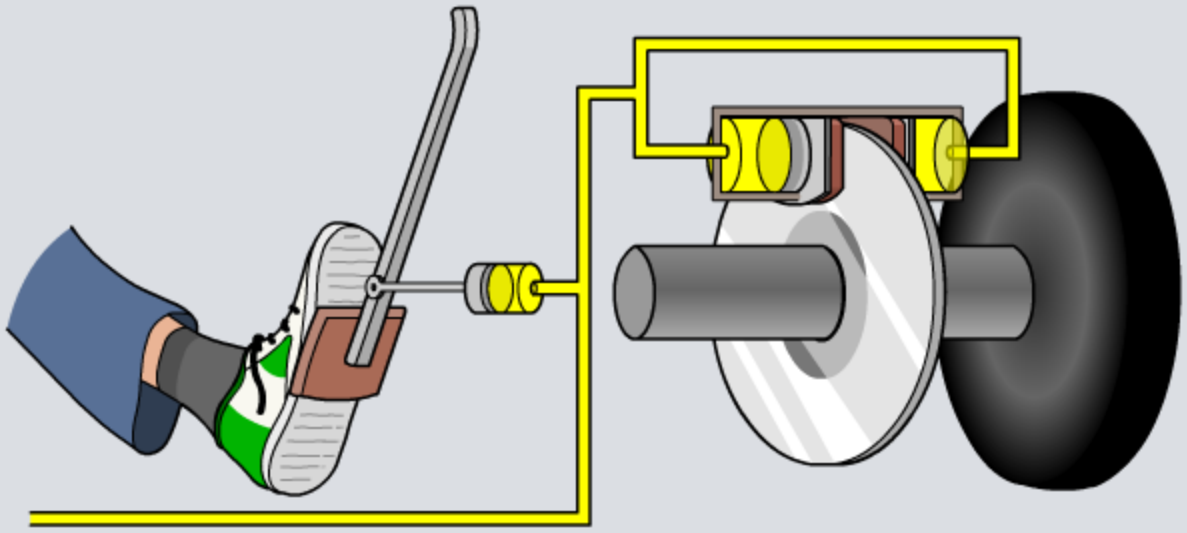
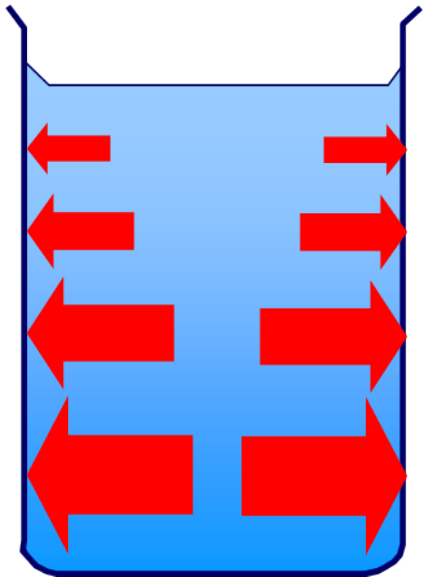
# Hydraulics



# Pressure in a liquid

Pressure in a liquid acts in all directions and increases with depth.

You can investigate this by using a needle to make holes at different heights in a plastic bottle, before filling it with water. The water escaping from the lower holes will travel further because it is at a higher pressure.



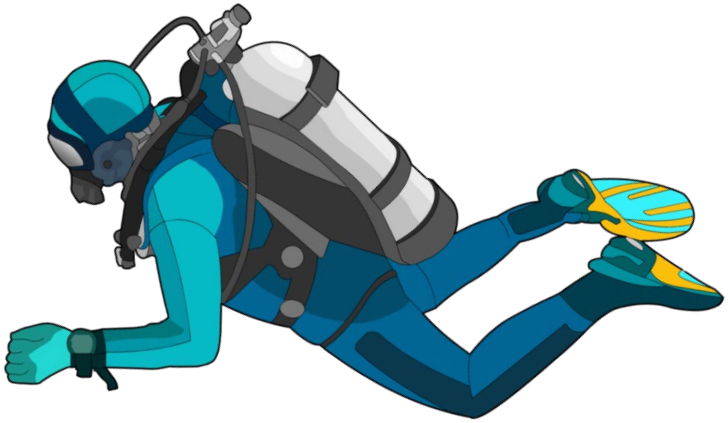
**low pressure**

**high pressure**

# Overcoming pressure underwater

When entering deep water, a diver will experience pressure from all sides.

At greater depths, this pressure becomes too much for the body to handle.



So how do we overcome this pressure?

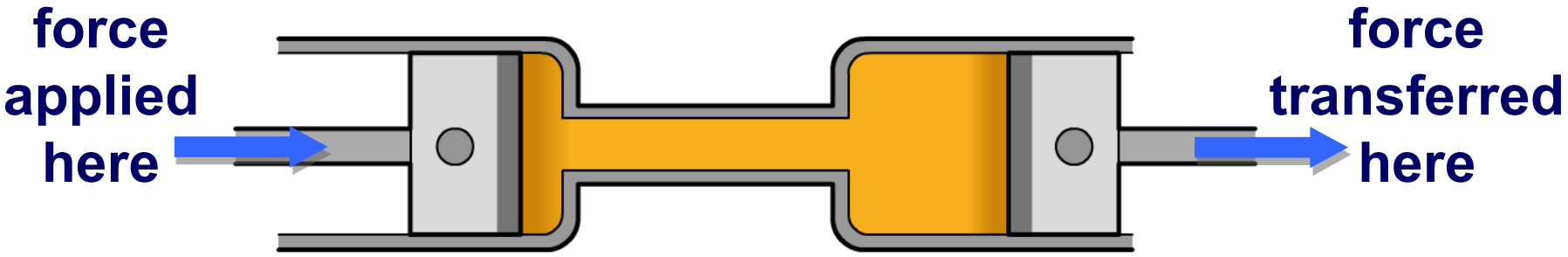

Submarines use extremely strong materials to withstand the huge forces. This means some can dive to the very deepest points of the ocean.

# Hydraulics

**Hydraulic systems** use the principle that pressure is transmitted throughout a liquid.

They are used to transfer movement from one part of a machine to another without linking the parts mechanically.

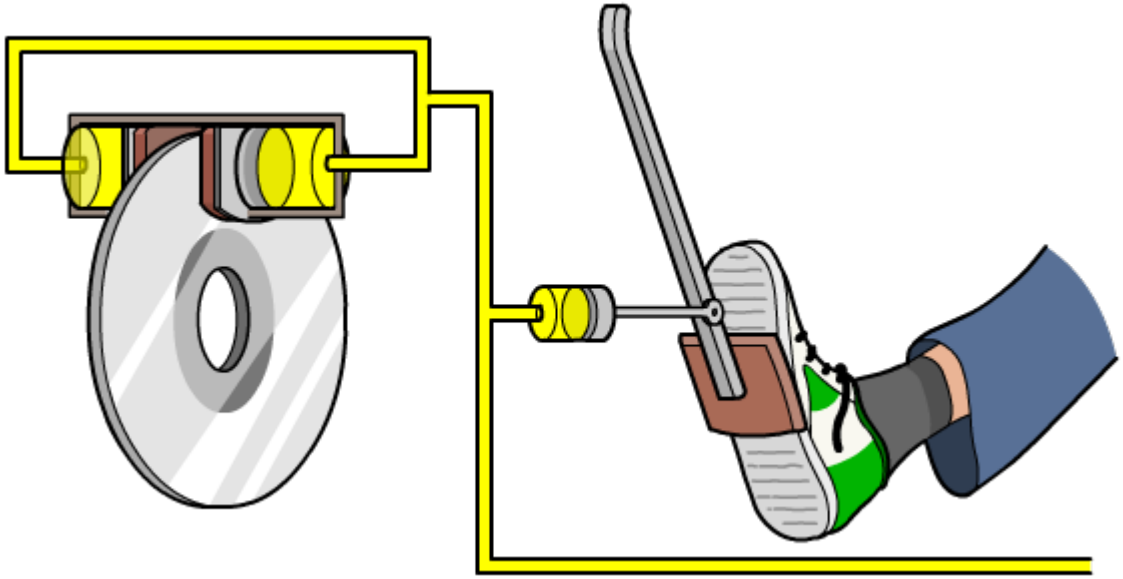
All hydraulic systems use two pistons linked via a pipe which carries special oil called hydraulic fluid.




**Pressure inside all parts of the hydraulic system is the same.**

# Hydraulic brakes

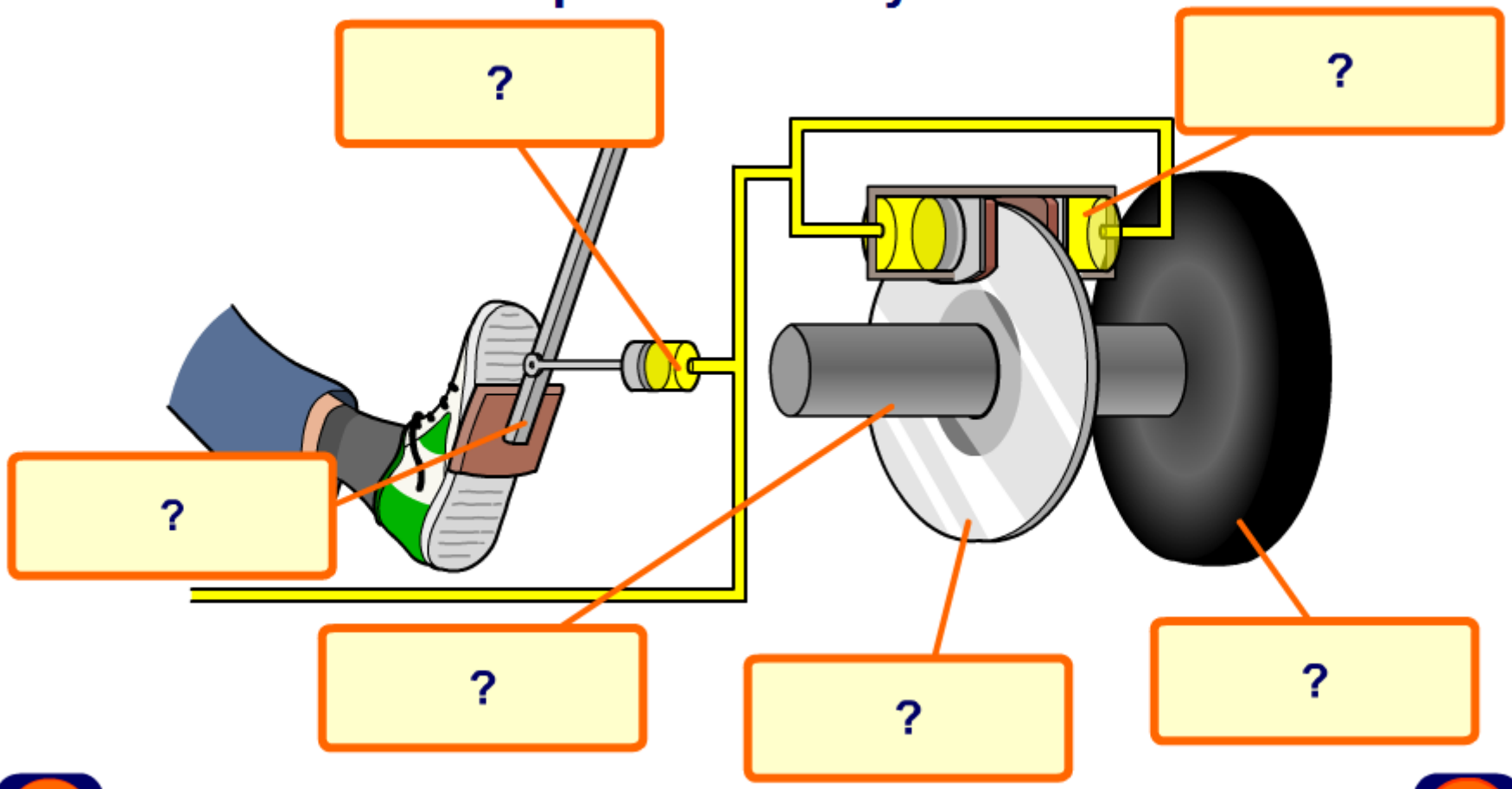
All hydraulic brake systems (like those used in cars) use a **small** master piston and **bigger** slave pistons.



The master piston is used to apply a force. This puts the liquid under pressure. The pressure is transmitted to the pistons on all four wheels of the car.

# Hydraulic car brake – labeling the parts

## What are the parts of an hydraulic brake?



# Hydraulic brake – pressure equations

The pressure exerted by the master piston on the hydraulic fluid can be calculated using this equation:

$$\text{pressure} = \frac{\text{force applied}}{\text{area of master piston}}$$

The pressure is transferred to the slave pistons, so the force exerted by the slave piston can be calculated using:

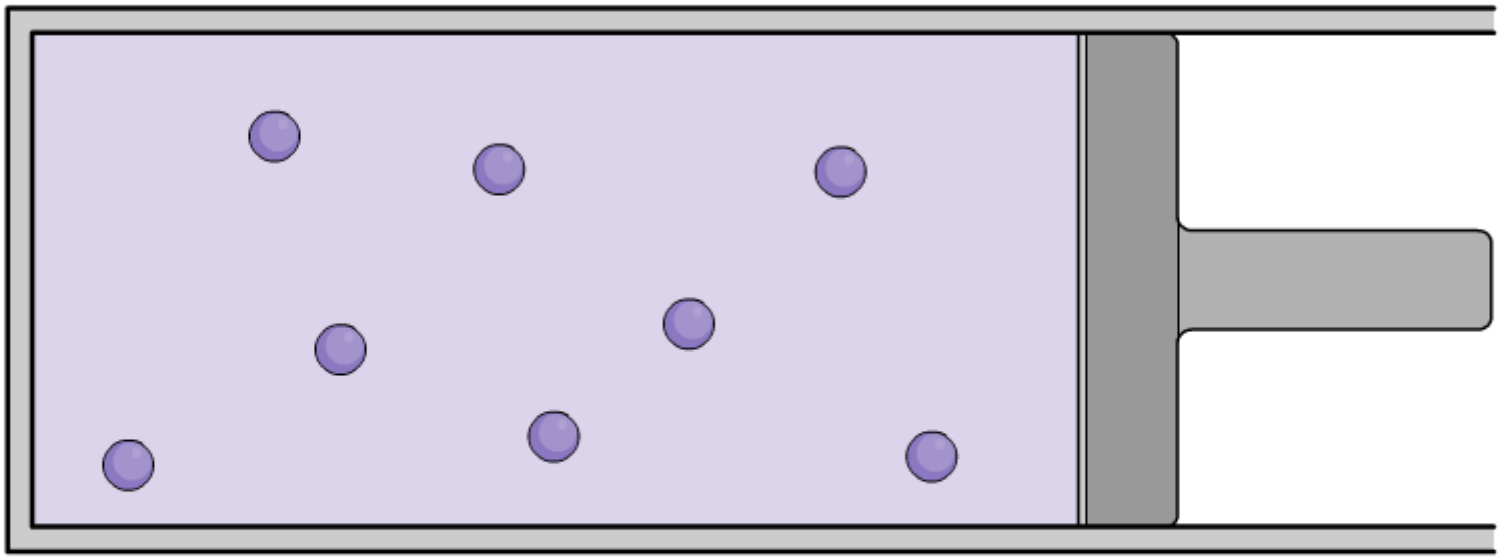
$$\text{pressure} = \frac{\text{force exerted}}{\text{area of slave piston}}$$

$$\text{force exerted} = \text{pressure} \times \text{area of slave piston}$$

The **slave piston** has a **larger area** than the **master piston**, so the force exerted by the slave pistons is **greater** than the force exerted by the driver on the brake pedal.

# What causes pressure in gases?

## What happens to the pressure of the gas in this piston as the volume changes?



| Pressure = | 0 kPA |
|---|---|

# Pressure: summary