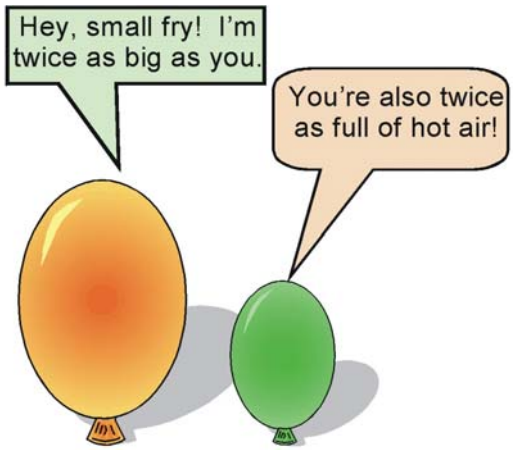
Applying Avogadro's Law

Avogadro's law says that under the same conditions of temperature and pressure, equal volumes of gases contain the same number of moles of particles. This makes sense. All other things being equal, a balloon that is twice as big as another contains twice as much air.

$$V = k\,n$$

V = volume; k = constant; n = number of moles

This has useful consequences. The volume of 1 mole of gas at STP (Standard Temperature and Pressure) is always the same. It doesn't matter what the gas is. The volume of a mole is the same. At STP the molar volume of a gas is always 22.4 *L*. Using the standard molar volume, it is possible to solve several types of problems. See below.



The insulting consequences of Avogadro's Law

Sample Problem 1: Moles to Volume
How many liters do 3.50 moles of oxygen occupy at STP?

$$3.50 mol\left(\frac{22.4 L}{1 mol}\right) = 78.4 L$$

Sample Problem 2: Volume to Moles
How many moles of nitrogen occupy 186 *L* at STP?

$$186 L\left(\frac{1 mol}{22.4 L}\right) = 8.30 mol$$

Sample Problem 3: Grams to Volume
What is the volume of 84.21 g of methane (CH_4) at STP?

$$84.21 g\left(\frac{1 mol}{16.04 g}\right)\left(\frac{22.4 L}{1 mol}\right) = 118 L$$

Sample Problem 4: Volume to Grams
What is the mass of 25.0 *mL* of dinitrogen trioxide (N_2O_3) at STP?

$$25.0 mL\left(\frac{1 L}{1000 mL}\right)\left(\frac{1 mol}{22.4 L}\right)\left(\frac{76.02 g}{1 mol}\right) = 8.48 \times 10^{-2}\ g$$

Answer the following questions using the procedures illustrated above.

1. What is the volume of 7.15 *mol* of propane at STP?
2. What is the mass of 3.00 *L* of hydrogen gas at STP?
3. How many moles of sulfur dioxide occupy 56.0 *mL* at STP?
4. What is the volume of 6.60×10^{-2} *g* of carbon dioxide at STP?
5. What is the mass of 112 *mL* of argon at STP?
6. What is the volume of 7.10 *kg* of chlorine at STP?
7. What is the volume of 0.0150 mol of hydrogen chloride at STP?
8. How many moles of neon occupy 3.36 *L* at STP?