mystery science

Grades K-5
Mini-Lesson: “How do fireworks work?”

VIDEO TRANSCRIPT

VIDEO 1

Hi, it’s Jay! When I was a kid, on certain special occasions like New Year's Eve or the Fourth of July, my family would gather outside after sunset. We weren't the only ones. Big crowds of families would gather in the dark, everybody looking up and waiting for the same thing—fireworks.

Each of us had our favorites. Some liked the colorful ones. Others liked the ones that made shapes. I liked the biggest ones best, but I also really liked the ones that sparkle all the way down.

Someone named Aaron has a question about fireworks. Let's call Aaron now.

[Video Call]

- Hi, Jay.
- Hi, Aaron.
- I have a question for you. How do fireworks work?
- That's a great question.

There are so many different kinds of fireworks out there. There's everything from small handheld sparklers to enormous, complicated fireworks displays timed to music. Maybe you've seen fireworks before and loved them. They're colorful and dazzling and like nothing else. Or maybe you find fireworks scary. They make really loud noises, and maybe they seem dangerous. I mean—isn't that fire up there in the sky?

I'm curious. Have any of you seen fireworks before? What was that experience like?

VIDEO 2

Fireworks are beautiful and incredible, and they can be dangerous, too. Those dazzling lights come from explosions. Explosions are big bursts of light and heat and sound. The bigger the firework, the more careful planning it takes to make sure the explosion stays safe.

Different places have different laws about who and where and how fireworks can be handled. And even when they're handled safely, anything that makes a loud bang and bright flash has an impact on the living things around it. Some really don't like them.

Nevertheless, fireworks have been popular for a long time. Fireworks first burst onto the scene thousands of years ago in China. Inventors in China discovered how to make a highly explosive powder. When they poured that explosive powder into hollow tubes of bamboo and set the tubes on fire, it created a loud, brilliant boom. Those tubes were some of the first fireworks.

Since then, inventors around the world have found ways to make more and more complex and decorative booms. The fireworks we see at big events like holidays and sports games these days have come a long way from thin tubes of bamboo. Each of these tubes is one

firework—look how big they are. Today, we're going to focus on these big fireworks, the ones handled by professionals.

For a firework like this to work, two things have to happen. First, you need to launch the firework into the air. You do not want a huge firework like this going off on the ground. Second, once that firework is high in the sky, then you need to make it explode in a thrilling blast of color and light.

Let's start with that first part. To launch a firework into the air, a cord called a fuse is lit on fire. The fire travels up that fuse. When the fire reaches the bottom of the firework, it sets something else on fire, a whole bunch of explosive powder. When that powder catches fire, it explodes in a huge burst of light and heat. But that light and heat is not the final explosion you see in the sky. Not yet. Instead, this first explosion of powder launches the rest of the firework up into the air like a rocket.

Now it's time for step two: explode the firework in midair. But how do we make that explosion happen? We can't have a person light it with a match like we could on the ground. But here's the thing: we don't have to. That first explosion on the ground did more than launch the firework into the air. It also set fire to a second fuse. As the firework flies up and up, that second fuse is burning and burning and burning. Eventually, the fire on the fuse reaches the main part of the firework and the whole thing goes like this, or like this, or like this.

What a firework looks and sounds like when it explodes depends on what's inside. Usually, this is some combination of powdered metals and other chemical parts. Different materials explode differently. For instance, this is what a firework that contains copper looks like when it explodes.

It's blue. A firework containing titanium looks like this: white. A firework with a material called strontium makes this: red.

In some cases, firework designers even mix colors together like you do with paints. So strontium, which makes red, mixed with copper, which makes blue, equals purple. And it's not just colors. For example, the material charcoal burns for a long time. So fireworks that have charcoal in them stay brighter for longer, making an explosion that looks kind of like falling streamers.

Certain chemicals make louder booms than others. Others explode in a crackling or popping sound. How chemicals are packed and arranged inside the firework makes a difference, too, in the shape of the explosion, whether it's a circle, a star, or even a smiley face.

So, in summary, fireworks are a series of explosions. One explosion launches the firework into the air, and another explosion makes the firework explode in dazzling lights. Fireworks have been thrilling onlookers for thousands of years, but over time, inventors have found ways to make more and more colorful and complex explosions. Different arrangements of different chemicals make different colors, sounds, and patterns. What should we invent next? A rainbow firework? A quieter firework? Or how about this…

These drones fly together to create stunning, changing light displays in the sky without all the danger and fuss of exploding fireworks. How else could we create incredible things to look at to help us celebrate our big moments?

That's all for this week's question. Thanks for asking, Aaron!