Are You Protected?

Introduction

When I vacation, I always get sunburned! I chose this project because I am interested in understanding what method of skin protection is best for sun exposure so I can enjoy my vacations more without a sunburn. Other kids can benefit from my experiment by knowing what to wear when doing outdoor activities like swimming, riding your bike, or anything under the sun. My project helps to know if you need to wait fifteen to twenty minutes before jumping in a pool or going outside under the sun. Also, my project compares different brands of sunscreens, application methods, and age of sunscreens to see what works best. This project also investigates how sunscreens compare to clothing such as rash guards and tee shirts.

Problem/ Hypothesis

This project investigates several problems:

How does the effectiveness of sunscreens (UVA and UVB wavelengths) compare being dry outside versus in water outside?

My hypothesis for my first problem is that the dry sunscreen environment would work better because the container shows that you need to reapply more if in water.

What type of applications of sunscreens (rub on cream, spray, and stick rub on) perform best for either dry of wet conditions?

My hypothesis was that the cream sunscreen would work better both dry and wet than spray on or stick because it goes on thicker.

Does age of the sunscreen affect the protection it is supposed to offer?

My hypothesis was that new sunscreen would work better than old because the chemicals have not had a chance to break down.

Which sunscreen brands are best at protecting against UVA versus UVB at the same SPF?

My hypothesis was that Blue Lizard would work the best because Blue Lizard is what we use on our vacations to Florida where we are in the sun all day.

Is it really necessary to wait 15 to 20 mins after sunscreen application before sun exposure or swimming?

My hypothesis was that the effectiveness of the sunscreen would be less prior to the recommended wait time even though I've noticed many adults and kids do not wait.

How effective is using clothing (blue rash guard and white tee shirt) compared to sunscreens both wet and dry?

My hypothesis was the rash guard would work better than all sunscreens and the white tee shirt when both wet and dry because I never burned my skin where a rash guard was covering it.

Variables

Independent: Environment (dry vs wet), Sunscreen ingredient, Application type, Swim clothing type, Age of sunscreen

Dependent: Level of protection (UVA & UVB) measured in mW/m2

Controls: All sunscreens rating SPF 30, sunny day (no clouds), application of sunscreen performed in same way

Background

In order to understand how to test effectiveness of different sun protection methods, I researched how sunlight affects the body. I learned about the effects of UVA and UVB rays on the skin. UVA rays penetrate deep into the skin causing long term skin damage and UVB rays cause surface sunburn redness and pain. It is important to protect against both UVA and UVB rays from sunlight in order to be safe from sunlight. I learned that by measuring the amount of UVA and UVB light that penetrates through the protective layer will indicate which protective layer is best at any given time or condition.

Procedure

To solve the problems, I needed to collect UVA and UVB data. We used my dad's laptop computer along with Logger Pro software and a Vernier Stream hardware to collect data live every 0 minutes, 35 minutes, 72 minutes, 120 minutes, and 180 minutes. I collected data while the sun was shining between the times of 11:00 am and 3:00 pm.

To prepare the testing station, I used PVC pipe to surround each sensor and glued a pink foam block to the end of each pipe that I could attach (pin) overlays on and that would protect the sensors when stretching the fabric collect UVA and UVB readings. To prepare the sunscreen samples, I used 3M transparencies (overlays) to wipe even amount of sunscreen on. I then attached a thumb tack for attaching the sample to the sensor testing station.

I started with just the UVA and UVB sensor pointing straight at the sun to get our baseline UVA and UVB data. Next, I used our control which was only an overlay (without any sunscreen on it) to get baseline data. I then applied sunscreen to a transparency and immediately pinned it to the pink foam board that was attached to PVC tube. I repeated this process for all sunscreens that were dry. After each sample was tested, it was pinned on a large foam board in direct sunlight to represent a person in the sun.

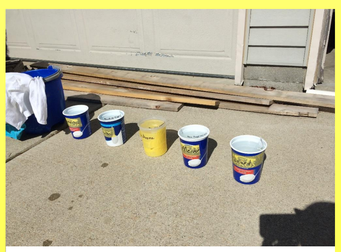
For the rash guard and white tee shirt, I stretched the shirt as if I was wearing it over the PVC and collected the UVA and UVB data.

For the wet locations, I first tested a wet transparency as a control. Next, I put sunscreen on the transparency and immediately dipped in water (in quart sized Yogurt containers) and then pinned transparency to the pink foam board/PVC to collect both UVA and UVB data. After I collected data, the transparency went back into the wet container for a set time to simulate a person in the lake.

We repeated data collection for no overlay, overlay (control), Blue Lizard (dry), Blue Lizard (wet), Meijer Sport (dry), Meier Sport (wet), Neutrogena Sheer Zinc (dry), Neutrogena Sheer Zinc (wet), Coppertone Sport Stick (dry), Coppertone Sport Stick (wet), Banana Boat Sport spray (dry), Banana Boat spray (wet), rash guard (dry), rash guard (wet), white tee shirt (dry) and white tee shirt (wet) for 0 minutes, 35 minutes, 72 minutes, 120 minutes and 180 minutes.

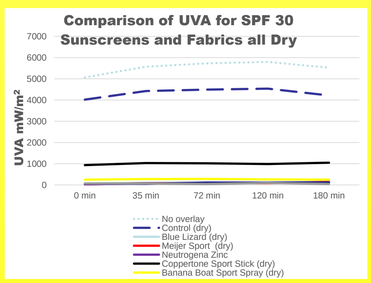
Sunscreens used in experiment all SPF 30

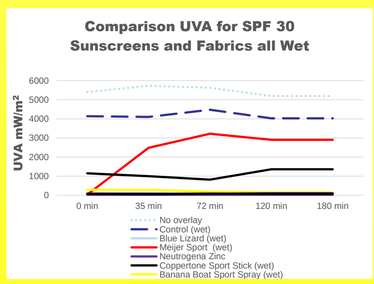

Project setup with computer, LabQuest Stream, UVA & UVB sensor

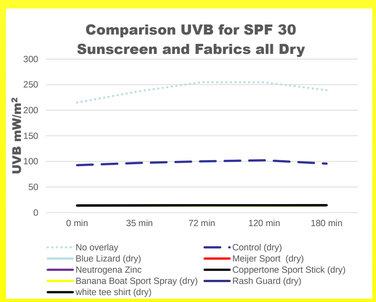

Water container for sunscreen transparencies and rash guard/tee shirt

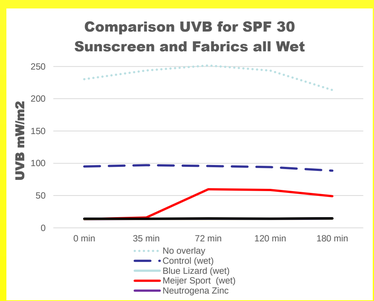

Applying sunscreen to transparency

Data Analysis









Results

After we conducted the experiment testing a wet environment versus a dry environment immediately after applying sunscreen, we found that all of the new sunscreens worked very well both dry and wet for both UVA and UVB. The only exception to this was the older sunscreens Meijer Sport and Coppertone Sport stick did poorly after they were wet. My assumption is that newer sunscreen sticks to your body better than ten or twenty year old sunscreens. The rash guard and white tee shirt performed as well as the sunscreens in both wet and dry environments.

From our experiment we can also compare different application of sunscreen: rub on, spray, and stick rub on. The data shows all applications of sunscreen worked well for the UVB spectrum but were not equal in the UVA spectrum. For UVA, we found that all of the newly purchased rub on sunscreen did the best, spray came in second and the stick came in last. We believe the stick did poorly because of it was manufactured in 2012.

Our data indicates the age of the sunscreen was the biggest factor in protecting a person from the sun. Older sunscreens don't protect as well against the UVA sun rays which strike farther into a person's skin than the UVB rays. Since 95% of UV radiation is UVA, I feel that this makes the age of sunscreen even more critical when using in extreme conditions like Florida.

From our experiment we can also compare the brand versus the protection from UVA and UVB. I found that brand isn't as important as the ingredients found in the sunscreen. I found that the sunscreens Blue Lizard and Neutrogena Sheer Zinc performed best for UVA in both wet and dry environments because they contained Zinc Oxide. During my research I found that Zinc Oxide sits on top of the skin rather than being absorbed into the skin. This allows it to protect your skin better from the sun. Also, the size of the particles of Zinc Oxide are smaller which offers better protection. In addition, it is safer to use Zinc Oxide because it does not get into our bodies. Avobenzone and Homosalate found in Banana Boat, Coppertone Sport and Meijer Sport did not provide the protection of the others.

Another result is that you do not have to wait after you apply sunscreen to enter a pool, lake or the ocean.

Finally, the data shows that white tee shirts and rash guards provide just as good of protection from the sun in both categories of wet and dry for both UVA and UVB. The great thing about a rash guard and tee shirt is that over time the protection does not decrease and you are not putting chemicals on your body.

Conclusion

The main conclusion I arrived at is to wear a rash guard or white tee shirt whenever possible to protect from the sun. My experiment shows it provides just as good of protection to both UVA and UVB rays as the best sunscreens and it doesn't lose effectiveness with time.

Secondly, you don't have to wait to enter water after sunscreen is applied. It works right away as long as the sunscreen is not old.

Finally, if sunscreen is to be used, old sunscreen should be avoided as it did not provide as good of protection as newer containers. Also, when choosing a brand, pick the ingredients of Zinc Oxide or Titanium Oxide. These ingredients work well for both UVA and UVB and are safe because they don't enter the human bloodstream like other sunscreens that contain Avobenzone, Homosalate and Octocrylene.