Expo Station

Light Prints

Participants shine a UV light onto a piece of treated paper covered with a stencil of their own choosing. The uncovered areas of the photosensitive paper rapidly turn from yellow to blue. Use this simple activity to introduce the historical uses of light-sensitive paper to make photos or copies that people could hold.

Age	Activity Time	Group Size
5-8	Preparation: 5 mins Activity 5-8 mins	Number of participants: 1 person per station Ratio of facilitators to participants: 1 facilitator for every 2 participants

Concepts to Explore

- A UV light is needed to start a chemical reaction on the chemical coating of the Starlight UV Sun Paper. This turns the yellow coating blue.
- Photography is the practice of creating images with light, either electronically or on paper coated with light-sensitive chemicals.

Safety Requirements & Other Considerations

- Safety glasses are appropriate for this activity.
- UV flashlights that produce a wavelength of 365 nm will react with Starlight UV Sun Paper to create more vivid and defined images than the more common 395 nm UV flashlights. The results from shining a 395 nm flashlight on Starlight UV Sun Paper are satisfactory for the purpose of this activity.
- Never look at a UV flashlight or other bright light directly. Never shine these types of light into the eyes of a person, pet, or other animal.
- Brief exposure to UV light, whether at 365 or 395 nm, will not damage skin. Prolonged exposure to UV light may irritate skin as well as cause both short- and long-term skin damage.
- Whether presenting the activity inside or outside, keep the unused paper face down and covered. Paper that has been exposed to light will become desensitized and not react as well with the UV flashlight or sunlight.

Question to Investigate

Which flashlight does a better job of making an image on Starlight light-sensitive paper?

Materials Required

Per station

- Twenty-four 4- x 5-inch pieces of Starlight UV Sun Paper
- A selection of stencils of animals, insects, plants, or complex geometric shapes
- A negative or print on transparency film, optional
- 1 UV flashlight, either 365 nm or 395 nm
- 1 regular flashlight, typically somewhere between 400 and 650 nm

Preparation Prior to Activity

In advance

- You may choose to cut each 8-inch x 10-inch sheet of paper into quarters to make four 4-inch x 5-inch sheets of paper.
- For best results, cut the paper in a darkened room and store the pieces in the dark bag that the larger sheets came in.
- Check the batteries on both the UV and regular flashlights. If you are presenting for two or more hours, be sure to bring extra batteries or flashlights.

On-Site

- Arrange three or four stations across the front of a 6- or 8-foot rectangular table.
- Each station should include one regular flashlight, one UV flashlight, and two 4- x 5-inch pieces of *Starlight UV Sun Paper* on a tray.

Instructions & Talking Points

Facilitate the activity		
Step	**Instructions**	**Talking Points**
Introduce photography	Tell participants: • Photography is the process of recording an image, either digitally or on paper. • The use of light is an important part of both taking and making pictures. Before digital cameras, people shone	• Have you ever taken a photo? How did you do it? • What would you do if you wanted someone else to see it?

	light through a brown film onto light sensitive paper. Then they put the paper into two chemical baths, rinsed it with water, and then hung it up to dry. Taking pictures and then making prints of photos on paper was both art and science. • In this activity, you are going to use stencils and light to make prints on light-sensitive paper. You are going to use science to make art!	
Invite participants to select the stencils that they would like to use.	Direct participants to: • Place both pieces of paper yellow-side-up. • Choose one (or more) stencils for each. • Arrange one stencil on top of both pieces of light-sensitive paper.	
Shine a regular flashlight and then a UV flashlight over the stencil	Direct participants to: • Choose the regular flashlight, turn it on, and hold it so that the light is close to, but not touching the stencil. • Hold it over the stencil for about 10 seconds and then turn the flashlight off. • Repeat over the other paper with the UV flashlight for about 10 seconds and then turn the flashlight off.	• Which flashlight does a better job of making an image on this light-sensitive paper?

Use various stencils and a UV flashlight to make designs on both pieces of paper	• Explain that the coating on this light-sensitive paper reacts with UV light to make blue-colored compounds. • Allow time for participants to make design choices and explore on both pieces of 4- by 5-inch paper. • Invite participants to take their designs home.	• Do you think this light-sensitive paper would change color in sunlight? • Why or why not? • What would you do if you wanted part of your image to be dark blue? • What would you do if you wanted part of your image to be light blue? • What would you do if you wanted part of your image to stay yellow?

Clean Up

- Reset for more participants by placing two new pieces of *Starlight UV Sun Paper* at each station.
- Replace batteries for flashlights as needed.
- At the end of the session, collect the stencils and place them in a bag to store them. Use tape, paper, and a pen to label flashlights that are not working well. Place the regular flashlights in one bag and the UV flashlights in another.
- Store all items for reuse at your home or workplace.

Explore the Chemistry

Starlight UV Sun Paper is a light-sensitive paper used to make prints quickly. Unlike other sun print papers, there is no need for water or another fixing agent.

To use the Starlight paper to make designs by placing stencils, objects, or negatives (from camera film or printed onto a piece of transparent plastic) on top of the yellow side of the paper. If you shine a regular flashlight over the stencil-and-paper, you will not notice any change. However, the uncovered yellow areas of the paper will quickly turn blue, when you shine a UV flashlight over the stencil-and paper.

Light

Starlight UV Sun Paper is extremely sensitive to ultraviolet (UV) light, particularly light at 365 nm. For comparison, the wavelengths of light from a regular flashlight are longer, typically between 400 and 650 nm in length. This range is known as visible light because it is the range that human eyes can detect. UV light, with its smaller wavelengths, reacts with this light sensitive paper.

Type of electromagnetic radiation	Visible light	UV-A	UV-B	UV-C
Wavelength range	400-700 nm	315-400 nm	280-325 nm	180-280 nm
Facts about light according to the size of their wavelengths	The wavelengths in this range correspond to the colors of a rainbow Red has the longest wavelength and purple has the shortest	Helps our bodies make Vitamin D Causes premature aging of skin The primary wavelength of light used in tanning beds	Causes cell damage that can lead to skin cancer The percentage of UV-A and UV-B in sunlight varies by latitude and time of year	Used in germicidal lamps to sterilize shared goggles in a chemistry lab Also used to sterilize tools for dental work and surgical procedures

Paper

The coating on Starlight paper is a bit different from other sun-sensitive papers because the chemical reaction occurs within seconds. No fixing solution is necessary. While we do not know exactly what causes the characteristic blue color of Starlight paper, we know that other sun-sensitive papers marketed to educators and parents for use with young students are coated with iron compounds, in particular ferric ammonium citrate and potassium ferricyanide. These compounds turn blue or cyan when they react with UV light. Starlight paper can become deactivated when exposed to indoor or outdoor light. If using the paper outside, wait until you are ready to use it before pulling it out of its protective packaging. For more information about Starlight UV Sun Paper visit the inventor's website at www.uvsunpaper.com.

Photocopies

Long ago, architectural drawings, were copied out in the sun using ferric ammonium citrate and potassium ferricyanide on paper. When exposed to sunlight, these iron compounds reacted making the copy blue. This is why we call architectural drawings and other detailed plans "blueprints" even though the copying methods we use today can produce many different colors.

Photography

The process of printing with Starlight and other sun-sensitive papers is like the cyanotypes made in the early days of photography. Before digital photography, cameras used small exposures of light on a film to create a physical image. The exposed film was called a negative because the light colors appeared dark and the dark colors appeared light, the

reverse of what the image looked like in real life. To develop an image from the negative, people went into a special room called a darkroom. This room was kept so dark that people could only use a a dim red light to see what they were doing. Redi light has the lowest energy in the spectrum of visible light, so it does not interfere with the development of the images. In the darkroom, people would project a focused white light (which contains all the colors of a rainbow) through a negative onto light-sensitive paper. This left behind a print on the paper which was made permanent or "fixed" by dunking the paper in a chemical bath containing silver salts.

Back when all cameras used film, each picture was taken on a small part of a thin strip of film. When all the film was used up, the photographer removed it and gave it to someone else who would carefully place it on a spool and give it a chemical bath. This made the image stay on the film. At this point, the prepared film was called a negative.

Here comes the paper part! Light was pointed so that it went through the negative and cast shadows onto the light sensitive photography paper. This made an image on the paper. To make the image stay, the paper was dipped in another chemical bath, rinsed off with water, and hung up to dry. Once dry, people could look at the picture and either keep it or give it to friends.

References

- Dr. Oksana Love, member of the American Chemical Society's Committee on Community Activities and author of the activity *Sunography* in the *Photography and Imaging: Picture Perfect Chemistry* issue of *Celebrating Chemistry*. Dr. Love is also assistant professor of chemistry at the University of North Carolina Asheville.

- Dr. Jackie Trischman, member of the American Chemical Society's Committee on Community Activities, co-chair of the NCW 2024 Theme Team, *Photography and Imaging: Picture Perfect Chemistry*, and author of the related activity, *Anthotype Printing with Turmeric* that appears in the *Picture Perfect Chemistry issue of Celebrating Chemistry*. Dr. Trischman is also Dean of the College of STEM at California State University San Marcos.

- *Starlight Vs. Cyanotype* on the Starlight UV Sun Paper blog