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EXTENSION SERVICE

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UV BEADS

A WVU Extension Service STEMCARE Lesson

Audience:

Grades K-9

Time:

45 to 55 minutes

10 minutes to read "Why Do Elephants Need the Sun?" (for grades K-5);
10 minutes to review sunlight and the visible light spectrum;
10 minutes for students to construct their UV bead bracelet;
5 minutes for teacher to share the science behind the UV beads color changing;
15 minutes for students to experiment with sunscreen, other sources of light and other situations, such as through glass.

Materials:

For each student: Elastic cord or ribbon cut into 6-inch strips (elastic cord is preferable for ease of removal); UV beads; two or more sunscreens that differ only in SPF; cotton swab (to apply sunscreen to bag); handout

Vocabulary:

Visible light spectrum, ultraviolet light, radiation

Goal:

To learn about ultraviolet radiation and investigate the protective power of sunscreen.

Introductory Activities

1. Read "Why Do Elephants Need the Sun?" (for grades K-5).
2. Review the electromagnetic spectrum, ultraviolet light and the visible light spectrum.

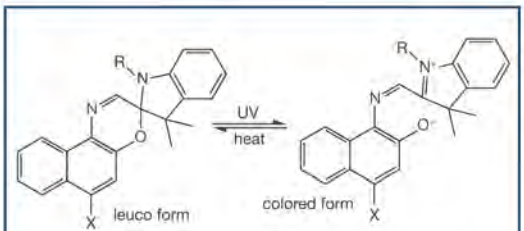
Core Learning Activity: UV Beads

Observe UV beads indoors and in sunlight.

1. Thread the beads onto the string and tie it loosely to form a bracelet on your wrist.
2. Cover the beads completely and walk outside into the sunlight.
3. Once outside, remove your hand and observe the beads continuously. Don't stop watching them.
4. Have students share with a partner what they saw and why they think it happened.
5. After several minutes, walk into the shade. Does anything change?

Background: The Science Behind UV Beads

We can see visible light but not UV light. The beads are sensitive to UV light and have a chemical substance embedded in the plastic. UV radiation (sunlight) interacts with chemical bonds of this chemical causing a small change in the molecule. This small change results in a change in the wavelengths of visible light reflected and perceived by your eye.



Reversible transformation of a photochromic molecule from colorless form to visible colored form. (Image by Shaddack, 2006 distributed under a CC0 License)

When indoors, the beads will remain white if they are kept away from windows or doors where UV light can leak into the room. Each bead will change color about 50,000 times before the pigment will no longer respond to UV light. The UV beads are not affected by

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light from light bulbs that do not emit UV light. UV light is the invisible radiation that will give you a sunburn and injure your eyes if you're not careful. Sunglasses and sunscreens absorb UV photons. Sunscreens are labeled with a sun protection factor or SPF. Higher numbers indicated greater protection. You can test their protective qualities by using your UV detecting beads.

Experiment

The UV color-changing beads are very sensitive to changes in UV energy. Have students design an experiment to determine the blocking potential of different sunscreens (try SPF 15 and 30). Keep your hands free from sunscreen to ensure no sunscreen touches the beads directly.

Here is one design to test one type of sunscreen:

1. Place half of the beads in a plastic zipper bag labeled "A" or "sunscreen."
2. Place the other half of the beads in a plastic zipper bag labeled "B" or "no sunscreen."
3. Use a cotton swab to apply a layer of sunscreen to the outside of the bag A.
4. Leave bag B without any sunscreen coating for comparison purposes. It will serve as the control in the experiment.
5. Expose bags containing beads to direct sunlight for 5 minutes and look for any changes in color.
6. Rate the change in color on a scale of 1 to 5 with 5 being the most change. Record your observations and reflect on your findings.

The beads will always change color, regardless of how well the sunscreen blocks UV; the beads are very sensitive! The key is to rate the color of the beads on a scale of 1 to 5, with 5 showing the most color or "burning" and 1 showing the least color. Manufacturers suggest that you throw away sunscreen that is over a year old because it loses its effectiveness.

Other Experiments

You can use UV beads in other experiments, such as testing the protective effectiveness of sunscreen that may be near or past the expiration date or testing the protective effectiveness of different fabrics. Each experiment should include a control so that you can make comparisons.

Resources

National Aeronautics and Space Administration, Science Mission Directorate. (2010). Introduction to the Electromagnetic Spectrum. Retrieved from NASA Science website: http://science.nasa.gov/ems/01_intro.

Shaddack. Photochromism: An example of a dye structure transition. January 2006. https://commons.wikimedia.org/wiki/File:Photochromic_dye_transition.png.

Wells, Robert E. "Why Do Elephants Need the Sun?" Wells of Knowledge Science Series, Albert Whitman & Company; Illustrated edition, 2012.

West Virginia Next Generation Standards

General Science

- S.1.GS.3 Waves and Their Applications in Technologies for Information Transfer – Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. (NGSS 1-PS4-3)
- S.4.GS.2 Energy – Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat and electric currents. (NGSS 4-PS3-2)
- S.9.ESS.1 Earth's Place in the Universe – Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. (NGSS HS-ESS1-1)

WVU STEMCARE UV Beads Demonstration Video: https://youtu.be/LizC8TpVHTc