Educational Innovations, Inc.®

SS-6

Liquid Light Demo Kit

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.

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 incl.)

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.

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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.