UV Beads

P3-6500, P3-6505

INSTRUCTIONAL GUIDE

Contents

- 250 multi-colored UV Beads (P3-6500)
  OR
- 1000 multi-colored UV Beads (P3-6505)

Recommended for activities:

- UV Flashlight and Holder (P2-9045)
- Sunglasses
- Different types of bulbs

Background

UV Beads contain a chemical that changes color when exposed to ultraviolet light and will fade back to white without UV exposure. The beads can cycle back and forth over 50,000 times. The sun emits ultraviolet light, so exposing the beads to sunlight will cause their color to change. Students can experiment with different conditions and see which cause a color change. The ultraviolet wavelengths in sunlight cause skin to tan and burn. Students can relate the results of their experiments to the likelihood of getting sunburned in different conditions.

The electromagnetic radiation needed to affect change is between 360 and 300 nm in wavelength. This includes the high-energy part of UV light Type A (400-320 nm) and the low energy part of UV light Type B (320-280 nm). Long fluorescent type black lights work well; incandescent black lights and UV-C lamps will not change the color of the beads.

Introduction

The dye molecules in the UV Beads consist of two large, planar, conjugated systems orthogonal to one another. No resonance occurs between two orthogonal parts of a molecule. When high energy UV light excites the central carbon atom, the two smaller planar conjugated parts form one large conjugated planar molecule. Initially neither of the two planar conjugated parts of the molecule is large enough to absorb visible light and the dye remains colorless. When excited with UV radiation, the resulting larger planar conjugated molecule absorbs certain wavelengths of visible light resulting in a color. The longer the conjugated chain, the longer the wavelength of light that is absorbed by the molecule. By changing the size of the two conjugated sections of the molecule, different dye colors can be produced. Heat from the surroundings provides the activation energy needed to return the planar form of the molecule back to its lower energy orthogonal colorless structure.

Although UV light is needed to excite the molecule to form the high-energy planar structure, heat from the surroundings provides the activation energy to change the molecule back to its colorless structure. If colored beads are placed in liquid nitrogen, they will not have enough activation energy to return to the colorless form.

Experiments

1. What kinds of light contain UV? Expose the beads to light from different sources, including the sun, incandescent light bulbs, fluorescent light bulbs, colored lights, and a blacklight (P2-9035).
2. Can you get sunburned on a cloudy day? Can you get sunburned in the shade?
3. How effective are different sunscreens? Coat the beads with different brands and compare the rate of color change.
4. Can UV pass through window glass? Try different types of glass, including tinted glass and car windows.
5. How much UV protection do different types of sunglasses provide?
6. How does the amount of UV from the sun compare to the UV in tanning booths?

Related Products

Portable Blacklight (P2-9035) Portable ultraviolet light source runs on 4 AA batteries.

Willemite, Quartz Demo Kit (P3-6700) A New Way to Explore Properties of Light Willemite is a fluorescent metamorphic rock with the unusual property of fluorescing only in the short wave UV.

Demonstration Electroscope (P6-1170) This electroscope's design makes it superior to traditional leaf-style electroscopes in part because the needle stays put as experiments are performed. Clearly demonstrate the photoelectric effect by shining UV light at the charged aluminum plate attachment.