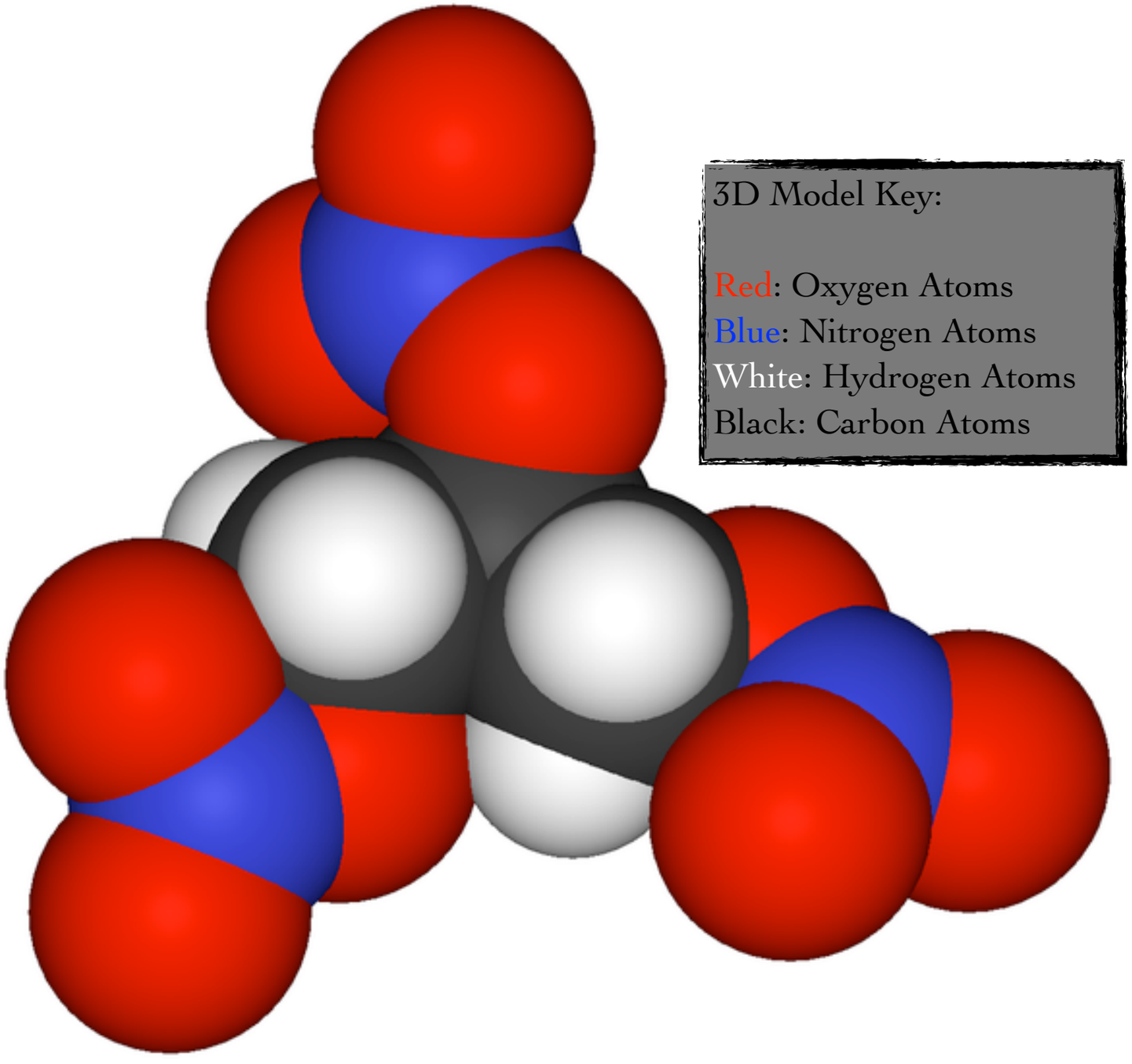


3D Model Key:

Red: Oxygen Atoms
Blue: Nitrogen Atoms
White: Hydrogen Atoms
Black: Carbon Atoms

3D model of Nitroglycerin courtesy of Wikipedia.

Conflict by the Numbers: Through the works of science and mathematics

By: Mari

What is conflict? - Conflict is when two people, groups, societies, or countries disagree. The effects can be catastrophic; people and the environment can be affected by conflict.

How can science and mathematics help us to tell a story of conflict? - The severity of a conflict looks different depending on how you look at. If you look at a conflict mathematically, you can see how many people died, how much damage was done, and how much the conflict cost. If you look at conflict scientifically, you can see how the environment was affected, how much damage the conflict caused in the world, and how the damage was caused (i.e. explosives).

SECTION 1

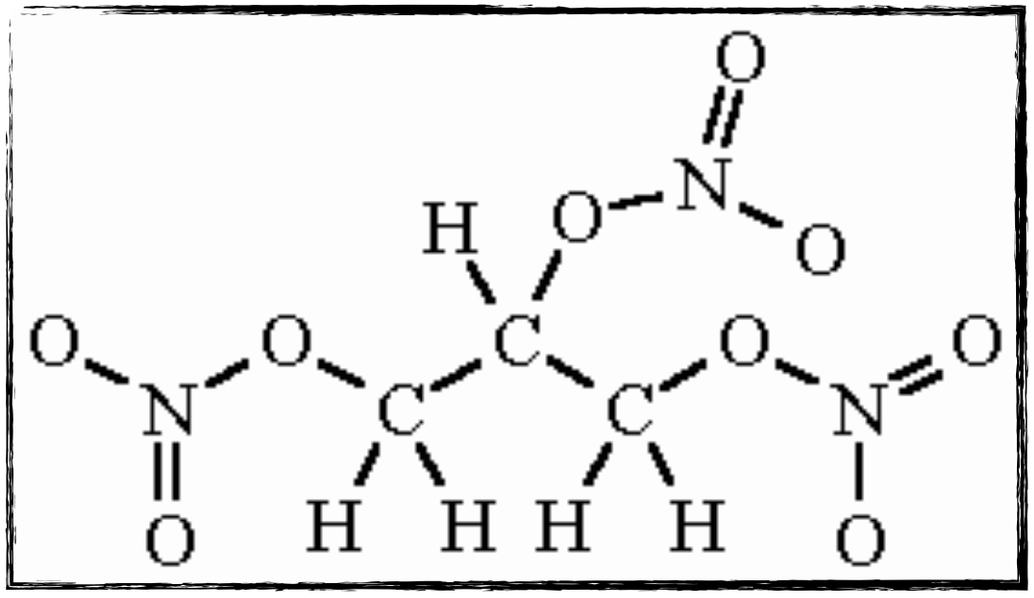
History of Nitroglycerin ($C_3H_5N_3O_9$)

Liquid nitroglycerin (formerly known as pyroglycerin) was discovered by Professor Ascanio Sobrero in 1846. Professor Ascanio Sobrero realized the level of explosiveness that nitroglycerin had, so he stopped his research. Unfortunately, Immanuel Nobel (his son Alfred became the namesake of the Nobel Prize) continued the research a few years later. The Nobel family had a lot of mishaps with this explosive, until 1864. Immanuel's son Alfred invented the blasting cap, making the ignition of nitroglycerin more stable. Three years later, Alfred Nobel discovered that mixing an absorbent clay with the nitroglycerin would make the transportation of nitroglycerin of safer.

Uses and Effects of Nitroglycerin

Nitroglycerin is a very powerful explosive. It is frequently used in commercial explosives, and is a powerful secondary explosive. It is most famously used in dynamite. It can also be used in explosive powders, rocket propellants, and propellant compositions. Exposure to nitroglycerin can cause severe headaches, that are called "NG head" or "bang head." It can also cause tachycardia, which is an abnormal or high heart rate.

Properties of Nitroglycerin

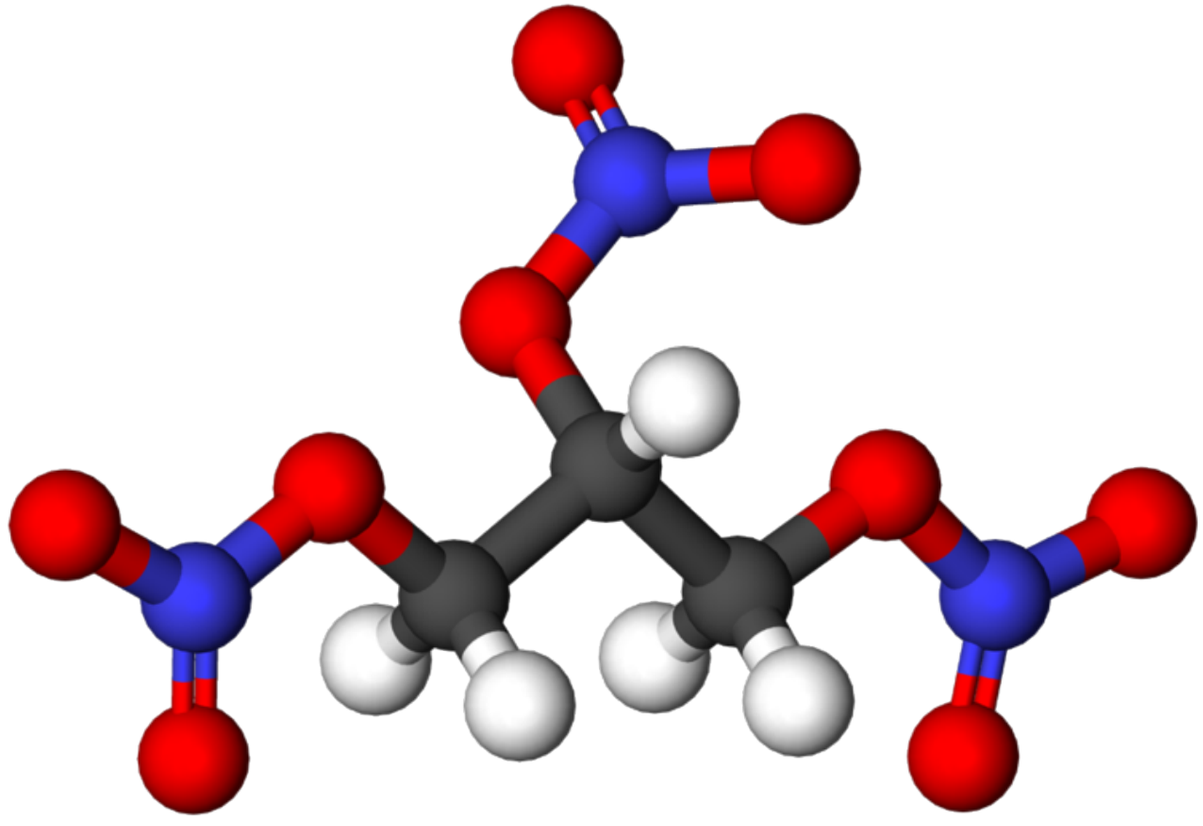


Nitroglycerin is classified by the European Union Directive as an explosive, very toxic, and dangerous for the environment. Nitroglycerin is a yellow oil that is insoluble in water. The molecular weight is 227.1 grams per mole. Its melting temperature is 13 degrees Celsius. Thermal ignition temperature is 200 degrees Celsius. The explosive velocity is 7700 m/s^{-1}. The boiling point is 50 degrees Celsius. Nitroglycerin's density is 1.6 g/cm^{-3} at 15° Celsius.

Nitroglycerin has a tetrahedral and dihedral shape, and has several double bonds. The double bonds bond the Nitrogen and Oxygen atoms in the compound. Double bonds make the atoms share electrons, and that can make them unstable. That could also be a contributing factor to why Nitroglycerin has been so unstable in the past.

3D Model Key:

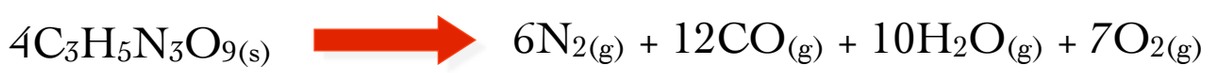
Red: Oxygen Atoms
Blue: Nitrogen Atoms
White: Hydrogen Atoms
Black: Carbon Atoms



SECTION 3

Reactions and Atomic Mass of Nitroglycerin

3C + 5H + 3N + 9O = 227.1 is the linear equation for the explosive compound. It is an exothermic reaction (i.e. heat is produced). Nitroglycerin is produced using a 1:1 ration of sulfuric acid and concentrated nitric acid. The reaction is a decomposition reaction, and looks like:



Scientists' Use of Cramer's Rule

Cramer's Rule could be very helpful to a chemist if they are trying to determine an unknown element's mass. First, a compound with the unknown element would have to be found. Then, it would have to be paired with several other compound equations to make a matrix. By finding the coefficient matrix, and finding the determinate, you can use that to find the mass of any of the elements (as seen on the right).

$$\begin{matrix} 3 & 5 & 3 & 9 \\ 3 & 6 & 6 & 6 \\ 1 & 1 & 1 & 0 \\ 7 & 5 & 3 & 6 \end{matrix} = 30$$ the coefficient matrix to find the determinate of Nitroglycerin

$$\begin{matrix} 227.1 & 5 & 3 & 9 \\ 222.1 & 6 & 6 & 6 \\ 27.03 & 1 & 1 & 0 \\ 227.1 & 5 & 3 & 6 \end{matrix} = 359.52$$

$$\begin{matrix} 3 & 227.1 & 3 & 9 \\ 3 & 222.1 & 6 & 6 \\ 1 & 27.03 & 1 & 0 \\ 7 & 227.1 & 3 & 6 \end{matrix} = 33.03$$

$$\begin{matrix} 3 & 5 & 227.1 & 9 \\ 3 & 6 & 222.1 & 6 \\ 1 & 1 & 27.03 & 0 \\ 7 & 5 & 227.1 & 6 \end{matrix} = 418.35$$

$$\begin{matrix} 3 & 5 & 3 & 227.1 \\ 3 & 6 & 6 & 222.1 \\ 1 & 1 & 1 & 27.03 \\ 7 & 5 & 3 & 227.1 \end{matrix} = 479.36$$

To find the mass of all these elements, you have to divide them by the determinate of the coefficient matrix, which is 30.

Mass of Carbon: 359.25/30 = 11.984
Mass of Hydrogen: 33.03/30 = 1.101
Mass of Nitrogen: 418.35/30 = 13.945
Mass of Oxygen: 479.36/30 = 15.97866667

Works Cited

Photos Courtesy of Wikipedia.

All Information Courtesy of Wikipedia at: http://en.wikipedia.org/wiki/Nitroglycerin.