

Ultraviolet Light

Overview: Stars, including our sun, produce all kinds of wavelengths of light, including UV (ultra-violet). That's the wavelength that gives you sunburns. We're going to find out the best way to protect you from the harmful rays.

What to Learn: The UV beads we're going to use in our experiment are made from a chemical that reacts with light. It takes the UV light from the sun and then re-emits it in a different wavelength that's visible to us.

Materials

- 5 UV beads (these change colors when exposed to the sun)
- tape (double-sided is easier)
- sun block
- sunglasses (ask the kids to bring a pair)
- sunny day
- water
- piece of fabric
- clear plastic bag

Experiment

1. Place a piece of tape on the data table, and stick your beads to the tape, one in each box.
2. Walk outside with your data table and record your observations.

UV Light Data Table 1

Bead	Color Inside	Color When in Sunlight	How Long Did It Take to Return to Indoor Color? (measure in seconds)
1			
2			
3			
4			
5			

3. Walk back indoors and cover the beads, blocking out all light. Peek at them every minute or two to find out when they've returned to their unexposed color.
4. Now prepare your second round of testing by doing the following *before* exposing the beads to the sun:
 - a. Place a bead inside a baggie.
 - b. Place a second bead inside a baggie filled with water.

- c. Smear a clean baggie with sun block and place a third bead inside.
 - d. Place a pair of sunglasses over a fourth bead.
 - e. Place a fifth bead under a piece of fabric.
5. Walk your five beads outside and record your observations in the data table.

UV Light Data Table 2

Bead	Color Inside	Color When in Sunlight
1: Baggie		
2: Baggie + Water		
3: Sun block		
4: Sunglasses		
5: Fabric		

6. Bring your beads back inside and return them to their unexposed color.
7. Prepare your third round of testing by exposing your beads to some of the following:
 - f. a fluorescent lamp
 - g. an incandescent lamp
 - h. flashlight
 - i. glow stick
 - j. computer screen
 - k. reflected sunlight using a mirror
 - l. candle flame (please be careful with this!)
 - m. any other light source you have access to
8. Record your observations in the data table.

UV Light Data Table 3

Light Source	Color Inside	Color When Exposed	How Long Did It Take to Change Color when Exposed?

Reading

Stars, including our sun, produce all kinds of wavelengths of light, even UV. The UV beads we're going to use in our experiment are made from a chemical that reacts with light. It takes the UV light from the sun and then re-emits it in a different wavelength that's visible to us.

When a particle of UV light smacks into an atom, it collides with an electron and makes the electron jump to a higher, more energetic state that is a bit further from the center of the atom than it's comfortable being. That's how energy gets absorbed by an atom. The amount of energy an electron has determines how far from the atom it has to be. The electron prefers being in its lower state, so it relaxes and jumps back down, transferring a blip of energy away as it does. This blip of energy is the light we see emitted from the UV beads. This process continues as long as we see a color coming from the UV beads.

UV sensitive materials have a pigment inside that changes color when exposed to UV light from either the sun or lights that emit in the 350nm – 300nm wavelength. (UVA is high-energy: 400-320nm, and UVB is low energy: 320-280nm). If you have fluorescent black lights, use them. (Do regular incandescent bulbs work? If not, you know they emit light outside the range of the beads!)

When light hits the pigment molecule, it absorbs the energy and actually expands asymmetrically (one end of the molecule expands more than the other). Different expansion amounts will give you a different color. Although it's a bit more complicated than that, you now have the basic idea. Your beads will change colors thousands of times before they wear out, so enjoy these super-inexpensive UV detectors.

A note about sun block: You can test different SPF levels of sun block, but here's the main idea behind the ratings: the number for SPF is the number of minutes it takes to get the same sun exposure than if you weren't wearing any for one minute. For example, SPF 30 will give you the same sun exposure after 30 minutes that you would normally get if you weren't wearing any after just one minute.

Exercises

1. What kinds of light sources didn't work with the UV beads?
2. Did your sun block really block out the UV rays?
3. Which was the best protection against UV rays?

Answers to Exercises: Ultraviolet Light

1. What kinds of light sources didn't work with the UV beads? (Check data.)
2. Did your sun block really block out the UV rays? (Check data.)
3. Which was the best protection against UV rays? (Check data.)