Making an Ultra Violet (UV) Light Detector

Subject Area(s)	Physics
Associated Unit	None
Associated Lesson	None
Activity Title	Making a Ultra Violet (UV) Light Detector

Header Insert Image 1 here, right justified

Image 1

ADA Description: Students displaying the UV bracelet in the presence of UV light

Caption: None

Image file name: uvlight_image1.jpg

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Group Size	1
Expendable Cost per Group	US$1
Grade Level	5 (4-6)
Time required	45 minutes

Summary

Students build a simple sensor for detecting ultra violet (UV) light. Students use specialized beads that are sensitive to UV light and various materials that facilitate the immobilization of the sensor to different objects, including themselves. Students show that although UV light cannot be seen by the human eye, it is still present in sunlight, and can be detected using this sensor. Students also test the effectiveness of various materials at blocking UV light, such as sunscreen and glass.

Engineering Connection

All types of light can be classified in accordance with the electromagnetic spectrum. The properties of light are of great importance to many areas of science, engineering and technology. For example, astronomers use various properties of light to learn about stars, nebulae, galaxies, and other far away phenomena. Although they collect information about all types of light, the various types of light differ in one key way: their wavelength. Only one part of the electromagnetic spectrum can be seen by the human eye, the visible spectrum. To obtain information about other parts of the spectrum, special instruments and materials, designed by engineers and scientists, are used to detect the wavelengths of light that our eyes cannot see. To function effectively as a sensor, the material or device must illicit a distinct response to the stimuli of interest and relay a signal back to the observer. In this activity, the UV sensitive beads will undergo a change in color from neutral to various colors while in the presence of UV light. Moreover, the intensity of the color change will vary as a function of the amount of light that is incident upon the detector (i.e., if the UV bead changes color from neutral to red, then a

deeper red will be observed when the bead is placed uncovered, in direct sunlight, as opposed to a lighter red if the same bead was covered by a piece of tinted glass and then placed in direct sunlight)

Engineering Category
Category #1: Relates science concept to engineering

Keywords
sunlight, ultra violet light, UV

Educational Standards
- New York science, 2008, S1.1a, b, c: Formulate questions of scientific inquiry with the aid of references appropriate for guiding the search for explanations of everyday observations.
- New York science, 2008 S3.1a,b: Employ tools to gather, analyze, and interpret data.
- New York science, 2008 S3.2a,b,c: Use data to construct reasonable explanations. Evaluate your hypothesis in light of the data.

Pre-Requisite Knowledge
None

Learning Objectives
After this activity, students should be able to:
- Give examples of the different types of light that are contained in sunlight.
- Give an example of a device that can detect an invisible type of light.
- Explain the fundamental difference between different types of light.
- Based on their observations, should be able to list materials are good and bad at blocking UV light.

Materials List
Each group needs:
- 1 pipe cleaner (www.teachersource.com, $3.25 for package of 100)
- 5 UV beads (www.sciencekit.com, $9.95 for package of 240)

To share with the entire class:
- Paper towel
- Black construction paper
- UV rated sunglasses
- SPF 30 sunscreen
- Desk lamp (with incandescent light bulb)
- Plastic wrap
- Aluminum foil

Introduction/Motivation
Many devices that we use everyday depend on the properties of light. For example, a microwave oven and an x-ray machine operate using different types of light

Scientists usually refer to light as an electromagnetic wave, where the distance from crest to crest of the wave (called, wavelength) is used to differentiate the different types of light. For example, radio waves have a long wavelength whereas gamma waves have a shorter wavelength.

However, not all segments of the electromagnetic spectrum can be seen by the human eye. In fact, the only part of the electromagnetic spectrum that humans can see is the visible

spectrum. Therefore in order to get information about other segments of the electromagnetic spectrum, scientists must use devices that can specifically interact with the invisible portion of the spectrum.

IMAGE Insert Figure 1 here, centered

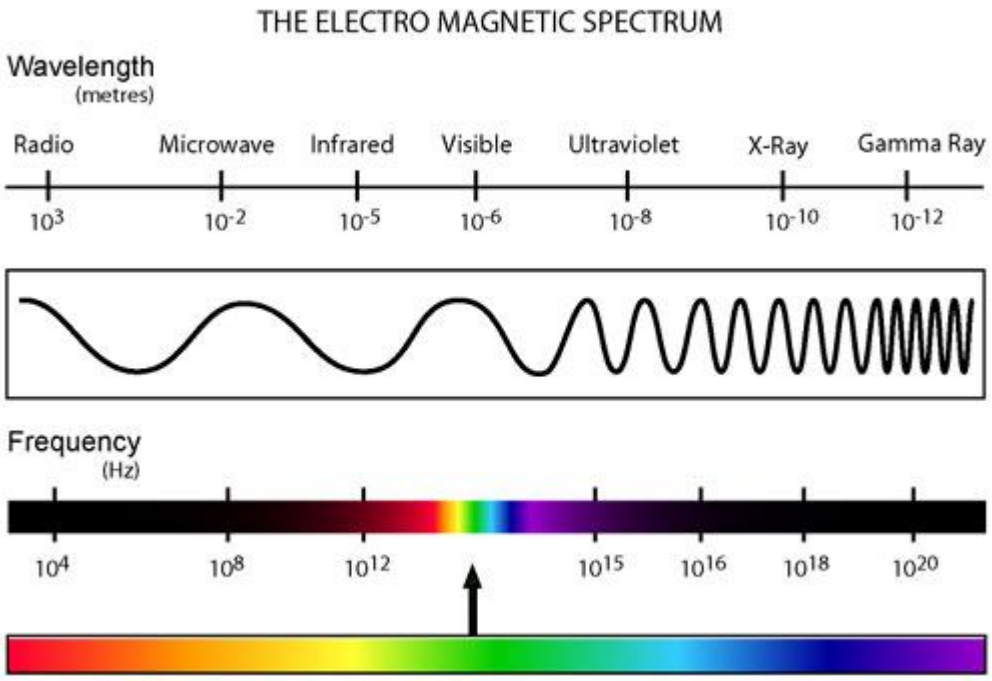

Figure 1

ADA Description: This figure displays the various parts of the electromagnetic spectrum with their respective wavelengths.

Caption: Figure 1: Diagram of the electromagnetic spectrum

Image file name: uvlight_figure1

IMAGE Insert Figure 2 here, centered

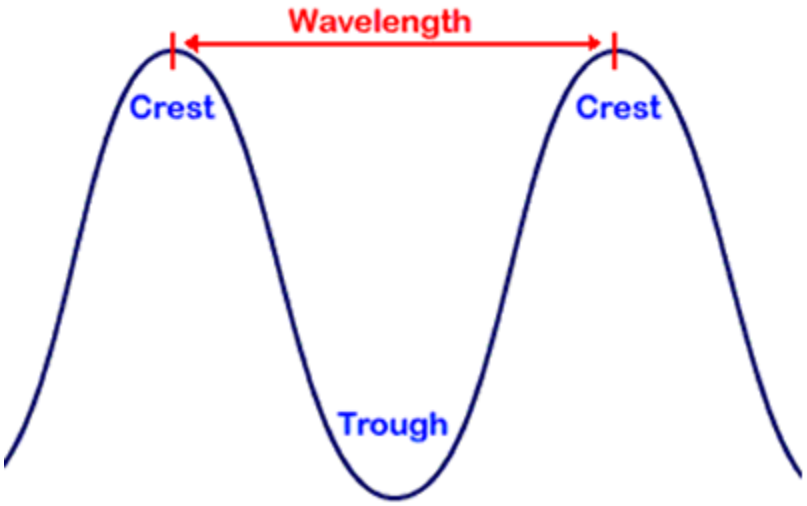

Figure 2

ADA Description: This figure displays the definition of wavelength as the distance between two consecutive peaks

Caption: Figure 2: Diagram of a the wavelength of a wave

Image file name: uvlight_figure2,jpg

Vocabulary / Definitions

Word	Definition
wavelength	Distance between two consecutive peaks of a wave.
electromagnetic spectrum	The range of wavelengths over which light extends.
ultra violet light	Range of light with wavelengths from 4 nanometers (border of x-rays) to 380 nanometers (slightly shorter than violet in the visible spectrum).

Procedure

Before the Activity

- Distribute 5 beads to each student
- Distribute 1 pipe cleaner to each student

With the Students

1. Have students construct the following table in their notebooks:

	Did the UV beads change color? Use the following scale to describe the level of change: 1 = no change in color 2 = small change in color 3 = big change in color	
Condition	Indoors	Outdoors
a. Uncovered		
b. Covered with sun block		

If an outdoor area is not available, use an open window that is exposed to direct sunlight.

2. Students will have a list of conditions depending on the number of available materials, and will answer each condition according to the provided scale.
3. For conditions that require covering the beads with a material, only cover half of the beads for a few minutes while leaving the other half exposed. When removing the material, students should be very observant to any changes, or lack there of, that are occurring, as the beads change color easily.
4. After all conditions have been investigated, all students in the class will compare their findings. Students should discuss the factors that influenced their sensor design as well as the effectiveness of their sensor in all areas tested. If possible, photographs should be taken and used to illustrate various sensor designs under the tested conditions to the entire class.

IMAGE Insert Image 2 here, centered

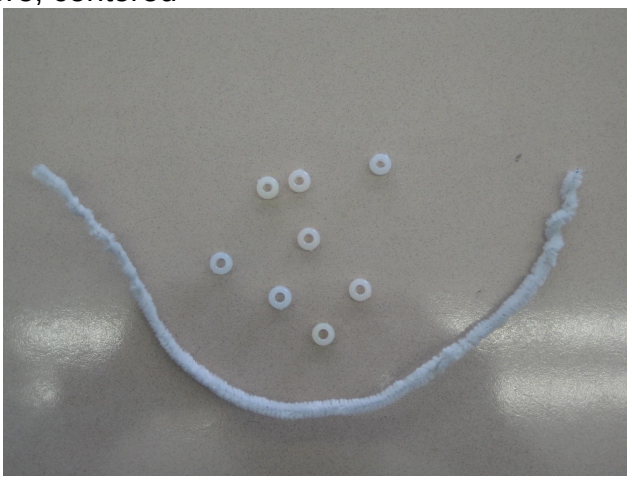

Image 2
ADA Description: Materials needed to construct the UV bracelet
Caption: Image 2: A pipe cleaner and a few UV beads are used to make an example UV sensor.
Image file name: UV_beads_and_pipe_cleaner_image2.jpg
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IMAGE Insert Image 3 here, centered.

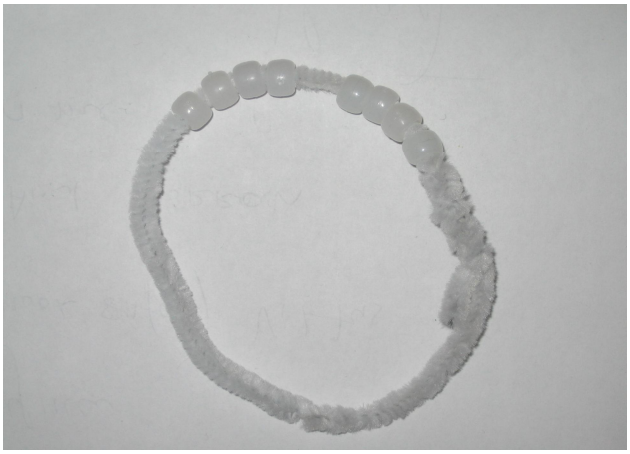

Image 3
ADA Description: A UV bracelet that is in the presence of non-UV light
Caption: Image 3: The neutral state of the UV beads
Image file name: UV_Bracelet_Neutral_Image3.jpg
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IMAGE Insert Image 4 here, centered.

Image 4

ADA Description: A UV bracelet that is in the presence of non-UV light

Caption: Image 4: The UV bracelet changes color in the presence of UV light

Image file name: UV_Bracelet_In_UV_Light_image4.jpg

Assessment

Activity Embedded Assessment

Analysis

There are two criteria that the students should be evaluated on: sensor design and the effectiveness of the tested materials at blocking UV light. For the sensor design, a superior design includes: simple attachment to an object (for example, a person's wrist or a fence) and the ability to render a distinct and clear change in color under the various conditions. For effectiveness, students should list the level in change of color for each material tested (a general scale can be used, such as: no change in color, small change in color and big change in color) and determine which material is most effective at blocking UV light.

Activity Extensions

None

Additional Multimedia Support

None

References

1. The American Museum of Natural History - Moveable Museum: Discovering the Universe

Redirect URL

http://GK12.poly.edu/AMPS-CBRI

Owner

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Contributors

Keeshan Williams, Vikram Kapila

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