Cloverbud Investigators: Career Detectives

Fireworks Show

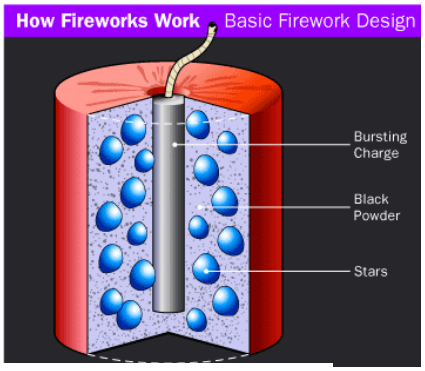
July

Background: Let Freedom Ring!

We all enjoy watching fireworks on the 4th of July! There is just something about the explosions, shapes, and colors that is exciting. The first recorded fireworks were created by the Chinese in the 6th century but they did not become popular in the United States until the 19th century. Where they were initially used as a way of celebrating Independence Day on July 4th, 1776.

The science of fireworks: - To understand the large aerial firework displays, it's best to break down what you are seeing. The easiest way to understand what is happening is to picture a sparkler and a firecracker. The sparkler shows us the bright sparkling light energy release of chemical reactions, while the fire cracker is the explosion of energy and sound, brought on by lighting an explosive fuel like black powder.

The larger aerial fireworks normally consist of four parts and a launcher: A **Shell** or **Container** that is normally cylinder shaped but can be various shapes depending on final patterns desired. They are normally made of some kind of paper and string. The **Stars**, which can be spheres, cubes or cylinders, are like the "sparkler" effect. The chemical compositions of each star and its location within the shell, is what creates the reaction, colors, light and patterns we see. The **Bursting Charge** which is like the "firecracker" explosion at the center of the shell. The **Fuse** is a designed to delay the explosion until the firework reaches its altitude.



The shell is launched from a mortar, which is normally a short, steel pipe with a lifting charge of black powder that explodes in the pipe and launches the shell out the other end. The lifting charge not only launches the shell it also ignites the fuse of the firework, which burns while the shell rises to its correct altitude, where it then lights the bursting charge and the firework explodes. The explosion ignites the outside of the stars, which begin to burn with bright showers of sparks. The explosion disperses the stars in all directions, causing the light displays that we see.

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Designing those beautiful colors and patterns takes a lot of chemical knowledge. Pyro Technicians use a variety of chemical compounds to produce the different color combinations we see. Fireworks get their color from metal compounds (also known as metal salts) packed inside them. (See chart below.)

Working with chemicals and explosives is best left to the experts, so in this lesson we will be focusing on simple fireworks, like firecrackers and sparklers. We will also look at how to combine certain colors to make new colors and with some creative science we can make our own firework show using food coloring and oil.

Local Career Connections: Careers to discuss

- Fire Fighter
- Chemist
- Event Planner
- Pyro Technicians
- Special Effects Coordinator

Optional Introductions:

- Show one of the YouTube videos to introduce the subject of fireworks. See list under additional links.
- Buy simple firecracker, party snaps and sparklers- Talk about how each works and what the active ingredients are in each. Allow the students to break open a snap and examine what is inside. Next open a firecracker and allow them to see what is inside. This is a great time to discuss firework safety and precautions that should always be taken around them.

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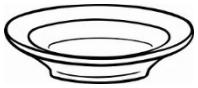
- Then go over safety steps of sparklers like: how to hold them, spacing between people holding them, keeping them away from eyes and hair, etc. explain that they will get to go outside and light a sparkler to examine what happens. Once their sparker has gone out they can place the used sparker in a glass jar, to cool safely and be disposed of properly. Safety and adult supervision should be stressed throughout this lesson.

July's Mystery: How can we make a fireworks show in a jar?

Supplies:

- **Plastic Test Tubes**
- **Food Coloring**
- **Vegetable Oil**
- **Large Glass jar**
- **Large shallow dish**
- **Fork**
- **Warm Water**





Science Behind: Just like in fireworks where chemist use different chemical compounds to make the colors for the explosions, they also use these same principals to make different colors in paints and dyes. In paint and dye we call them pigments. Just like in fireworks, traditional paints and dyes were made up of metal compounds (salts) to make the different colors. For example, titanium dioxide (a bright white chemical often found in sand) was used to make white paint. Iron oxide was used to makes yellow, red, brown, or orange pigments. The chemical chromium oxide makes green pigments and so on. If we mix different pigments together we can make just about any color, we want. In this experiment, students will get to do just that, as they see the chemical explosions of dye mixing with water.

What makes this activity work? The density difference and chemical make-up of the dye, water and the oil are the key to this experiment. While the food coloring is water based and Hydrophilic, the oil is Hydrophobic and so they will not easily mix. When the oil is poured into the jar of water the dye will seek to mix with the water molecules and the oil will not. Thus the oil will float to the top, while the dye sinks to the bottom and mixes with the water. When the dye eventually starts to mix with the water, it creates a tiny color explosion, similar to color bust in fireworks.

What to Do: This activity can be done in large or small groups. For a large group, use the jar to demonstrate and give them tubes to take home to try on their own.

Step 1: Fill a jar ¾ of the way full with warm water.

Step 2: Using a large shallow dish, add 3-4 tablespoons of oil or enough to cover the bottom of the dish.

Step 3: Next, use food coloring, colors of your choice and place 3-4 drops of each color in the oil.

Step 4: Gently mix the oil and food coloring together with a fork to break the dye drops into smaller dots.

Step 5: Finally, carefully pour the oil mixture into the jar of warm water. **Hint - Try to pour most of the oil in first.*

Step 6: Watch the droplets of food coloring.

Go Over Findings:

What are the parts of a firework?
How are fireworks like firecrackers and sparklers?
Where does the color come from in a firework display?
Why does the oil slow down the reaction of the dye mixing with the water?
Can you name a few of the careers we discussed that help make fireworks?

Add On*: Invite a high school Chemistry teacher in to talk to your group about the different types of chemicals that make colors when burned. In a small campfire setting, have them add chemicals to the fire so the students can watch as the flames change color.*

Investigate, Create, & Take: Investigators can take with them:

- ✓ A test tube with instructions to perform the experiment again on a smaller level.
- ✓ Sparklers
- ✓ Shaving Cream Fireworks

Sources:

- FIREWORKS IN A JAR lesson, *https://www.icanteachmychild.com/fireworks-in-a-jar/*
- *Pictures and basic information: https://science.howstuffworks.com/innovation/everyday-innovations/fireworks1.htm*

Additional Links:

Fireworks video how Fireworks work - https://www.youtube.com/watch?v=Nnbfs2wvpFM
Chemistry Videos- The Science of Fireworks: *http://www.sciencekids.co.nz/videos/chemistry/fireworks.html*
Short video about how fireworks work - https://www.youtube.com/watch?v=XtHtAiUVb7M
How stuff works video - https://www.youtube.com/watch?v=4MX_50540rk

Developed by: Tiffany Sanders Riehm, Gallia County 4-H Program Assistant, Ohio State University Extension, riehm.11@osu.edu, and Tracy Winters, Gallia County 4-H Extension Educator, Ohio State University Extension; winters.5@osu.edu. Edited by Michelle Stumbo, Meigs County 4-H Extension Educator, Ohio State University Extension, stumbo.5@osu.edu.

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