



Chapter 6

Pressure in Fluids



Force is anything that causes a change in the motion of an object.
Example) A push or pull

Pressure is the force acting on a certain area of a surface.

When you lean against a wall you exert pressure on the wall.

Calculating Pressure

- The unit for pressure is the Pascal (Pa)
- You can determine pressure if you know the force and the area.

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

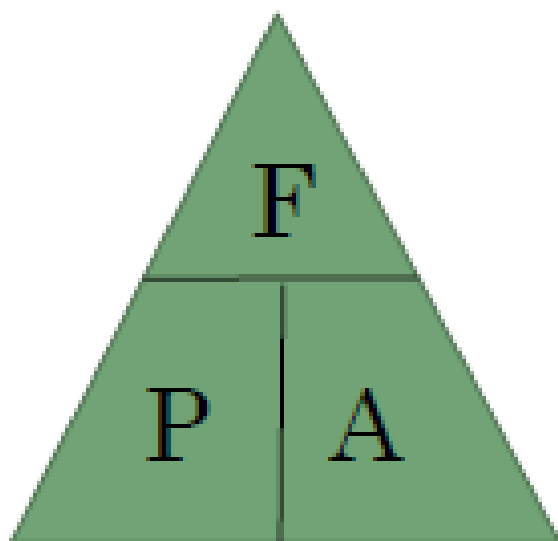
Force is measured in Newtons (N)

Area is measured in m^2 measure the base shape

so Pascal (Pa) is N/m^2

Formula:

$$\text{Pressure (P)} = \frac{\text{Force (F)}}{\text{Area (A)}}$$



SAMPLE PROBLEMS

1. An aquarium is filled with water that weighs 10 000 N. If the base of the aquarium has an area of 1.6 m², what pressure does the water exert on its base?

$$P = \frac{F}{A}$$

$$P =$$

2. If the atmospheric pressure is 101 200 Pa and you are holding your hand, the atmosphere is exerting a force on your hand. If the area of your palm is 0.006m², calculate the force on your hand.

$$=$$

3. The weight of water in a glass is 4.9 N. If the water is exerting a pressure of 1700 Pa on the bottom of the glass, what is the area of the bottom of the glass?

=

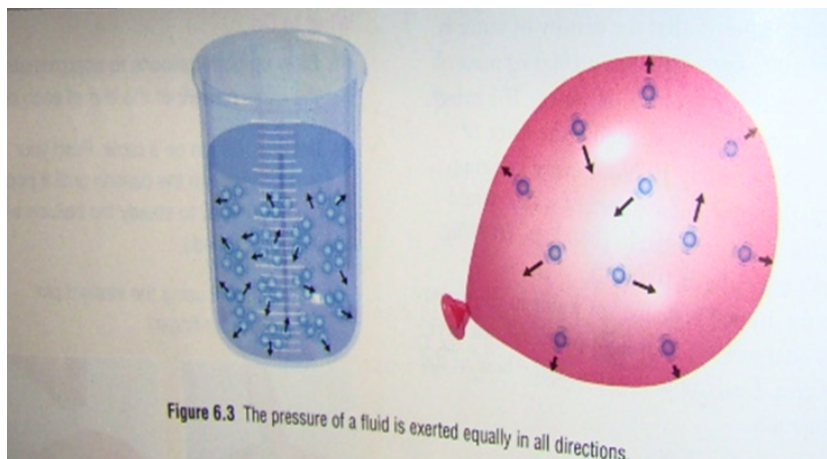
On the computer compared pressure, temperature and volume

<https://phet.colorado.edu/en/simulation/legacy/gas-properties>

Pressure and Particle Theory

Particles in solid, liquid and gas are constantly moving. When we increase energy(temp) then particles move faster and when we decrease energy (temp) then particles move slower. When they move the particles bump into each other spreading them out and leaving more space between them.

Moving particles exert force in the direction of their motion. Most of the forces cancel out each other, but some are not canceled. These forces are exerted against the wall of the container, causing pressure. Thus when there is a crack or hole on the container the fluid will flow out. This indicates that the pressure of a fluid is exerted equally in all directions, as shown below.



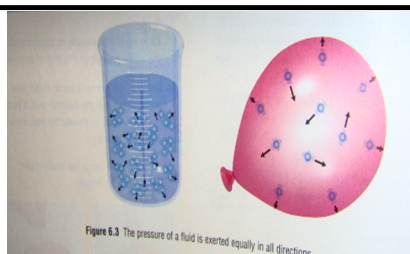
Spaces Between Particles

Space between particles depends on 2 factors:

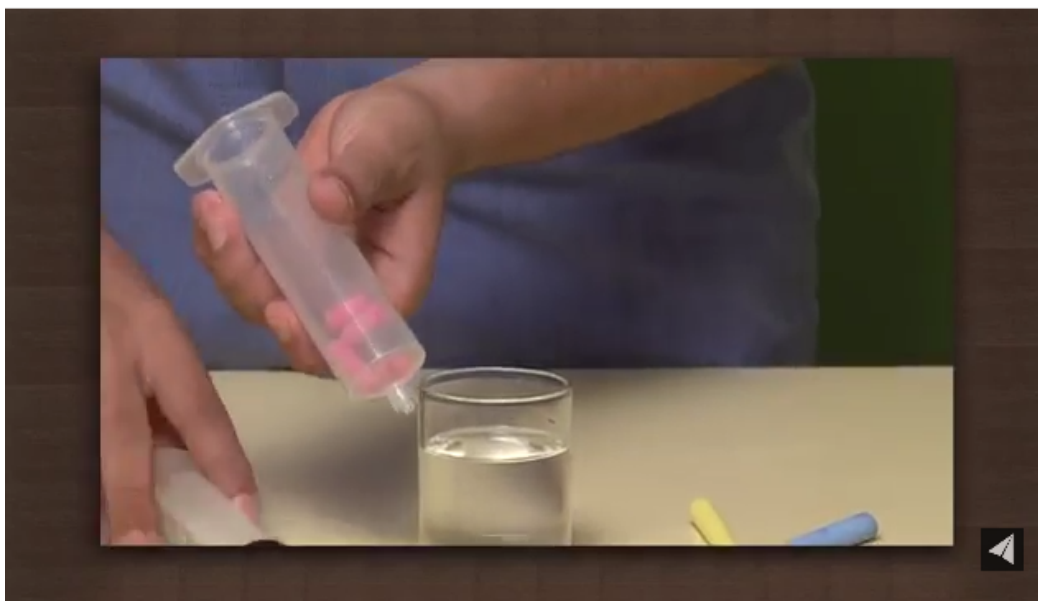
- 1) the physical state of the substance (solid, liquid, or gas)
- 2) the amount of energy that the particles have

Since gas particles are spread out they have lots of space between particles, thus gases are compressible.

Compressible - is the ability to be squeezed into a smaller volume



When force is applied to a solid or liquid the particles within cannot move closer so they transmitted (pass along) the force like the domino effect. They are **incompressible**.



Gases are easiest to compress, solids most difficult | Compressibility | Chemistry

When gases are under pressure (squeezed in a bottle), they are ready to expand when given the opportunity. So when a gas finds a way to escape, through a hole or nozzle, it exits with a great deal of force.

Great for oxygen tanks and certain tools such as air compressors

Flow Pressure - is pressure that causes motion because the fluid is moving

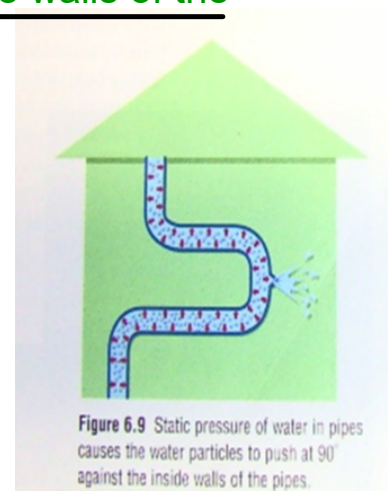
ex) wind is moving air that can lift your hair

ex) water pressure from tap can remove food off plates

Static Pressure - is a fluid's pressure that exerts a force on an object even if it is not moving. It pushes 90° to the walls of the pipe.

ex) When the water in your tap is turned off, the water in your pipes is exerting static pressure.

ex) when you swim deep underwater you can feel pressure on your eardrums. (the deeper you go the more pressure you feel since the weight of the water and air above you pushes down.)

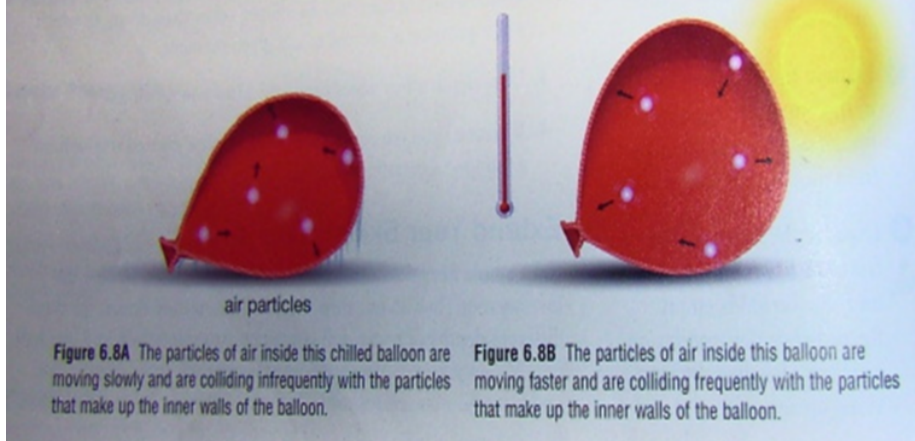


Pressure and Temperature

The particle theory suggests that particles move faster when they are heated because they gain more energy. Keeping the particle theory in mind, compare Figures 6.8A and B, representing the behaviour of air particles inside two balloons.

- In which balloons are the particles of air colliding with each other and with the inner walls of the balloon with greater force?
- Pressure is force measured over a certain area. In which balloon are the particles of air exerting greater pressure against the inner walls of the balloon?
- Does an increase in temperature cause an increase or a decrease in pressure?

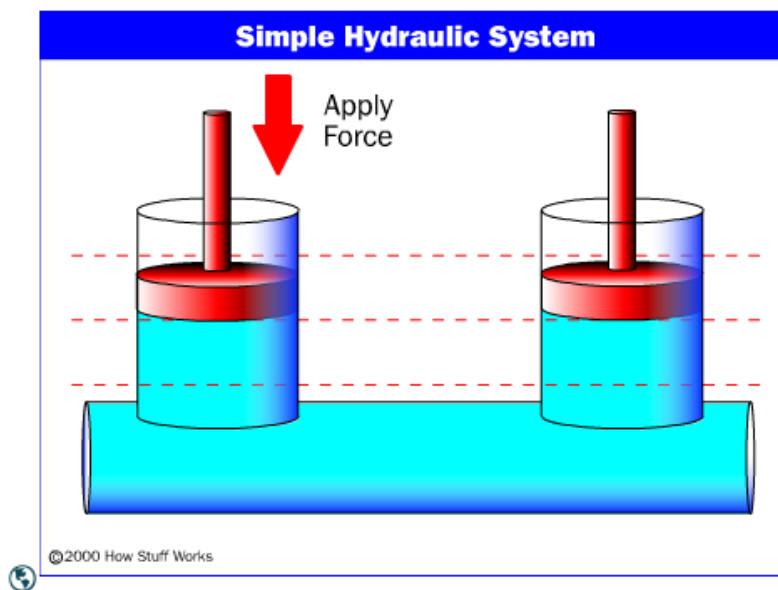
Increase heat causes an increase in pressure

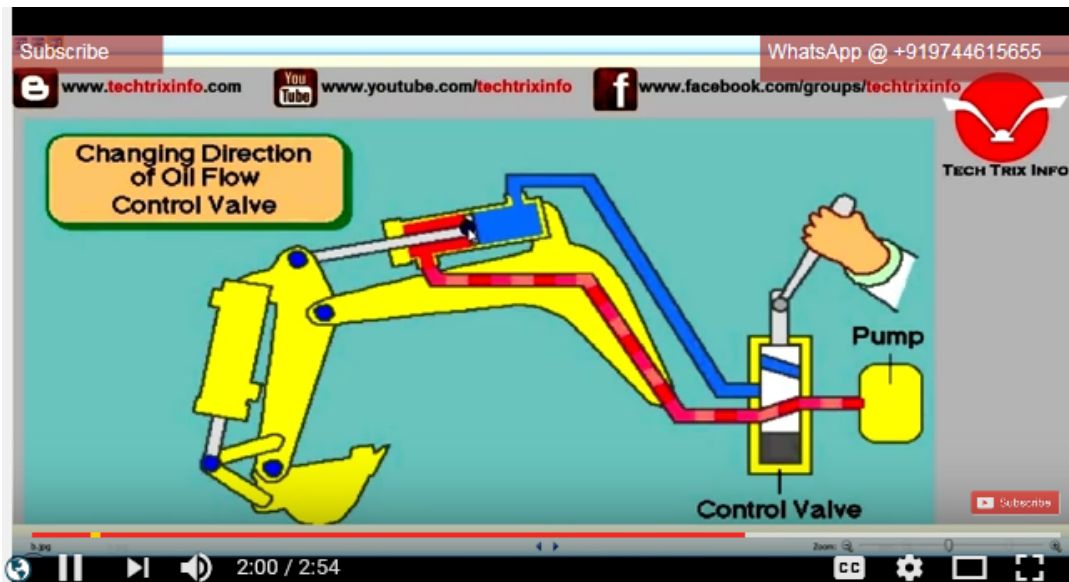


Pressure in fluids is important in hydraulic machinery

Hydraulics - is the study of pressure in liquids

Hydraulic Systems - are devices that transmit applied forces through a liquid to move something else.





In most hydraulic systems, a force is exerted on a continuous, enclosed liquid. This applied force created pressure that moves the liquid through a series of tubes, pipes or hoses, which causes motion at the other end of the system.

Liquids must be enclosed in a tube





The term "**Jaws of Life**" refers to several types of piston-rod hydraulic tools known as cutters, spreaders and rams, which are used to pry open vehicles involved in accidents when a victim may be trapped.



attachments for jaws of life

Rams



Cutters



Spreaders



Pipelines use fluid pressure and hydraulics to transport liquids such as oil, water and other liquids over large distances.

Pumps provide a force that pushes the fluid through the pipes.

Water that comes out of our faucet comes from the lakes, rivers or from underground in wells. Thus water MUST flow up to get to your home. In order for water to travel up, it must be places under pressure in order to give the water particles the energy to move against gravity. (No energy from a pump means water sits in the low parts of pipes) The pressure transmitted in the pipes must be large enough to transport the water over large distance but not too much to make the pipes burst.

Friction in pipes - caused by rough surfaces or bends in pipes- can affect the fluids pressure. Particles lose energy as they brush past each other in the pipe or bump into walls. Therefore pump stations are needed along long distance to renew energy.

Valves - are devices used to regulate the flow of a liquid in a hydraulic system.

Our Body

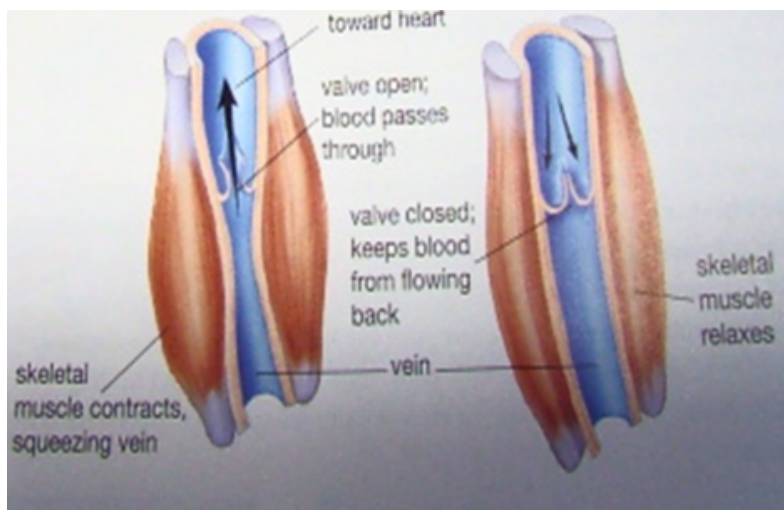
[The Heart, Part 1 - Under Pressure: Crash Course Anatomy & Physiology #25 - YouTube](#)

The heart in our body acts a pump.

- *Highest blood pressure occurs close to the heart
- *Lowest blood pressure in distant regions (hands and feet)

Arteries and capillaries act as the pipeline for blood

Valves in the veins keep the blood moving in one direction.



Air Pressure and Pneumatic

Pronounced
new-mat-tics

-Air is a fluid that exerts pressure on everything that it surrounds.


Pneumatic - is the study of pressure in gas.

The pressure of the Earth's atmosphere is so well balanced by our body, both inside and out, that we hardly ever notice air pressure.

-Air pressure changes with altitude (This is why your ears may pop in a plane or while driving up a mountain. Your ear drums are adjusting to air pressure)

As you increase in altitude, fewer air particles press against you on the outside of your body. BUT the air pressure inside your body does not change as quickly. Thus, the number of particles pressing from the inside out is still the same as when you were at ground level. Your eardrum is a thin membrane that can be moved by this pressure causing a pop sound.



 Imploding Can Crusher - TB#1



When you drink a juice box, the straw makes a tight seal that as you draw juice up the straw and reduce the air pressure inside, the juice box will buckle. The air pressure outside pushes the walls of the box together.

Thus if the air pressure inside a container is not balanced with the air pressure outside a container then it will cave in. (Unbalanced forces)

Barometer - is a devise that measures air pressure



The history of the barometer (and how it works) -
af Bar-Yosef



Pneumatic Systems

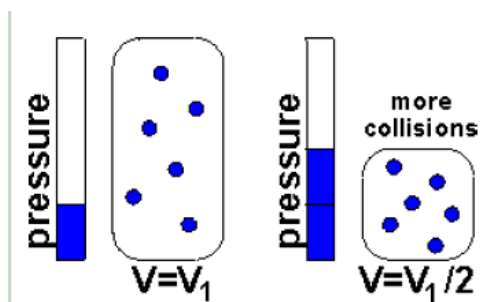
- A gas is used to exert a force on the gas in an enclosed space.
- Compressors - are devices that compress air. They are necessary as gases can be compressed. They build up air pressure. As it is released it decompresses the air pressure.



Air brakes on big trucks

Pressure and Volume

Increasing pressure of a fluid will decrease volume



Double pressure

Volume will decrease to half the size. (More collisions of particles)

Increasing volume of a fluid will decrease the pressure

TEMPERATURE & VOLUME

- Increasing temperature will increase the volume of a fluid.



TEMPERATURE & PRESSURE

- Increasing temperature of a fluid will increase the pressure.



Quiz on Ch 5 & 6

Science 8 Unit 2

Test Outline for Chapter 5 & 6 2023

Name: _____

Part A: Matching 12 Points

Know the definition of each of the following

Gravity	Pressure	Density	Force	Hydrometer	Hydraulics
Capacity	Mass	Buoyancy	Pneumatic	Weight	Volume

Part B: Short Response

Explain how buoyant force and gravitational force can cause an object to float or sink (May want to draw a picture to help explain)

EX) To Float \rightarrow $BF > GF$, To Sink \rightarrow $GF > BF$

Explain Archimedes principles (2 Parts) and know the story on how he reached this principle

Know what happens to the density of water as the temperature of water increases? (Use the particle theory to explain this)

Recall (The formulas will be given) $P = F \div A$ $F = P \times A$ $A = F \div P$

answer the following:

An aquarium is filled with water that weighs 24 000 N. If the base of the Aquarium has an area of 1.4 m², what pressure does the water exert on its base? (Show the math and you can use calculators)

The density of water is 1.00 g/ml. For each of the following indicate whether the substance would **float or sink** (In the first blank below) and if it is **more or less** dense (For each second blank)

1. A substance has a density of 1.23 g/ml would _____ in water. It is _____ dense than water.
2. A substance has a density of 0.53 g/ml would _____ in water. It is _____ dense than water.

If an item sinks in a liquid then what does that say about the items density?

Compressibility is the ability to squeeze into a smaller volume. Explain using the particle theory why gasses compress but solids do not.

How do big ships actually float (What characteristic do they have?)

What happens to pressure if you increase or decrease volume?

What happens to pressure if you increase or decrease temperature

Chapter 5 and 6 Test Outline 2022.docx