

# DETECTING UV LIGHT

grades 5–8

## Objective

To demonstrate the existence of light invisible to our eyes by making a bracelet from beads that respond to ultraviolet (UV) light by changing color.

## Introduction

Why is it that when we're outside for a long time, we get sunburned, but when we're inside, we don't? What's so different about light inside and light outside? Light is light, right?

In fact, sunlight is different than the light from a light bulb. The sun gives off many different wavelengths of light. Some of these wavelengths we can see with our eyes as "visible" light. However, only about 2% of the wavelengths the Sun gives off are detectable with human eyes.

Ultraviolet light (UV) is an example of light that cannot be seen by the human eye. (Other examples include radio waves, microwaves, infrared light, X rays, and gamma rays.) UV light is present in sunlight, but not present in most artificial light from lamps. One way we can tell when ultraviolet light is present is with our skin, because ultraviolet light causes our skin to tan, burn, or even freckle.

When astronomers analyze light from distant stars, they collect both visible light and invisible light. Though our eyes cannot see most wavelengths of light, these rays can be detected in other ways. X rays, for instance, change the color of photographic film. So although you will never see X rays themselves, an X-ray photograph can show where X-ray light struck the film.

The beads in this activity work like X-ray film. They contain pigments that change color when they are struck by UV light. Make sure your students understand that when the beads change color, they will still not be seeing UV light. The color change of the beads simply indicates that UV light is hitting the beads.

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## Background Reading for Educators

**Light: Its Secrets Revealed**, available at:

<https://www.amnh.org/learn-teach/curriculum-collections/discovering-the-universe/light-its-secrets-revealed>

## Materials

**UV Detecting Beads** (Source: [www.teachersource.com/catalog/index.html](http://www.teachersource.com/catalog/index.html), \$6.95 for package of 240, or [www.sciencekit.com](http://www.sciencekit.com), \$9.95 for package of 240, catalog #46586-00.)

**Pipe cleaners** (Source: [www.teachersource.com/catalog/index.html](http://www.teachersource.com/catalog/index.html) \$3.25 for package of 100)

**Desk lamp** (with incandescent light bulb)

**Additional Materials:**

Paper towel

Black construction paper

UV-rated sunglasses

Baseball cap, Cup of water

Paper clip, Plastic wrap

SPF 30 sunscreen

## Procedure

### Part One: Detecting UV Light

- 1] Begin by introducing students to the notion of ultraviolet light by talking about sunburns.  
**Ask:** How do we get sunburned? What time of year do we usually get sunburned?  
**Why doesn't the light inside your house and school cause your skin to tan or sunburn?**  
**Explain:** Use this last question to prompt students to think about light that we may not be able to see. One type of light that our eyes can't see — ultraviolet light — can still be detected by our bodies. Ultraviolet light causes our skin to freckle, tan, or sunburn.
- 2] A safer way to detect UV light is with a UV detector. Tell your students that they will use beads with a special pigment that changes color when exposed to UV light. These beads are called UV detectors. They can use them to look for UV light around the school.
- 3] Have them assemble their UV bracelets by stringing five beads on a pipe cleaner, then loop the bracelets around their wrists and twist the ends to fasten them.

- 4] Allow your students to expose their beads to a number of indoor light sources, such as a desk lamp, an overhead projector, or fluorescent lights in the classroom.

 **Teacher's Note**

Beads will likely remain white because most indoor lighting does not emit much UV light.

- 5] If you have a window in your room, students may notice that the beads change colors when they hold them next to the window. Have students go outside, or place the beads outside the window and observe them. Once outside, find a shady spot out of direct sunlight and have the students determine whether or not a shady area is protected from UV light.

 **Teacher's Note**

Beads will change colors quickly due to UV light, which can pass through clouds and is scattered by the atmosphere.

### Part Two: Blocking UV Light

- 6] Begin a discussion with your students about the importance of UV light. Explain: Humans need some exposure to ultraviolet light to stay healthy, but too much exposure can cause sunburn and skin cancer. For astronauts, this is a big concern. Though UV light can hurt us, we are protected from most of it by the air above us — our atmosphere. However, astronauts work above the Earth's atmosphere and have no protection from UV light.
- 7] Depending on your students, you may wish to talk about the ozone layer, which blocks most of the UV light from reaching Earth. The ozone layer has received a lot of attention lately because it has been thinning in recent years due to chloro-fluorocarbon (CFC) pollution. Reduced ozone has allowed more UV radiation to reach the ground, causing increased risk of skin cancer.
- 8] Next, explain to students that there are many products available to protect us from the Sun. Guide students as they test some forms of Sun protection, using the UV beads as detectors.

- 9] Find an area in full sunlight (either outside or on a windowsill). As a class or in groups, have your students test some possible materials to see whether they block UV.

Examples could include:

Control: Set it on a desk or the ground with nothing over it.

Lay a paper towel over it.

Cover the bracelet with plastic wrap.

Cover the bracelet with plastic wrap and then coat the wrap with sunscreen (spf 30).

Put UV-rated sunglasses over the beads on the bracelet.

Cover with clear glass, such as ordinary eyeglasses.

Lay a black piece of construction paper over it.

Put a baseball cap or any hat over the bracelet.

Fill a can with water. String three UV beads on a paper clip so they will sink.

Immerse the beads in water containing salt, sugar, or food coloring.

- 10] After five minutes, students should check their bracelets one at a time and write down their results.



#### Teacher's Note

Students will need to check very quickly because the beads will start changing color as soon as they are exposed to sunlight.

- 11] Have students discuss the results as a class and list ways to protect our skin from too much ultraviolet light. Finally, have students talk about what astronauts wear in space, and ask them to consider why astronauts need spacesuits. Have them record their answers on their worksheet.
- 12] List other forms of invisible light: radio waves, microwaves, infrared light, X-rays, and gamma rays.  
Explain: Some of these waves can pass through things that visible light cannot, while others are blocked by things visible light can pass through. For example, X-rays can pass through your body, while visible light cannot. However, visible light can pass through sunscreen, but UV light can't, as your experiment showed. Glass blocks some wavelengths of UV but not others.