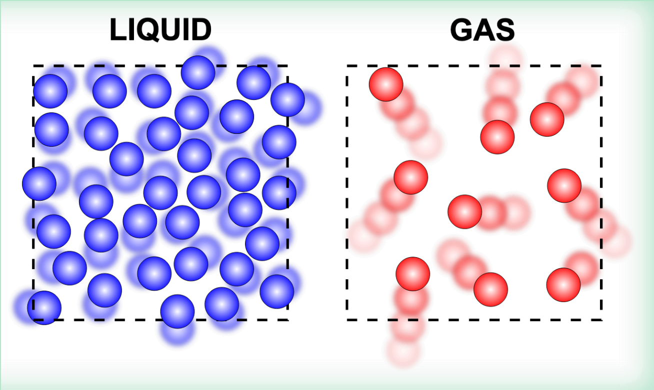
K. Pressure and Compressibility

When a force pushes on an object, the object is said to be under compression.

- Compressed objects tend to deform in shape
- Solid objects can be compressed if a great enough force is applied to it. (Ex. baseball)



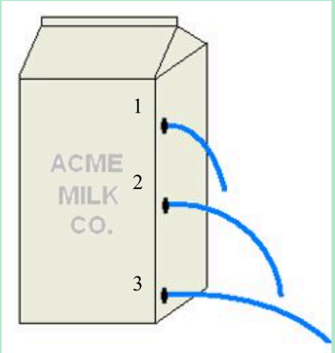
Gasses can be compressed more than liquids.

- This is because there is much more space between the particles in a gas than there is in a liquid

- Liquids are incompressible - they cannot be compressed easily.

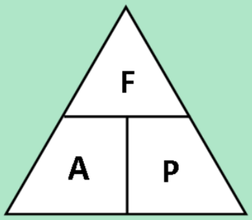
In the table below decide which would compress more:

Objects:	Which compresses more?
A helium balloon or water balloon	
A solid rubber bicycle tire or an inflated mountain bike tire	
A plastic bubble wrap or a liquid filled baby's teething ring	
A golf ball or a soccer ball	
In general, why did you choose the objects that you did to compress more? Use what you know about compressibility and spaces between particles in your explanation.	



Using the diagram on the right, explain why the water coming out of hole #3 is shooting out the farthest.

Just like with density, we can calculate pressure using the following formula:

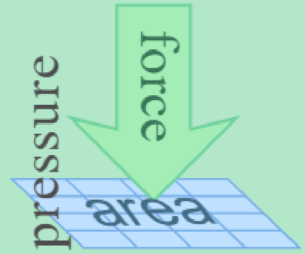


$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

$$\text{Area} = \frac{\text{Force}}{\text{Pressure}}$$

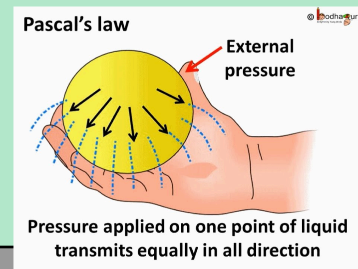
$$\text{Force} = \text{Area} \times \text{Pressure}$$

Force, F - Newtons (N)
Area, A - meters squared (m^2)
Pressure, P - pascals (Pa)



Note:

- If area is in cm^2, you need to convert to m^2 to make it pascals
- If you leave it as cm^2, then you have to put the answer in N/cm^2 and NOT PASCALS



Pascal's Law

States that an enclosed fluid transmits pressure equally in all directions.

	Pneumatic Systems	Hydraulic Systems
Definition & Comparisons		
Ex #1		
Ex #2		

Practice Questions

1) A snowmobile has a mass of 1000 kg. On the snow it applied a downward force of 9 800N. If the surface area of the track and both skis is 1.8 m^2, what pressure does it apply to the snow?
2) A dog applies a pressure of 900 Pa to the floor of a house. If it has 4 legs, and a surface area of 0.02 m^2 per foot, what is the overall force it has when standing?
3) What area does a bookcase have if it has a downward force of 10 000 N and creates a 6 000 kPa (6 000 000 Pa) pressure on the floor?
4) A hydraulic system has 1000N applied to an input piston that has an area of $3m^2$.
    a) What is the pressure exerted on the liquid by the input piston?
    b) If the force were doubled, what would be the pressure?
    c) If the area were reduced to $1.5m^2$, what would be the pressure?

Can Crusher Demo

Instructions:
1. Fill the bucket with ice water.
2. Fill the soda can with approximately 1 cm of water.
3. Place the pop can on the hot plate until the water boils. Be alert to not let the can boil dry!
4. Use the tongs to carefully remove the can from the heat. Quickly invert it and submerge the can opening in the bucket of ice water.

Results:
Explained what you saw:

ANALYSIS
Why did the can collapse?

By boiling the water, the water changes states — from a liquid to a gas. This gas is called water vapor. The water vapor pushes the air that was originally inside the can out into the atmosphere.

When the can is turned upside down and placed in the water, the mouth of the can forms an airtight seal against the surface of the water in the bowl.

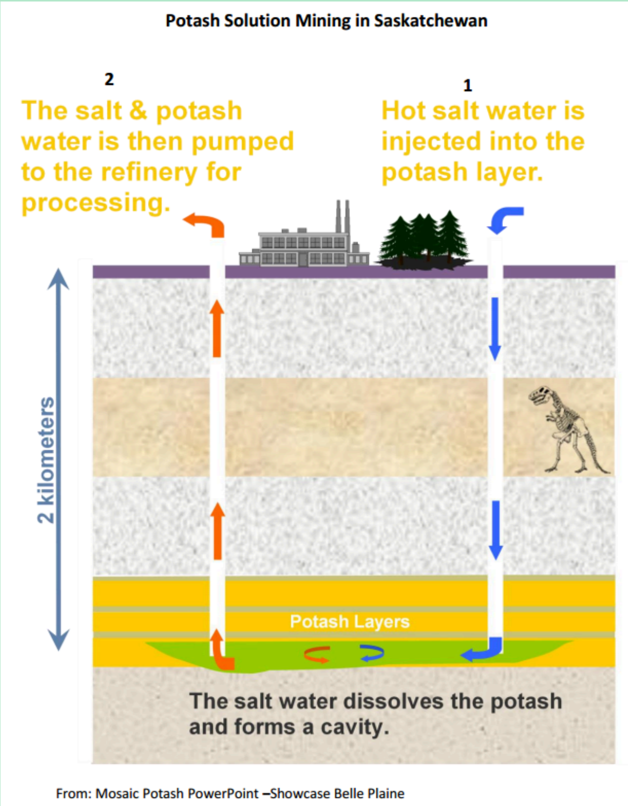
In just a split second, all of the water vapor that pushed the air out of the can and filled up the inside of the can turns into only a drop or two of liquid, which takes up much less space. This small amount of condensed water cannot exert much pressure on the inside walls of the can — and none of the outside air can get back into the can.

The result? The pressure of the air pushing from the outside of the can is great enough to crush it! Amazing, right?

L. Fluid Technologies and Applications

Potash Mining

- Technology based on the solubility of materials
- A potassium-rich salt used mainly as fertilizer to improve the quality and yield of agricultural production
- Potash can be harvested in many ways. Here is one way:
    1. Salt is added to the water and heated
    2. Hot salt water is injected into the potash layer
    3. Salt water dissolves the potash and forms a cavity
    4. The salt and potash water is then pumped to the refinery for processing
    5. Water is evaporated, which leaves the salt and potash behind



Pumps

- Devices that move fluids through or into something
- Some common pumps include: your heart, bike pump, gasoline pump, soap dispenser
- One of the first pumps invented was Archimedes Screw. Explain how it works here:

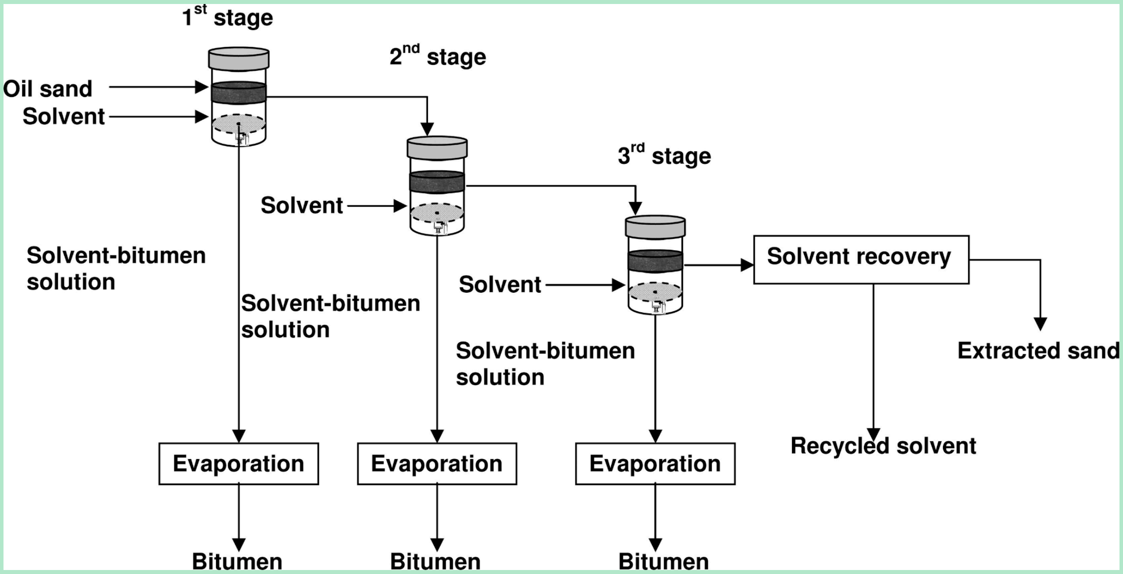
- How does a bike pump work?

Valves

- Devices that regulate the flow of a fluid
- Today's valves can control the flow, rate, volume, pressure and/or the direction of liquids, gasses, slurries or dry materials
- Some common valves include: water bottle lids, hydrants

Oil Sands

- Using the video, list the main steps in separating the bitumen from the sand



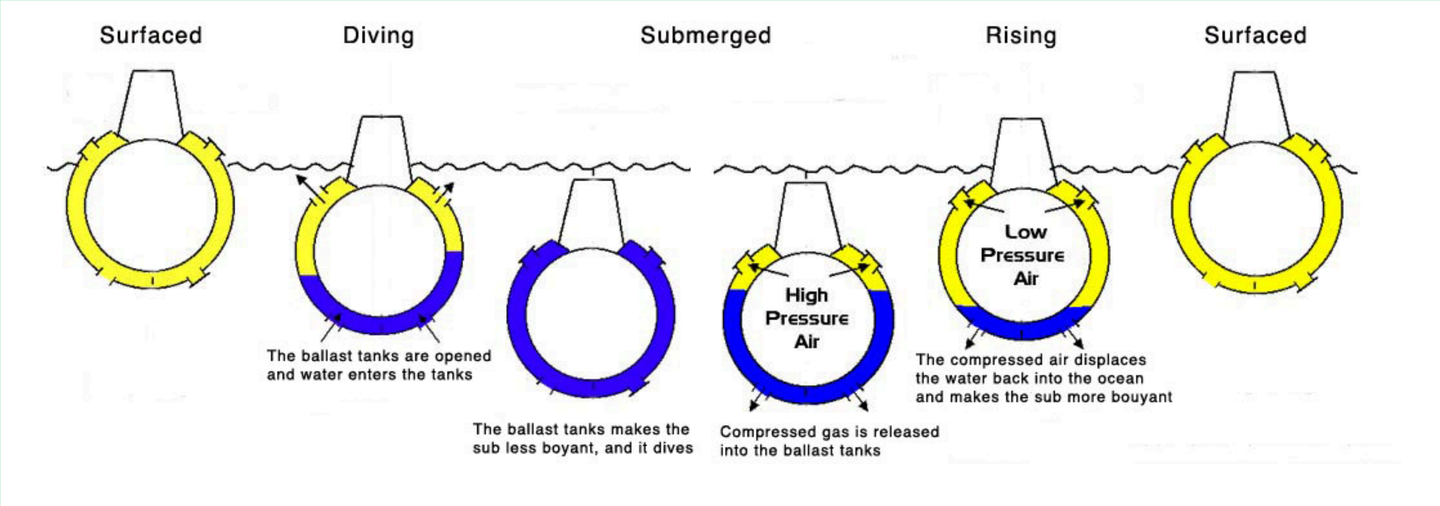
Submarines

- A vessel that can be submerged and navigated under water, usually built for warfare and armed with torpedoes or guided missiles

- **Submarine on Surface** = ballast tanks are full of air
  (The density of the submarine with all this air is less than the density of the water and so it floats)

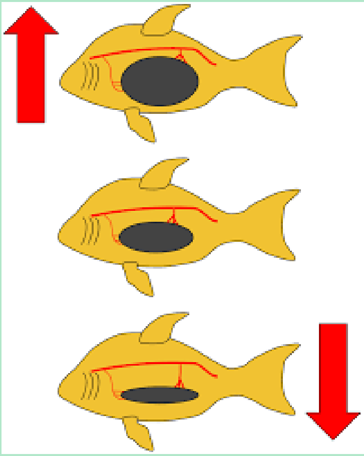
- **Submarine Diving** = Air is released from the top of the ballast tanks. Valves at the bottom of the ballast tanks open and allow water to enter.
  (The density of the submarine with the water becomes greater than the density of the water outside, and so the submarine begins to sink)

- **Submarine Re-surfacing** = Compressed air is forced into ballast tanks through top valves. This forces seawater out of bottom valves.
- (The density of the submarine with air in the tanks is less than the water outside, and so the submarine resurfaces)



Swim Bladder

- A gas filled sac found just under the backbone of most fish, which they use to change their BUOYANCY
  - Dissolved gasses in the fish's blood move into the sac to give it greater buoyancy (have fish rise to surface)
  - Fish empties the swim bladder if they want to dive deeper



Submarine Activity

Question: How can you make a working submarine that sinks to the bottom of the cylinder all by itself, sits there for a period of time, and then rises back to the top all by itself?

Materials:

- pill container with hole
- quarters
- alkaseltzer tablet (½)
- water
- beaker

Procedure:

SECTION 1:

1. Find out how many quarters are JUST needed to make a pill container with air sink to the bottom. Record this in the results section.
2. Remove the canister from the water, dry it off, and find the mass. Record this in the results section.
3. Take 2 quarters out (now your canister should just float). Find the mass. Record this in the results section.
4. Each pill container displaces about 50mL of water. Water has a density of 1 g/mL. Use the density formula to figure out the density of each of the containers in the Results section.

SECTION 2:

1. Take your pill bottle and put the number of pennies from step 3 in it.
2. Fill the rest of the bottle with water. Add one alka seltzer (pill bottle should now have pennies, water, and an alka seltzer) and then quickly close the lid. QUICKLY place the bottle upside down in the water.
3. Watch what happens!

Results:

Section 1 Results:

Container	Number of Quarters	Mass	Volume (of pill bottle)	Density
Floating Container			50 mL	
Sinking Container			50 mL	
Water		1 g	1 mL	1 g/mL

Section 2 Results:

What did you see? (use words or you could insert a video or photo)	

Analysis:

1. A canister that floats in water has a density (less than/greater than) that of water?

2. A canister that sinks in water has a density (less than/greater than) that of water?

3. If a pill container has a volume of 40mL and a mass of 8 grams, what is its density?

4. The density of silver is 10.5 g/mL. What is the mass of a piece of silver with a volume of 5 mL?

Conclusion:

1. Describe what causes your sub to sink then float in terms of buoyancy force and force of gravity?

2. Why did the gas from the tablet help the container rise to the surface?