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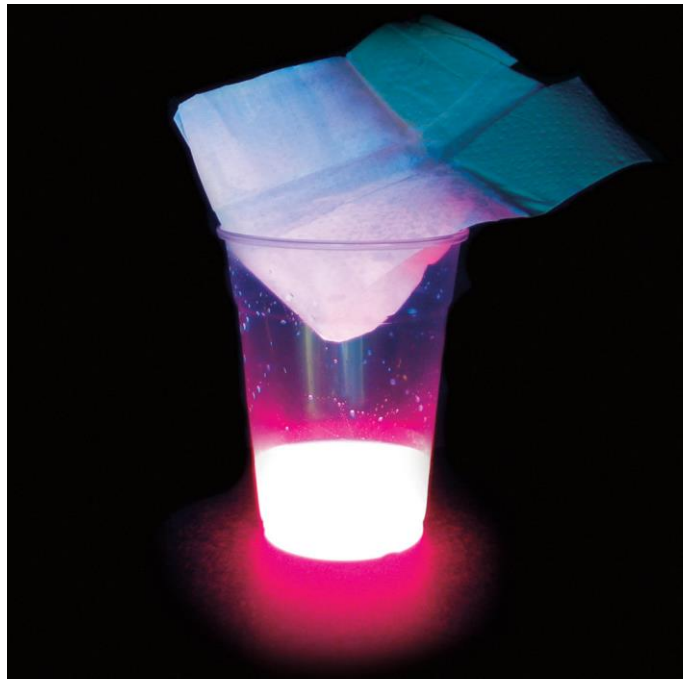
Liquid Light Demo Kit

SS-6



Anyone who has played with finger paints knows that if you mix enough different colors together, you end up with a black mess. Mixing different colors of light, however, yields quite a different result. When all the colors of visible light are combined, you can end up with white!

To understand how this works, consider the primary colors of both light and pigment. Red light is the name given to visible light (visible electromagnetic radiation) with a wavelength of about 600 nm (.0000006 meters).

Red paint, in contrast, is made from a pigment which absorbs all visible light, except red. When light hits a mirror, nearly all the colors are reflected equally. When light strikes red paint, only the red light is reflected. Other colors are absorbed by the paint. In other words, an apple looks red because the pigments in its skin reflect only red light.

Paint pigments are designed to systematically absorb and reflect different colors of visible light. In this way, scientists and artists are able to produce just about any color of the rainbow. If the primary colors of pigment (red, yellow, and blue) are mixed together, all the colors of visible light will be absorbed and we will see black.

The primary colors of light, however, are quite different. When they are combined, we perceive white light. Many light sources emit white light. In actuality, these sources are emitting nearly all the colors of visible light. When we see each of these light waves together, we perceive the color white.

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NGSS Correlations

Our Liquid Light Demo Kit and these lesson ideas will support your students' understanding of these Next Generation Science Standards (NGSS):

Elementary

2-PS1-1
Students can plan and conduct an investigation with the Light Sticks to describe and classify different kinds of materials by their observable properties.

4-PS4-2
Students can plan and conduct an investigation with the Light Sticks to develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

5-PS1-4
Students can use the Light Sticks to conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Middle School

MS-PS4-2
Students can use the Light Sticks to develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials.

High School

HS-PS1-7
Students can use the Light Sticks to construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the Periodic Table and knowledge of the patterns of chemical properties.

Try This Experiment

Materials:

- 6 light sticks: 2 red, 2 green, and 2 blue
- 4 small (~50 ml) beakers or clear plastic cups
- 2 white paper towels
- 1 sharp pocket knife or X-acto knife (not included)

Procedure:

This demonstration should be performed in a dark room (the darker the better). In practice, the demonstration produces enough light to work by, so we usually make the room completely dark.

1. Unwrap three (3) light sticks, 1 red, 1 green, and 1 blue – the primary colors of light.

2. Activate each light stick by carefully bending it until the glass ampule inside breaks. Shake each light stick well.

3. Shake all the liquid and glass down to the bottom of one of the light sticks and CAREFULLY slice off the top of each plastic tube. Decant the glowing liquid into a clean beaker or cup.

Repeat with the remaining two colors, decanting each into a different container. Set the empty light sticks (with broken glass inside) aside and dispose of them properly.

4. Show your audience the primary colors of 'liquid light'. Explain that each liquid contains a different fluorescent dye, and that the color of the light emitted depends on this dye.

5. One at a time, pour each of the glowing liquids into a fourth clean beaker or cup. As the liquids are mixed, so are the primary colors of light. When all are combined. the light being emitted should be white. The light does not look white because the fluorescent dye which produces the red light is actually red in color. This dye selectively absorbs some of the green and blue light resulting in a slight red tint.

6. To see the light as white, it is necessary to reduce the amount of red dye through which the light must travel. This can be demonstrated simply by dipping a white paper towel into the solution. Once it is wetted with the solution, open the paper towel and show that the light being emitted is an even mixture of the primary colors—it is white!

Safety:

While the chemicals contained within lights sticks are reported to be non-toxic, this demonstration should only be attempted in an appropriate, properly equipped, laboratory environment. Goggles and gloves should be worn at all times. Also, be aware that the chemicals contained with the light sticks can stain clothing.

Disposal:

The chemicals contained within light sticks may be safely washed down the drain with water. All glass and plastic should be disposed of properly.

Special Precautions:

Light sticks contain a small glass ampule, which must be broken to activate. This glass is extremely fine and sharp, and breaks into small slivers. Extra special care must be taken to avoid touching this glass. Do not pour the chemical within the light sticks onto your hand, or place your hand in the chemical after it has been poured into a beaker. The glass is extremely difficult to see (especially in the dark) and it is probably that some glass will remain in the liquid even after it has been decanted.

References:

Sarquis, Mickey and Jerry Sarquis. Fun with Chemistry – A Guidebook of K-12 Activities, Volume 1. Institute for Chemical Education: Madison, WI; pp. 163-166.

Shakhashiri, Bassam Z. Chemical Demonstrations: A Handbook for Teachers of Chemistry, Volume 1. The University of Wisconsin Press: Madison, WI; pp. 146-152.

Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons.
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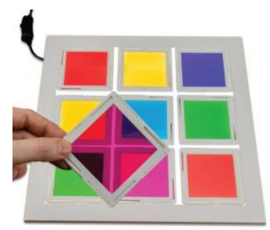
To extend your lesson, consider these Educational Innovations products:

Light Modulator (LGT-350)

The Light Modulator is an easy-to-use, plug-and-play demonstrator of light and physics principles that will leave your students in awe. Plug the flashlight transmitter into a cell phone, play a song, and the sound will "ride" the light beam to the solar panel receiver! Ten unique experiments are provided. You'll be teaching concepts such as amplitude modulation, AC vs DC, fiber optics communication, persistence of vision, molecular kinetic theory, light properties, the Inverse Square Law and more.

Subtractive Color Theory Demonstration (LGT-330)

The Subtractive Color Theory Demonstration can be used to promote memory retention, encourage logical thinking, and teach the optics and physics of color mixing. As you are challenged to create specific color designs on the back-lit board, you must predict how colors of the filter tiles will mix either by experimentation or previous understanding - then you must strategically slide the squares into the correct configurations.



Let It Glow Kit (LGT-325)

Students are often intrigued by the idea that different colors of light possess different amount of energy. This fascinating, hands-on lesson will "shine a light" on the concept in a way your students won't forget! A do-it-yourself tabletop version of one of the most famous physics experiments of all time—the photoelectric effect. Using a red laser pointer and an array of colored gel filters, your students will discover which colors of light are able to "charge up" a phosphorescent square.

The Color Chaos Class Kit (LGT-300)

Confounding, compelling, and just plain fun, this engaging experiment explains how we see color. Your students will use an assortment of colored beads, a trio of LED lights (in red, blue, and green), a battery, and their own powers of observation to demonstrate the science behind color perception. What happens when different colors of light shine upon different colors of beads?