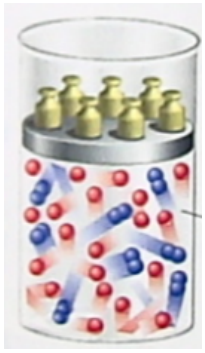
5.5 - Dalton's Law of Partial Pressure

If we had a 1 L glass jar containing x moles of air, that air would exert a certain pressure on the walls of the bulb.

If we had a 1 L glass jar containing y moles of water, that water would exert a different pressure on the walls of the bulb. Let's say that the pressure of the water is less than the pressure of the air in the situation above.

Now, if we were able to combine the two gases, how could we explain the pressure?



When there are multiple gases in one container, they all act as if they are alone in the container, each exerting their own pressure. This individual pressure is called the gas's **partial pressure**.

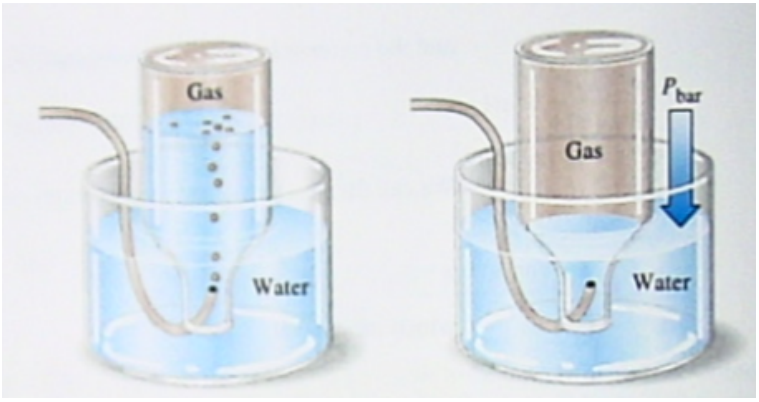
Therefore, we can use the thought process above to explain the pressure in a vessel containing many gases.

That is, the total pressure in a container is equal to the sum of each of the partial pressures of the individual gases in the mixture. This is known as **Dalton's law of partial pressure**.

$P_t = P_1 + P_2 + \ldots + P_n$

One situation where partial pressure is considered is when a pure gas is needed in a laboratory. The process of collecting a pure gas is called **collecting over water**.

This means you need a setup similar to that below.



The collecting container is full of water. It is then tipped upside down and the brim of the container is submerged in water.

A tube carrying the desired gas is placed inside the desired container.

When the gas enters the container, it rises to the 'top' in the form of a bubble and displaces the water out of the container.

The problem with this is that many gases are soluble in water. Therefore, the gas in the container will contain water vapor as well.

Therefore, to know the pressure of the desired gas, you must account for the pressure of the water vapor.

A table of water vapor pressure is needed to do questions involving collecting gas over water.

Ex) What is the pressure of hydrogen gas collected over water at 24.0° C? The total pressure is 94.4 kPa.

Ex) 10.0 g of nitrogen gas and 10.0 g of helium gas are placed together in a 10.0 L container at 25.0^{o}C. Calculate the partial pressure of each gas and the total pressure of the gas mixture.

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