THE EFFECTS OF UV RAYS ON UV BEADS

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ABSTRACT

The purpose of these experiments was to find out which items protect the skin best from UV rays. Ultra violet light is an invisible form of electromagnetic radiation that has a shorter wavelength than the human eye can see. Bags with sunscreen on the top were soaked in water for different amounts of time and then placed on UV beads to see how well they protect them from UV rays. The beads that were protected by the sunscreen that had been soaked for the least amount of time absorbed the least amount of UV light and the beads that had protection from the sunscreen that had been soaked for the longest time absorbed the most amount of UV light. This is because the water the sunscreen bag was soaked in slowly washed away the sunscreen from the top making it easier for light to reach the beads so, the longer the soak the most amount of sunscreen will come off and the most amount of UV light will be absorbed.

INTRODUCTION

UV or Ultraviolet light is an invisible form of electromagnetic radiation that has a shorter wavelength than the human eye can see. Usually UV light is divided into different groups, UVA, UVB, and UVC. UVA is lower in energy but penetrates more deeply than UVB does. UVB is a high-energy ray that causes the most damage to the eyes. Lastly, UVC is the most powerful form of UV light. This light can also cause some substances to radiate visible light, an occurrence known as fluorescence. UV light carries more energy than visible light, and can sometimes alter the chemistry of materials exposed to it. This is caused by a breaking of bonds between atoms and molecules. UV light can be beneficial to one’s health because it is important in the production of Vitamin D and kills harmful microorganisms. Although UV light can be great for the health, excessive exposure can cause the skin to burn and increase the risk of skin cancer. There are many uses for UV light including fluorescent light bulbs, disinfection and astronomy.

Sunglasses are one of the best items when it comes to blocking UV light. There are tints in the lenses of sunglasses that keep UVB light from reaching the eyes. Manufacturers add certain
colors that best block UV light but amber and brown tints absorb the most UV light. These lenses are made by soaking polycarbonate lenses in a tint solution. Sunglasses can also have an extra UV coating. This coating is also applied to regular glass lenses as well. Another obvious substance that blocks UV light: sunscreen. Sunscreen has a factor called SPF (sun protection factor) that determines how strong the sunscreen is when protecting the skin from UV rays. The higher the SPF the more protection against UVB and UVA rays. The majority of sunscreens protect the skin from UVB rays and not UVA. Sunscreen comes in many forms such as lotions, gels, ointments and sprays. Even some cosmetics such as lipsticks and moisturizers have some sort of sunscreen added to them. Clothing also plays a big role in UV protection. Long sleeve shirts, pants and skirts cover the majority of the skin so they offer more protection than shorter clothing items. Generally, lighter fabric colors such as white are better to wear because they reflect the UV light instead of absorbing it like darker color do. A tightly woven fabric such as denim protects better than loosely woven fabrics. Remember, if light can be seen through a fabric, UV rays can get through too.

The outer layer of skin of is called the epidermis. The outermost cells of the epidermis, the ones that can be seen and felt are dead. Just below this layer of dead cells is a layer of living ones. These cells continuously re-produce new dead cells to replenish the skin. When the skin is exposed to sunlight, it is being exposed to ultra-violet light. UV light has the ability to kill cells. It hits the layer of living cells of the epidermis and starts damaging, if not killing them. Next, the immune system comes to help by increasing blood flow in infected areas and opening up capillary walls so that the white blood cells can remove the damaged cells. This increased blood flow makes the skin warm and appear red. The nerve endings for pain begin sending signals to the brain. Damaged cells release chemicals that activate pain receptors. This is why sunburned skin is so sensitive. Certain skin tones can become sunburned faster than other skin because of its coloring. People with fair skin, light colored eyes and red or blonde hair are more likely to get sunburnt than someone with darker features. This is because lighter-skinned people have less melanin. Melanin is a chemical in the skin that protects it from sun damage by reflecting and absorbing UV rays. The sun produces ultraviolet light of all categories but the shorter, higher energy wavelengths are absorbed by oxygen in the atmosphere but particularly the ozone layer. Because of this, the UV light that does reach the surface consists of mostly UV-A with a smidge of UV-B. UV-B is responsible for sunburns. Earth’s sunlight has both benefits and dangers.
Luke Johnson also did some experiments relating to UV beads. His first experiment involved finding the amount of UV light that (on a scale from 0-10) the beads had been exposed to after UV light had been shining on them for different amounts of time. It was determined that after being exposed to UV light for one or more minutes, the beads were almost completely exposed to all UV light. After three min of being exposed to UV light the beads were fully exposed to the UV light. The beads were measured at a zero when not being exposed to any UV light at all but got a 7.5 when having the UV light shinned on them for three minutes. One of his other experiments was seeing which type of t-shirt (polyester, cotton, nylon/spandex and no t-shirt at all) blocked the most UV light from the beads. When the beads were placed inside the polyester t-shirt, the intensity of the UV light that touched the beads was only 1.5, the maximum of bead color level intensity among the t-shirts. The bead color intensity was at a 9.5 when the beads were not placed inside any t-shirt. Another experiment done was protecting the beads with different amounts of sunscreen. When the beads were not being shielded by any sunscreen, they had been exposed to the most amount of UV light whereas when the beads were being protected by the most amount of sunscreen (40mL) they had been exposed to least amount of UV light. The bead color intensity was measured at a 9 when placed outside in broad daylight with no sunscreen and a 1.5 when being protected by 40 mL of sunscreen.

**MATERIALS AND METHODS**

In the experiments, a ruler, bandana, napkin, dropper, Coppertone water babies sunscreen (SPF 50), banana boat sport performance sunscreen (SPF 15), Coppertone sport (SPF 30), banana boat deep tanning oil (SPF 4), a towel, sunglasses, human hair, ziploc bags, UV beads, water, UV light probe, timer, and a target plastic bag were used.

UV beads were placed on the table. The UV light was shined on the beads from different levels to mimic different times of the day. The UV light probe was positioned first right next to the beads, a few centimeters above them (12:00 am). Next, the stick was moved slightly to the left to signify 5:00 am and then it was moved to the center (12:00 pm). The next times (5:00 pm and 12:00 am) had the same positioning as 5:00 am and 12:00 am. The UV light was shinned on the beads in each position for one minute. The amount of UV light absorbed was recorded by using a paper key that shows the different levels of UV bead coloration.
The UV beads were placed on the table and the UV light was shinned for 30 sec from different heights onto the beads. The amount of UV light absorbed was measured (using the paper key) for each height the UV light was shining from. These heights were 2.54 cm, 12.7 cm, 25.4 cm and 38.1 cm.

Different objects such as a napkin, bandana, towel, hair, sunglasses and plastic bag were placed on top of the UV beads. The UV light was shined onto the beads covered by a certain object for 1 min, and then the amount of UV the beads had absorbed was recorded.

The beads were placed in a small Ziploc bag, and each type of sunscreen (SPF 50, 30, 15 and 4) was squirted/sprayed 3 times onto the front of the bag. The UV light was shined onto the beads for 1 min and the amount of UV light that the beads had absorbed after being protected by different types of sunscreen was recorded.

Again, the beads were placed into a ziploc bag and SPF 15 sunscreen was squirited onto the top. Zero, one, five, ten and fifteen squirts of water were squirited onto the sunscreen. The amount of UV light the beads had absorbed when being shielded by slightly watered down sunscreen was recorded and the results were then written down.

SPF 15 sunscreen was squirited once into a ziploc bag. The UV beads were placed underneath the bag. Zero, one, five, ten and fifteen squirts of water were squirited onto the sunscreen. The UV light was shined on the beads and sunscreen for 1 min, and the amount of UV light the beads absorbed was recorded. Next, all the same things were done except that there were four squirts of sunscreen in the bag instead of one.

SPF 50 sunscreen was squirited twice on top of a ziploc bag. This bag was then soaked in a small amount of water for different amounts of time. These times were: 1 min, 3 min, 5 min and 7 min. Each time the sunscreen bag had been soaked in water for a certain amount of time, the beads were placed under the bag and the UV light shined on it for 1 min. This was done each time and the amount of UV light the beads absorbed was recorded.

**RESULTS AND DISCUSSION**
Figure 1- The Amount of UV Light When Exposed from Different Positions

It was determined that the beads had absorbed nearly all of the UV light when the light probe was shining on them at the 12:00 pm position and the least amount at the 5:00 am position.

When the UV light was shining on the beads at 12:00 pm, the level of bead color intensity was measured at a 7 on a scale from 0-10. This was the maximum amount of UV light that the beads had absorbed during the whole experiment. When the light was shining on the beads at 5:00 am, the beads were only measured at a 2, the minimum amount absorbed. This is because at the 12:00 pm position, the light probe was directly above the beads making it easier for the light to reach all of the beads. Unlike the 12:00 position, the 5:00 position is directly to side of the beads, so the light isn’t completely being shined on the beads themselves.
The beads were found to have absorbed the most UV light when the light probe was shining on them from the smallest height. This is the opposite of the amount absorbed when the light probe was shining from the largest height. When the light probe was shining 2.5 cm away from the beads, they amount of UV light absorbed was measured at an 8 from a scale of 0-10. The beads were measured at a 0 when the UV light was shining from 38.1 cm away from them. This is because the closer the light is to the beads; the light is more intense and it shines directly onto the beads instead of other objects in the room.

**Figure 2- The Amount of UV Light When Shining from Different Heights**
Figure 3- How Different Objects Block UV Light from the Beads

When the beads were covered by the napkin, they absorbed the most amount of UV light, whereas they absorbed the least when covered by a towel, sunglasses and hair. The amount of UV light absorbed was at a 9 out of 10 when being covered by a napkin, which means the beads absorbed almost all of the UV light. When being covered by sunglasses, hair and a towel, the beads absorbed none of the UV light, 0 out of 10. This is because the items that blocked the most light, like the towel for example is made out of a thicker material that doesn’t let any light through. This is the opposite from papery and thin makeup of the napkin.
Figure 4- How Different Types of Sunscreen Effect UV Light Absorbed by Beads

When the beads were being protected by the SPF 30 and 50 sunscreen, the beads absorbed the least amount of UV light. The beads absorbed the least amount of UV light when being shielded by SPF 4 sunscreen. The amount of UV light absorbed was measured at a 7 out of 10 when having protection from the SPF 4 sunscreen. The beads’ light absorption was measured at a 0 when protected by SPF 30 and 50 sunscreen. Like what was said in the introduction, SPF means sun protection factor, so the higher the SPF, the more sun protection there is. The data displayed on the graph makes sense because the sunscreens with the higher SPFs protected the beads more from the UV light and the lower SPF sunscreens protected the beads less.
Figure 5- How Watered Down Sunscreen Protects from UV Light

When the sunscreen shielding the beads had the least amount of water squirited in it (0), the beads absorbed the least amount of light. This is the opposite from when the sunscreen had the most squirts of water in it (15) and the beads absorbed the most amount of light. When the beads were being protected by sunscreen with no drops in it, the amount of light absorbed by the beads was measured at 0 out of ten. When being protected by sunscreen with 15 drops of water in it, the beads’ UV light absorption was measured at an 8. This is because (a) when the water drops are being squirited in the bag, it washed the sunscreen of the sides and (b) made the sunscreen super watery so that it fell to the bottom of the bag. This made it easier for UV light to get through the bag onto the beads.
When there was only one squirt of sunscreen in the bag, and there were no squirts of water, the beads absorbed the least amount of light whereas when the sunscreen had the most squirts of water in it (15) it absorbed the most light. When being protected with water free sunscreen, the UV light absorbed by the beads was measured at a 2 on a scale from 0 to 10. When having protection from sunscreen with 15 drops of water in it, the beads were measured at 7. This data was compared to beads being protected with 4 squirts of sunscreen instead of just 1. The amount of UV light absorbed was the highest when being protected by sunscreen with 15 drops of water, a 4 out of 10. The amount of UV light absorbed was the lowest when being protected by sunscreen with zero drops of water, a 0. This is because of two things. One, the drops of water pushes the sunscreen to the bottom of the bag, and washes it off the sides making it easier for light to reach the beads. Secondly, the more sunscreen there is, the more protection from UV rays there is.
When the sunscreen protecting the beads was soaked in water for the least amount of time (1 min), the beads absorbed the least amount of UV light. The beads absorbed the most amount of UV light when being protected by sunscreen soaked in water for the longest time (7 min). The amount of UV light absorbed was measured at a 0 on a scale from 0 to ten when the sunscreen protecting them was soaked in water only 1 min. These results are different from when the sunscreen was soaked for 7 min and the amount of light the beads absorbed was measured at a 5. This is because the water slowly washes off the sunscreen from the front of the bag so the longer the bag and sunscreen are soaking, the more sunscreen comes of the bag.

**CONCLUSION**

In conclusion, it was found that the napkin and the plastic bag were the most unreliable sources to protect the skin from UV rays, but a towel, hair, and sunglasses were the most reliable. This was predicted because the towel for example is made out of a thicker material that wouldn’t let as much light through as the thin makeup of the napkin and plastic bag. These results are important for people with sensitive skin who need extra skin protection from UV rays. It would
be interesting to do a follow up experiment on whether being wet helps or doesn’t help protect the skin from UV rays.

**CITATIONS**


