

Jennifer Swanson

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## The Chemistry of Fireworks

Bang! Boom! Red, blue and green streaks light up the night sky. Fireworks are signaling a celebration: the Fourth of July, New Year's Eve, or a nightly event at Disney World. Colors amaze, delight and excite. But how are these brilliantly loud spectacles of light created? The answer is simple chemistry.

To truly understand the chemistry behind fireworks, you must learn how a firework is constructed. Fireworks are composed of metal salts, clay stars, and three types of fuses. The metal salts determine the dynamic colors visible in the night sky when the firework explodes. These salts are inserted into a star, a lump of clay 3 to 4 cm in diameter. The stars contain an oxidizing agent and a reducing agent which reacts with the mineral salt to produce the loud sound and light effects. Once the mineral salts are added, the stars are carefully packed into cardboard containers for safety. To ignite the fireworks, three different fuses are used. The initial fuse, called the main fuse, serves to ignite the other two time-delayed fuses. The second fuse provides the initial lift charge. This charge propels the firework high into the sky. The final fuse has the longest time-delay as it needs to wait until the firework is airborne before igniting the stars, which then explode loudly as bright colors in the sky.

Where does the chemistry come in? First you need to know that different minerals in the salts give off different colors of light. If you wish to have a bright red display, then

you would use strontium or lithium. But if you desire a bright green show, then you would use barium. Copper chloride gives you blue and sodium chloride explodes as bright yellow.

How does the explosion occur? The black powder in the initial charge creates a highly exothermic (heat-producing) reaction which in turn causes the oxidizing agent in the stars to react. Oxidizing agents are compounds that give off Oxygen upon combustion. Typically potassium nitrate, a common component of gunpowder, is the oxidizing agent in fireworks. The reducing agents combine with the Oxygen and release a large amount of energy. When these reactions occur, it creates an instantaneous explosion which results in a bright light and loud noise. Boom! The firework has gone off.

So, the next time you sit entranced by the bright lights and sounds at a fireworks display, remember chemistry is what made it possible. Fireworks, simply put, are science at its best.