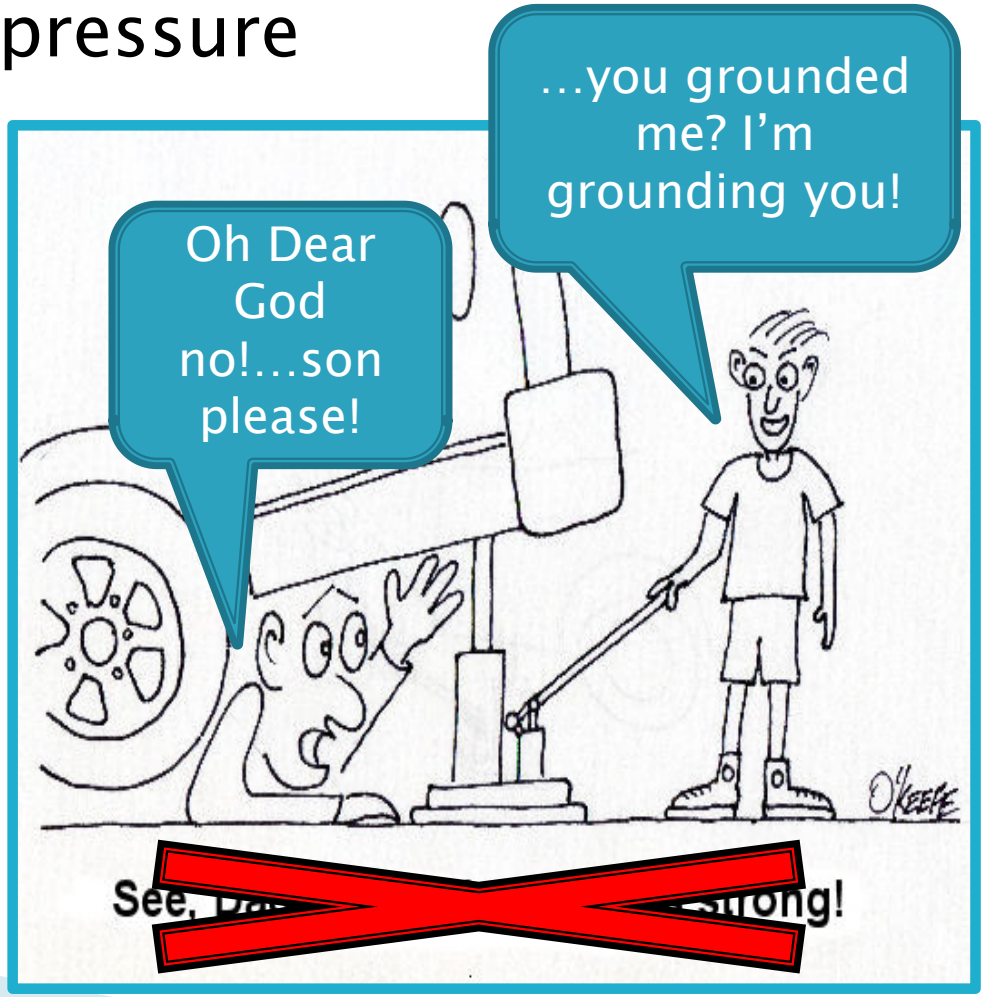
Bottle Blow-Up Demo

Does anyone have a plastic water bottle?

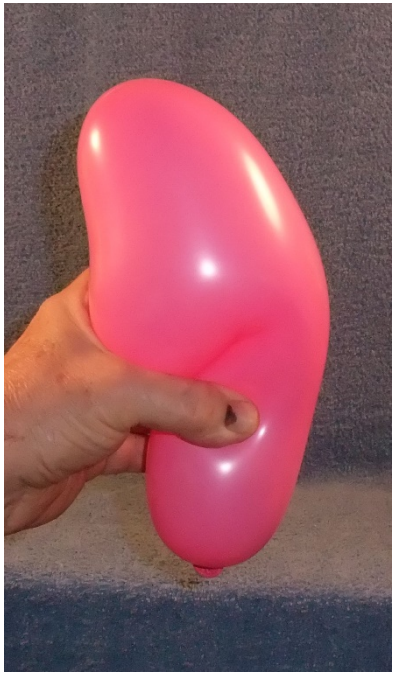
Liquids & Gasses

- More compression in gasses than liquids
- Compression builds pressure

- Materials in a liquid state are said to be incompressible



Why does poking a needle into a balloon pop it easily whereas squeezing a balloon does not?



Why is lying on a bed of nails safe, whereas standing on the same bed of nails proves to be deadly?

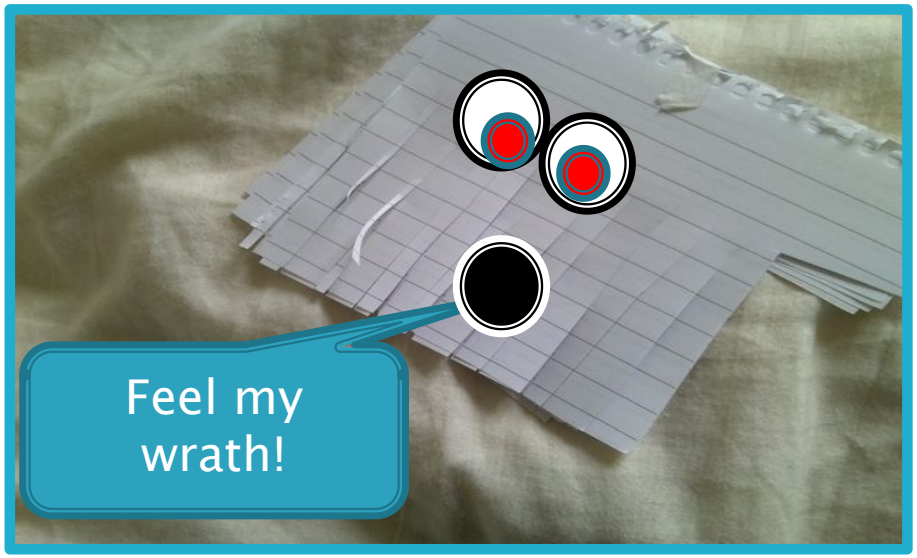
Enter Pressure!

Pressure in Fluids

- What is pressure?
  - Amount of force applied to a given area
- Measured in Pascals (Pa)
- 1Pa = 1N (Newton) for force over an area of $1m^2$

Pascal's Law

- A Pascal is very small
  - (Like the force of paper on your desk)



- Typically measured in kPa
  - 1kPa = 1000Pa

- Can also be N/m^2

Back to the balloon and spike bed example.

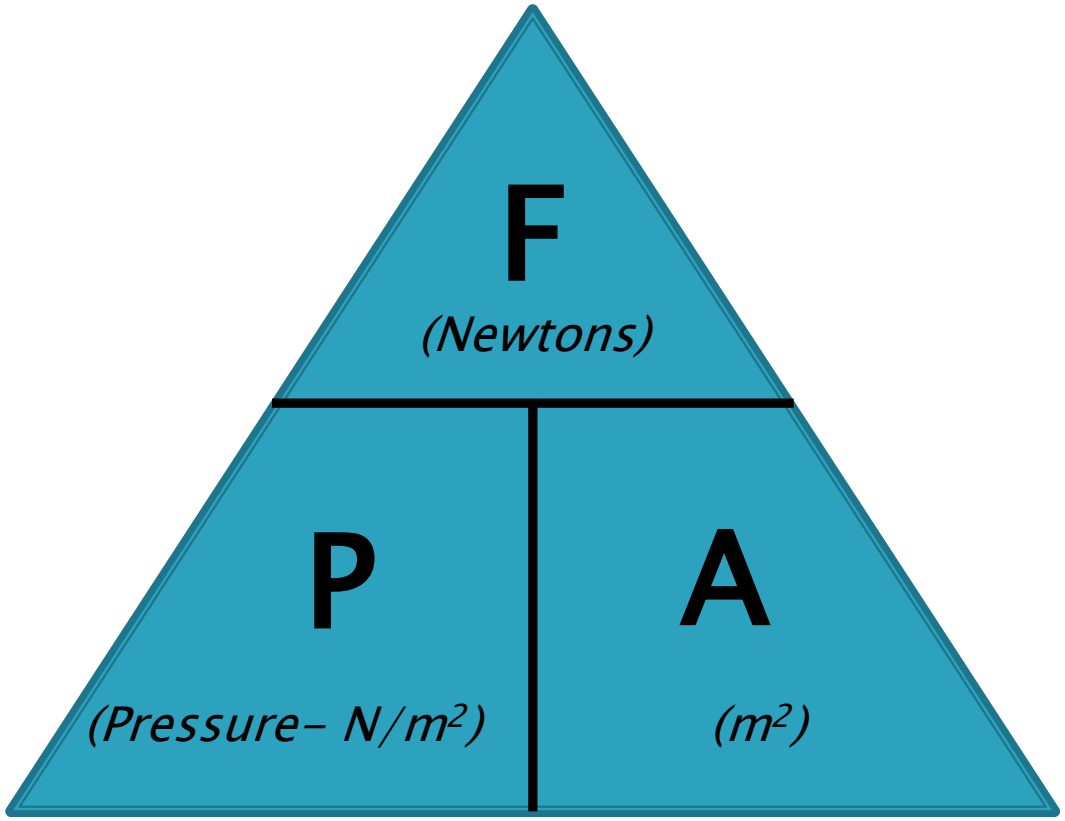
- When you push over a **small area**, the **pressure is Huge**. (ex. Needle head has a tiny area so pressure will be massive)….balloons pop easily.
- Push just as hard (Force) over a and suddenly the pressure drops. (Ex. Squeezing a balloon with your large palms)…Balloon does not pop.
- When you lie above a bed of nails, you are spreading your force over a really **large area** (low pressure)…. The Nails do not pierce your body.
- If you stood up on the bed of nails, your force would be spread over a **small area** (the size of your foot)…**MASSIVE PRESSURE**….Nails penetrate your foot. Gross!

Compare the Pressures created when the same person wears both of these types of shoes.

Use Science To Explain Why Wearing Snowshoes keeps you on top of the delicate snow instead of falling through it!

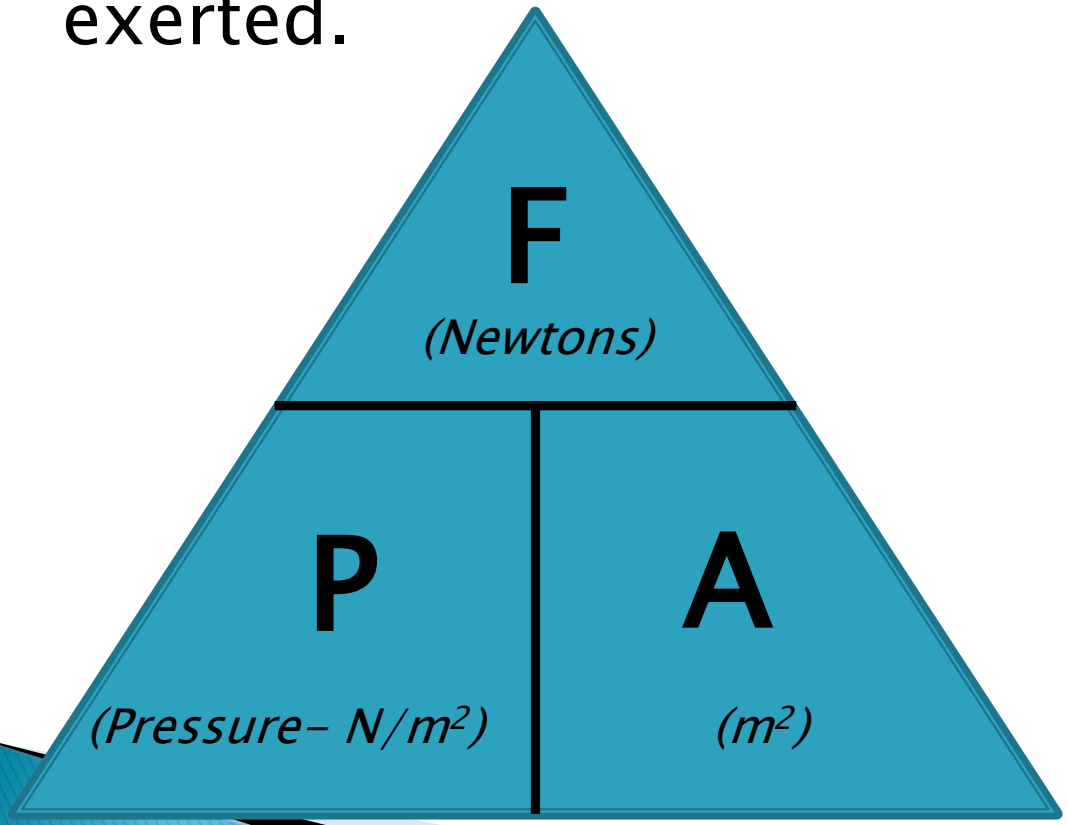
Use Science To Explain how you can Increase the Pressure of this Water!

Welcome To More Math!



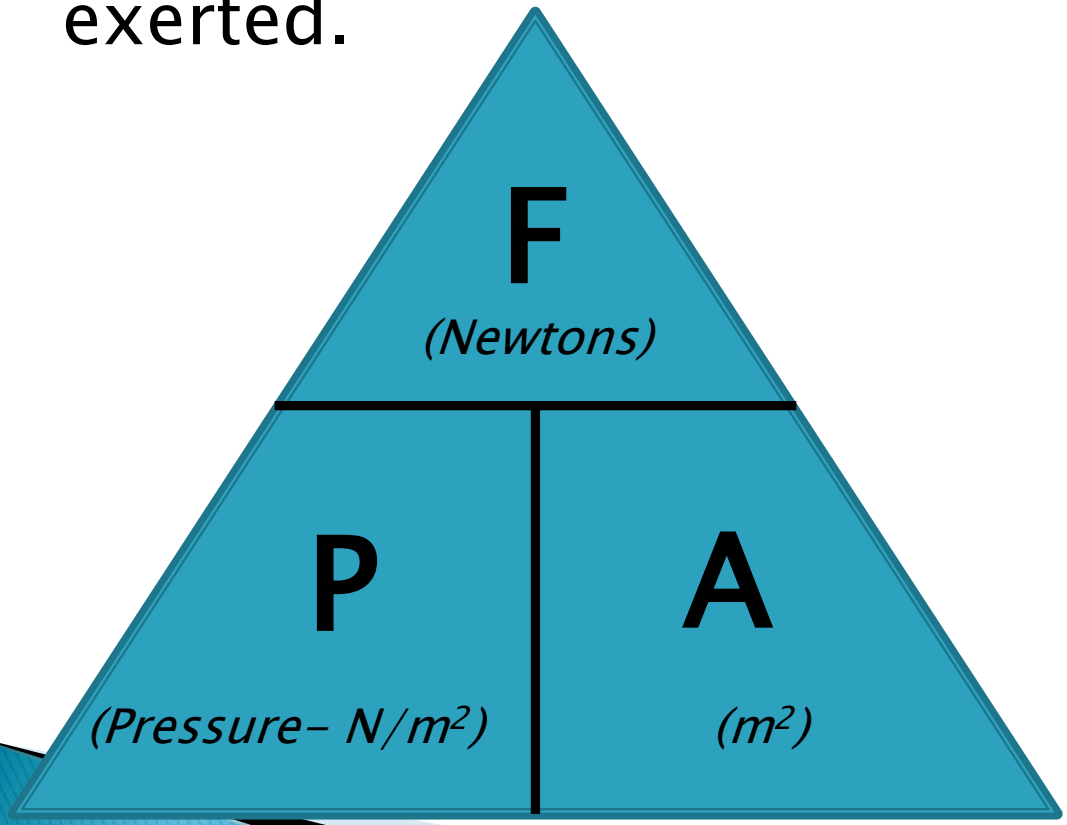
Calculate Pressure

- Mary applied a force of 50N over a $2m^2$ surface. Calculate the pressure that she exerted.



Calculate Pressure

- Mary applied a force of 50N over a 0.2m^2 surface. Calculate the pressure that she exerted.



Pressure & Depth

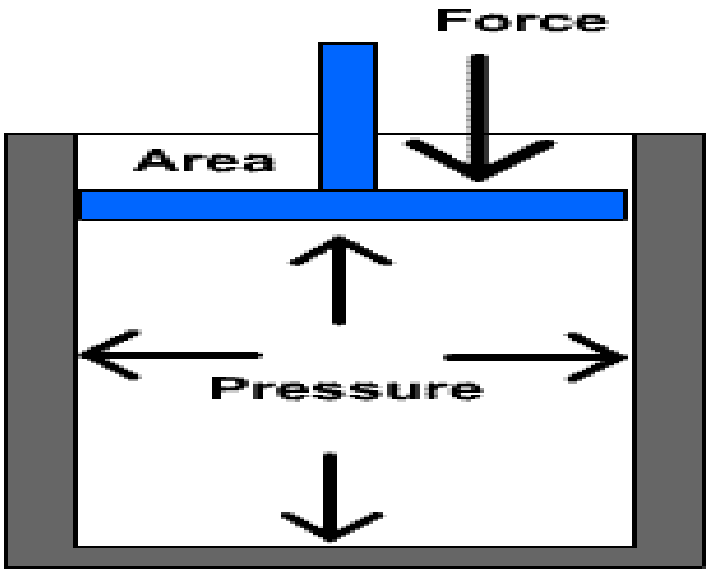
- If you have a can of water with holes at different depths … what happens?
- Do the holes push water out differently?
- If so, why?

Pascal's Law

- Wondered what would happen if force was applied to liquid in an enclosed space

- Discovered …
  The force is transmitted equally in all directions in the fluid

- Why was this important?



Hydraulics & Pneumatics

- Hydraulic System – ***liquid*** in enclosed space
- Pneumatic System – ***air*** in an enclosed space

- The car lift … How A Car Lift Works

Liquid!

Air!

More Practice

- Kirby & Carson (*Thunder Buddies 4 Life!*) are walking through a desert when they discover something shining in the distance. They sprint over to the object to discover they have just found a bottle of some sort of liquid. Being nerdy, Kirby always carries his hand held scale with him and discovers it weighs 9.32g and reads on the label that without the water the bottle should weigh 2.0g. While this is happening, Peyton calculates the bottle is 750mL. Randomly, a wizard appears and steals the bottle. "You can only drink this water if you can calculate the density of the liquid inside it!" They need the water to live … can you save them by calculating the density of the water?