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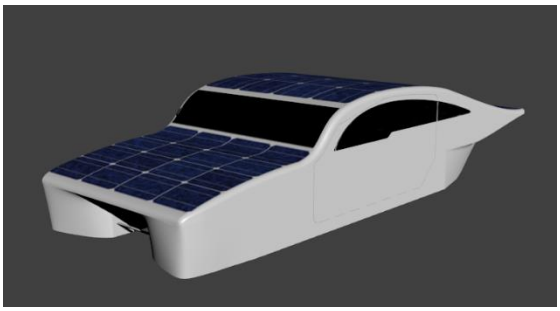
THE CANE INSTITUTE FOR ADVANCED TECHNOLOGIES

Hello ADHUS and FAUHS Students (and Parents)!

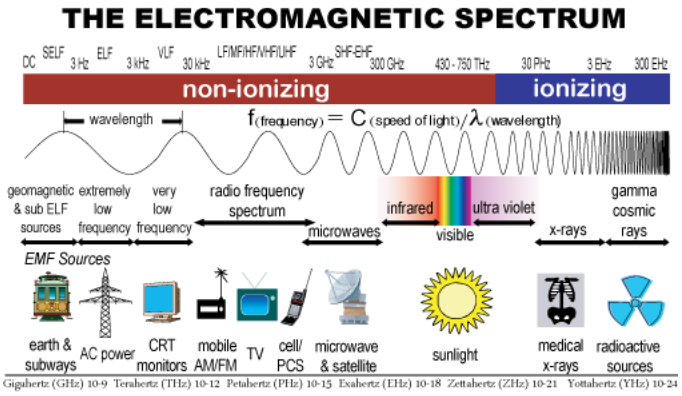
The Cane Institute is excited to provide your sixth TCI STEM@Home mailer. This mailer is designed to teach you a little about solar UV radiation and is sponsored by the FAUHS Solar Owls solar car team! We are building the first solar cruiser in the Sunshine State!!! Our solar car will carry 4 students in a cross-country competition from Ft Worth, Texas to Boulder, Colorado, all while using less energy than a hair dryer! Our FAU High team has been busy designing our solar cruiser and cannot wait to be able to get back together to begin the construction of this innovative vehicle pictured to the right in a Computer-Aided Design rendering. Our solar car will use sunlight with wavelengths from 380 nm to 750nm to create an electrical current in our solar cells. So, if these UV beads change color, it is a great day to drive our solar car!

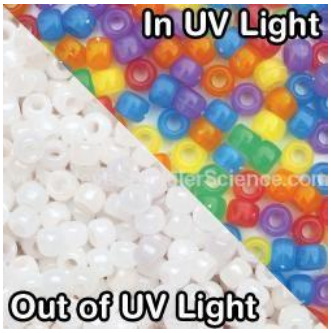


Background:

Ultraviolet (UV) light is electromagnetic radiation with a wavelength shorter than that of visible light, but longer than X-rays. UV is so named because the spectrum consists of electromagnetic waves with frequencies higher than those that humans identify as the color violet. UV frequencies are invisible to humans, but near UV is visible to several insects and birds.

Although UV radiation is invisible to the human eye, most people are aware of the effects of UV on the skin, like suntan and sunburn. Short-wavelength and mid-wavelength UV can cause much damage to living organisms, such that life on Earth outside of the deep oceans is possible only because the atmosphere, primarily the ozone layer, filters out nearly all short-wavelength and most mid-range UV. A smaller amount of UV reaches the surface and can cause long-term skin damage and cancer, but we do need a little UV to help with the formation of vitamin D in our bodies.





These beads contain a special chemical that changes color when exposed to ultraviolet (UV) light. UV is an invisible type of light from the sun that is beyond what the human eye can see. It can burn our skin and cause skin cancer, damage our eyes, and destroy our cells. Most UV is blocked by our Earth's ozone layer and atmosphere, but some still gets through and can be detected. The beads will stay white when inside or not exposed to UV. They will only turn bright colors when exposed to UV, usually from the Sun or a UV ("black") light. The darker the color of the beads, the more UV rays they are detecting. Once you bring the beads back indoors, they will slowly change to white again. If placed in the dark, these beads will phosphoresce, or glow in the dark and give off visible light as they return to their resting state. This process can be repeated many times.

What wavelengths of light cause a color change in the UV beads?

Infrared 1000-700 nm	Visible Light 390 – 700 nm	UV-A 400 – 315 nm	UV-B 315 – 280 nm	UV-C 280 – 100 nm
Infrared light makes our skin feel warm and can be detected by some animals such as snakes.	Visible light can be seen by our eyes. It includes all the colors of the visible rainbow.	Too much exposure to ultraviolet A can result in the same damage as UV-B but to a lesser degree.	UV-B light is needed for vitamin D synthesis in our bodies, but is a major cause of sunburn, skin cancer, cataracts, suppression of the immune system, and photo-aging.	UV-C is extremely dangerous, but completely absorbed by the ozone in the Earth's atmosphere and does not reach the Earth's surface.
				
Beads are white > 360 nm		Beads are colors between 360 to 300 nm		Beads are white from 300 nm to 100 nm

Experiment: Test the effectiveness of sunscreen with different SPF levels.

Knowing you will spend some time in the sun, you carefully spread a sunscreen lotion labeled "SPF 50" on exposed skin. The next day, you look and feel like a steamed lobster. What happened??? Instead of using your skin as a UV detector, do a test your UV beads to see if the sunscreen you are using is effective. Knowing the effectiveness of your sunscreen will make your sun time more of a fun time!

- If testing two different sunscreens, you will need 3 small Ziplock snack bags. Put 3 beads in each bag.
- On one plastic bag, use a marker to write the word "control."
- On the other two bags, write the name and the SPF number of each sunscreen you are testing.
- On the unlabeled side of the bag, smoothly and evenly spread a half-teaspoon of sunscreen directly onto the bag. Do the same with the other bag and its corresponding sunscreen. The Control bag receives no sunscreen. Be sure to wash your hands in between each application so the test is fair. Let the sunscreens dry completely.
- Go outside. Lay the bags, labels down, next to each other in direct sunlight and watch them for a few minutes.
- Keep the labels down and sort the bags by the brightness of the colors you see. Place the brightest colors to the left, palest colors at the right. Then turn the bags over to reveal which sunscreen was more effective compared to the control which should have the brightest colored beads.

A UV Awareness Bracelet, Necklace, or Zipper pull for your Backpack:

Thread your UV beads onto a piece of leather, yarn, or string to make a bracelet, necklace, or zipper pull for your backpack. Use the beads to track your UV exposure and as a reminder to apply sunscreen. Remember, if the beads change color, you are being exposed to UV and might consider protecting yourself with sunscreen, a wide-brimmed hat, or long sleeves. Be sun smart!

For Further Study:

Use the attached data sheet to help you on your scientific quest to collect data while you are using your UV beads. Remember, scientists take a lot of notes about their observations! The data sheet has lots of ideas of ways to test your beads. Remember to write down your predictions BEFORE you test your beads. Did any of your results surprise you?

We want to hear from you! Are you enjoying your TCI STEM@Home kits? Please let us know! Remember to share your photos on social media and tag @FAUCaneInstitute on Facebook or Twitter. Feel free to email us at aphipps@fau.edu.

YOU BE THE SCIENTIST!

Experimental	Your Prediction (Do you think the beads will be white, faint, or colored?)	Actual Color of Beads (white, faint, or colored)	Safe from UV? (yes or no)	Notes
Hold beads 1 ft underwater				
In sunlight				
In shadow				
Cloudy sky (no direct sunlight)				
Behind paper				
Behind sunglasses				
Behind eyeglasses				
Under cloth				
Inside orange plastic medication bottle				
Behind window glass				
Behind car windshield				
Behind tinted car glass				
Under brim of cap				
Behind plastic				
Sun at mid-day				
Sun at sunset/sunrise				
UV (black) light from your pocket microscope				
Fluorescent light				
Incandescent light				
LED light				
Sunscreen SPF 15				
Sunscreen SPF 30				
Sunscreen SPF 50+				