9.5: Gas Laws

Toward the end of the eighteenth century, many scientists began studying the relationships between pressure, temperature, and volume for gases. They began to realize that relationships between these measurements were the same for all gases. Gases behave similarly to a good approximation over a wide range of conditions, due in part to the large space between gas molecules. Simple gas laws were devised to predict the behavior of most gases. These gas laws, now recognized as special cases of the The Ideal Gas Equation, describe the effect of pressure on volume (Boyle's Law), of temperature on volume or pressure (Charles's Law and Gay-Lussac's Law), and of amount of gas (in mol) on volume (Avogadro's Law).

There are several videos on YouTube that show the effects that can be understood in terms of these laws, and help visualize the impact of the 14.7 lb/in^2 of air pressure that we live under and seldom notice:

• In the first, water is added to a 55 gallon drum and boiled, letting steam and air escape, so that the drum is filled with hot water vapor; then the drum is sealed and cooled. The water condenses (because of it's high polarity, the molecules attract), and the drum collapses. The 55 gallon drum crush demonstrates intuitively what Gay Lussac's Law tells us about how temperature affects volume.

Even railroad tankers aren't immune to the pressure:

Again, note how this relates to the gas laws. The temperature or pressure of the tank was altered and it (quite spectacularly) altered the volume of the tanker.