HYDRAULIC JACK

PASCAL'S LAW

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Pressure in Fluids – PASCAL'S LAW

Pressure

- **Pressure** is the amount of force applied to a given area.
  - Measured in pascals (Pa)
    - A pascal equals the force of 1 N (newton) over an area of 1 m^2

- The **MORE** force you can apply to an area, the **GREATER** the pressure

Pressure Formula

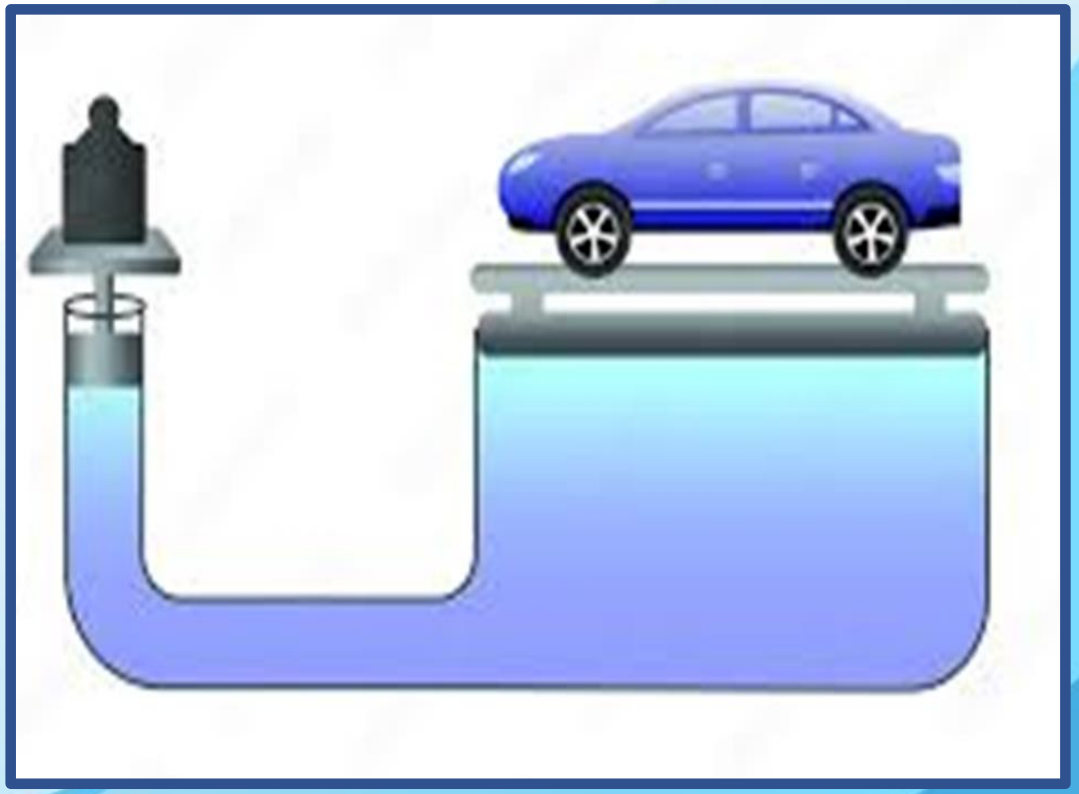
The formula for calculating pressure is:

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

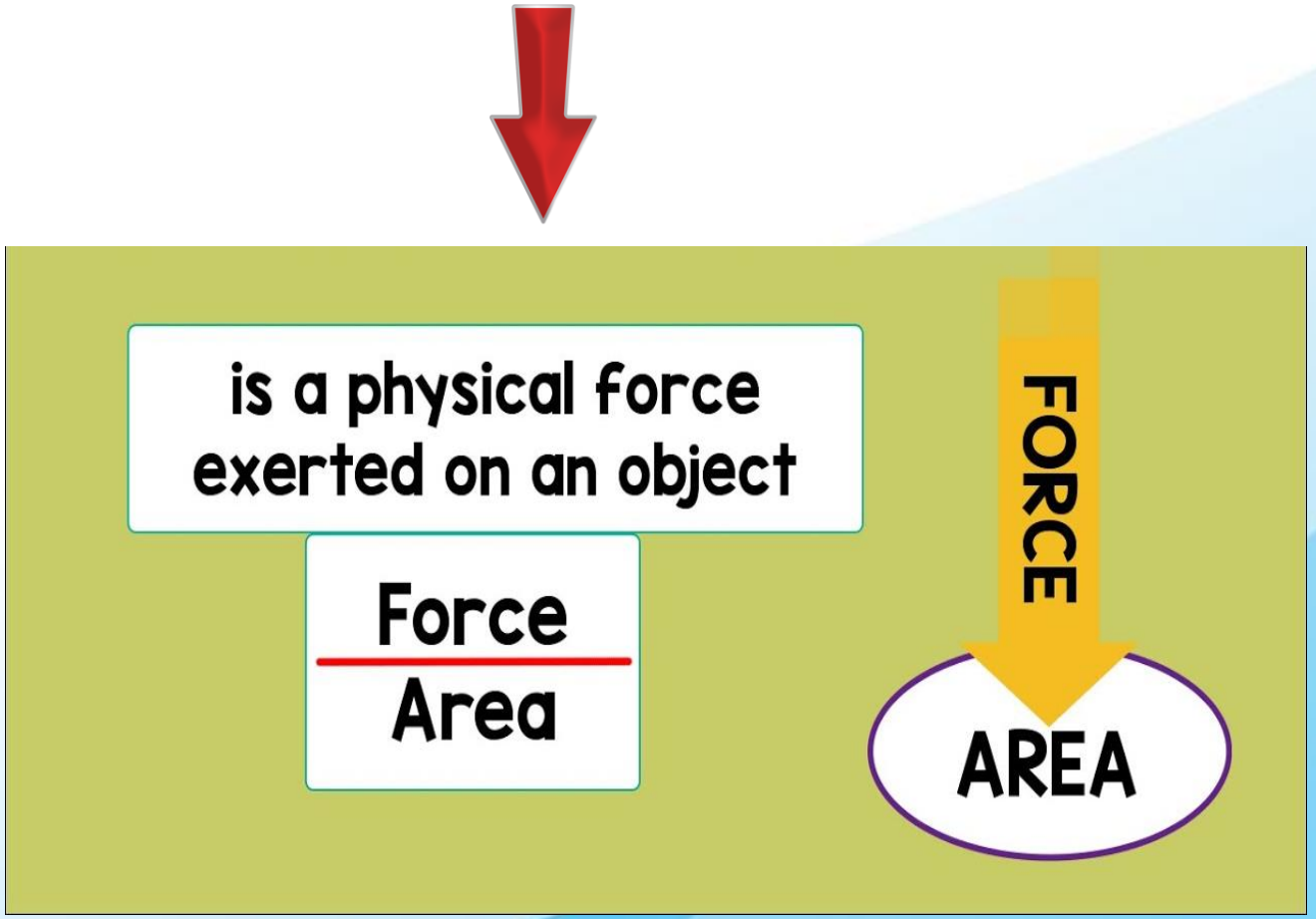
P = pressure (Pa)

F = force (N)

A = area (m^2)



Pressure Formula



Example

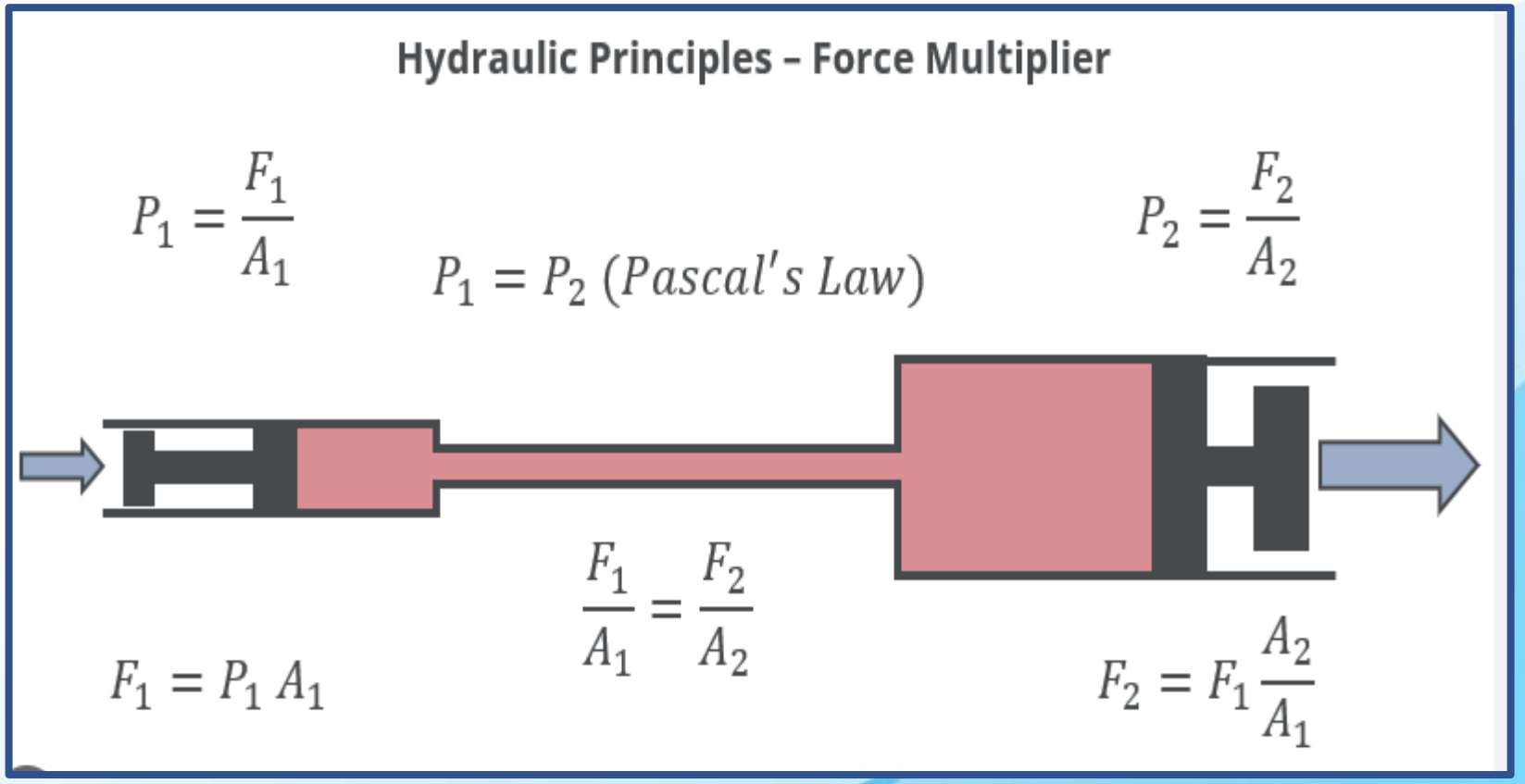
You have a force of 10 N on an area of 2 m^2. What would the pressure be?

Area = 2 m^2
Force = 10 N
Pressure = ?

$$P = \frac{10\ N}{2\ m^2}$$

P = 5 N/m^2 @ Pa

Pressure Formula – Hydraulic Principles



Tin can experiment

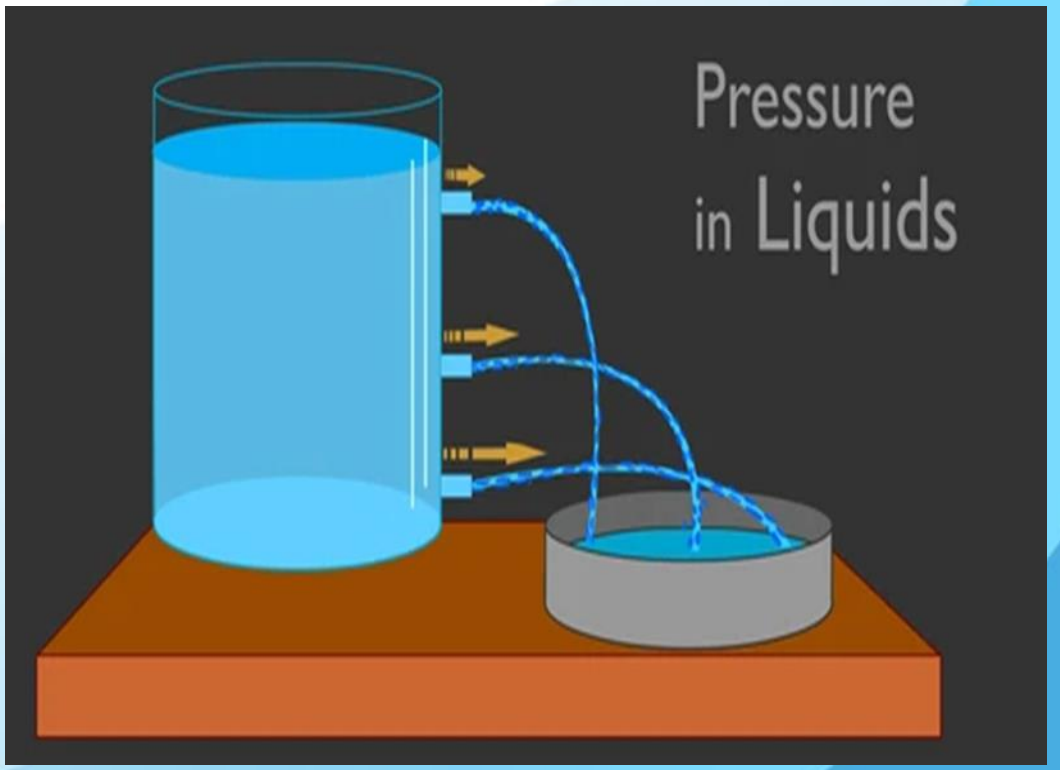
- The water is coming out almost in the exact same way. Why is this?

- The weight of the water in the upper part of the tin can is pressed down on the water in the lower part.
  - **The more water above the hole, the more pressure.**

Tin can experiment

- Water in a tin can is exerting pressure on all the walls of the tin can

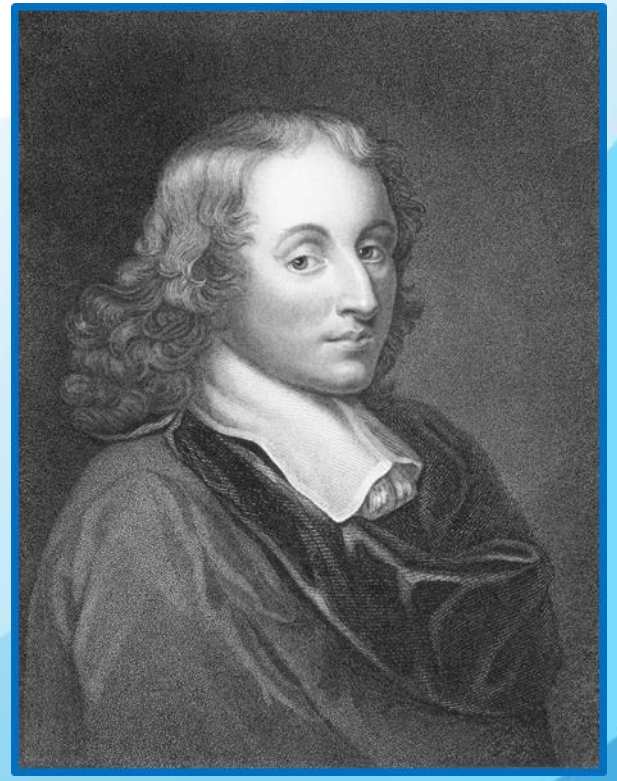
- If we were to punch THREE holes in this tin can, how would the water come out?



Pascal's Law

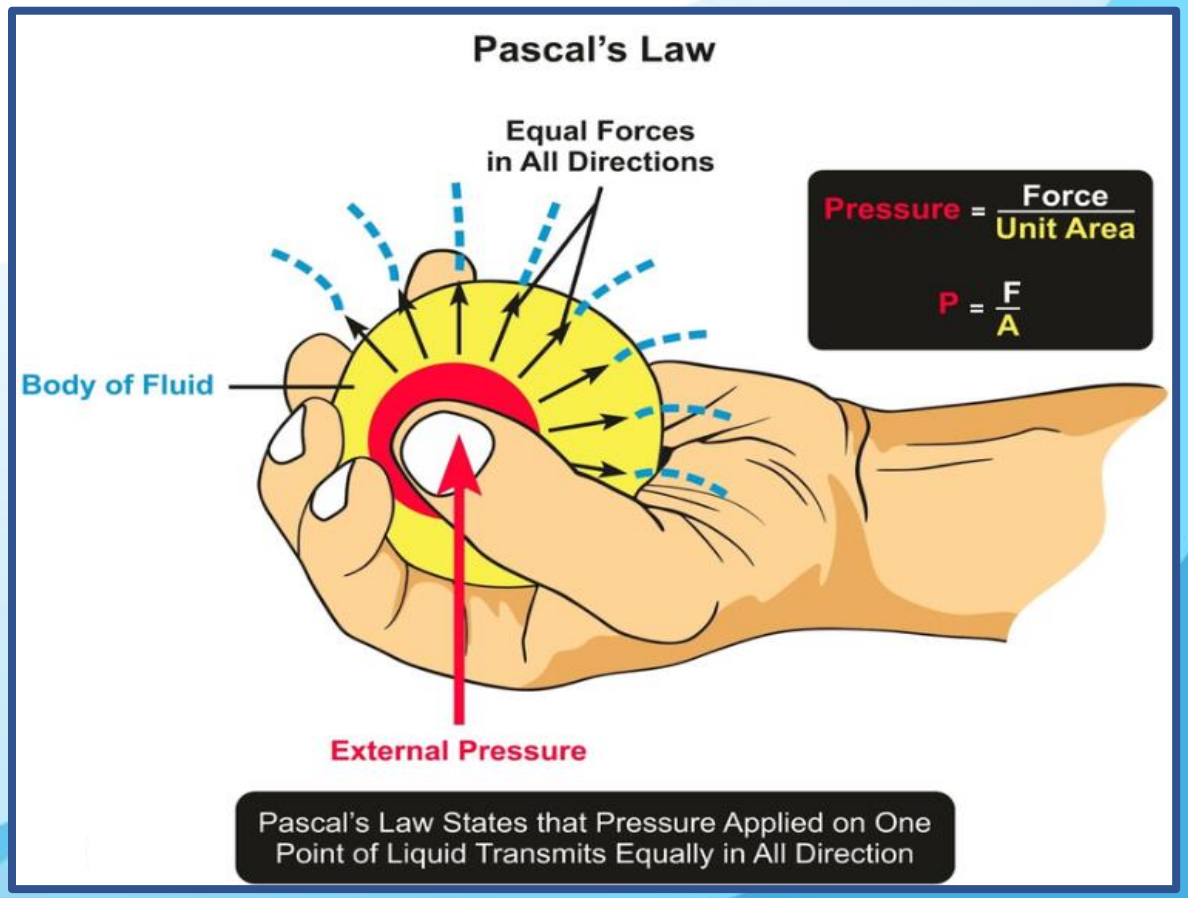
- Meet Pascal --------→
  - Handsome man eh?

- Pascal developed a law to explain how pressure is equal in all directions in fluids



Pascal's Law

- **Pascal's Law** states that an enclosed fluid transmits pressure EQUALLY in all directions.



Real Life Examples of Pascal's Law

Blood Flow

Blood flow in the circulatory system of humans and animals happens via Pascal's law, as blood is transported through vessels using a small force.

Hydraulic Brakes

Hydraulic brakes on cars and other vehicles stop the car by applying smaller force to a small piston, increasing braking force on a larger piston.

Hydraulic Presses

Hydraulic presses are used in manufacturing and shaping metals, plastics, and composite materials.

Pascal's Principle

Pressure Exerted Equally

Pressure exerted on a fluid in a closed system is transmitted equally in all directions.

Large Force with Small Force

A small force can be used to apply a larger force, as long as the area difference is sufficient.

Pressure Independent of Volume

The pressure in a confined fluid is independent of the volume of the fluid.

Pressure Magnitude Increases with Depth

The pressure magnitude increases with depth, due to weight of the fluid.

Applications in Hydraulic Systems

Vehicle Lifts

Vehicle lifts use Pascal's Law to lift cars using a small force.

Heavy Machinery

Hydraulic systems power heavy machinery like excavators and bulldozers.

Mobile Stairs at Airports

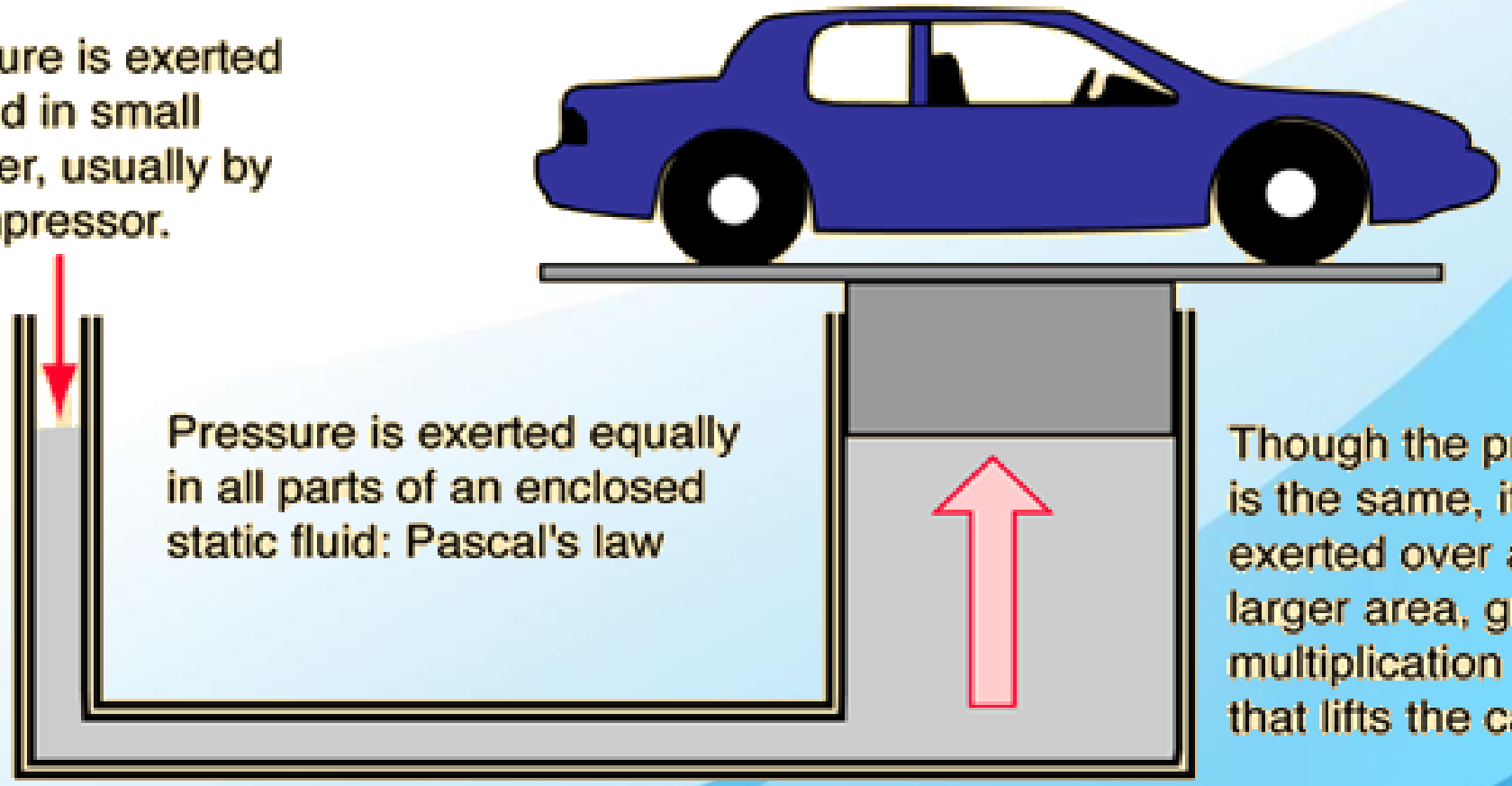
The mobile stairs at airports use hydraulics to move up and down.

Oil Rigs

Pascal's Law powers machinery on oil rigs through hydraulic pressure.

Applications in Hydraulic Systems – Vehicle lift

Pressure is exerted on fluid in small cylinder, usually by a compressor.

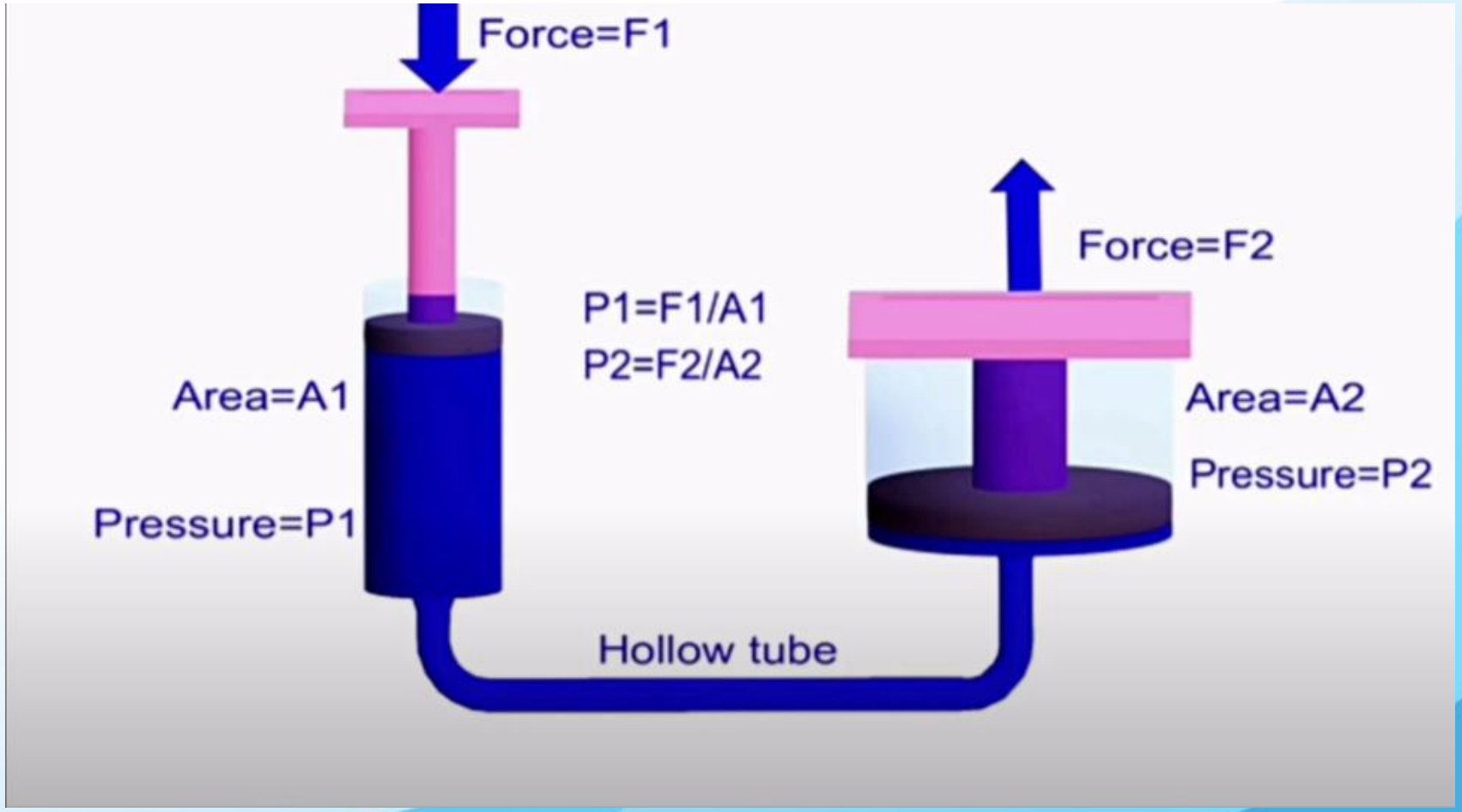


Pressure is exerted equally in all parts of an enclosed static fluid: Pascal's law

Though the pressure is the same, it is exerted over a much larger area, giving a multiplication of force that lifts the car.

The force in the small cylinder must be exerted over a much larger distance. A small force exerted over a large distance is traded for a large force over a small distance.

Pascal Law


Force=F1
P1=F1/A1
P2=F2/A2
Force=F2
Area=A1
Area=A2
Pressure=P1
Pressure=P2
Hollow tube

Advantages to Hydraulic Systems

- In the lift we just saw, the output force is 16 TIMES greater than the input force.
- A benefit of this type of system is it can **multiply force**.

Pneumatic Systems

- **Pneumatic systems** use air to do tasks.
  - Examples of this would be
    - Dentist drills, jack hammers, paint sprayers and air brakes on trucks

- These cost less and are more safe than hydraulic systems

Maintaining Pressure

- For a hydraulic and pneumatic system to function properly, the entire system must be **SEALED**
  - The smallest hole or leak causes the system to fail.

Importance of Pascal's Law in Engineering

1

Efficiency

Hydraulic systems can convert small forces into large ones, increasing efficiency in machinery.

2

Ease of Operation

Hydraulic systems require less physical effort from operators due to the use of small forces turning into large ones.

3

Adaptability

Pascal's law can be applied in a range of machines and industries, making it an adaptable engineering principle.


THANK YOU!