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Period 1
Role Observer/recorder

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Learning Group Table 6

"The Effect of **SPF Level** on The **Color Change of UV Beads**"

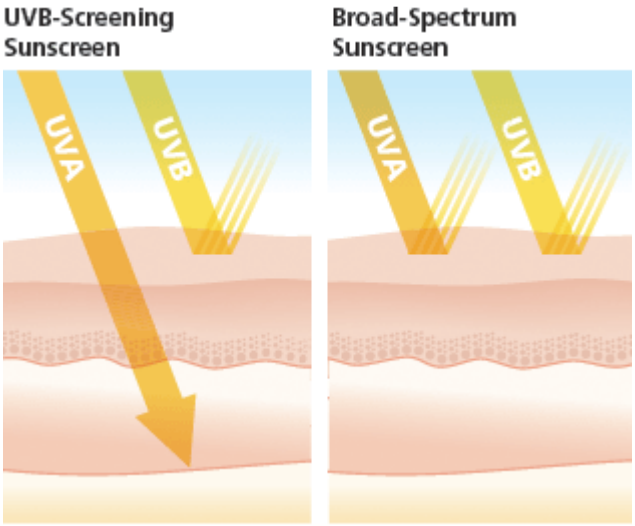
Key Question: Does higher levels of SPF provide more protection from the sun's harmful ultraviolet radiation (UV rays)?

Background:

Sun protection factor (SPF) is a numbered scale ranging from 2-100 that rates the degree of protection from sunburn provided by sunscreens. Sunscreens contain various chemicals that "block" UV rays by either absorbing or reflecting or scattering UV rays. The higher the SPF the more UV rays are blocked.

Unfortunately it isn't quite that simple. UV rays come in 2 types UVA and UVB, both of which can be harmful to humans when exposed for longer than recommended durations. UVB does not penetrate the skin as deeply and is primarily responsible for sunburns; on the other hand UVA penetrates more deeply and may be linked to higher frequency of skin cancer. SPF is a measure of how well UVB rays are blocked and not UVA. In addition some claims made by sunscreen manufacturers are not accurate.

Based on this information it would seem that higher levels of SPF would indeed provide greater protection from UV rays since more of the rays would be blocked. However we can't be sure of the manufacturer's claim and are uncertain about the amount of UVA rays that are blocked. Also the majority of UV rays reaching Earth's surface are UVA.



In order to test the effectiveness of sunscreen at blocking UV radiation we need something that can detect or measure UV rays. In the lab we have something called UV beads which are normally white or close to white in color but when exposed to UV rays turn various colors. The beads have a substance in them that will absorb the invisible ultraviolet light and convert it to longer wave radiation which is visible. So the color change will indicate the presence of UV radiation.

Sources:
http://www.medterms.com/script/main/art.asp?articlekey=5590
http://www.scientificamerican.com/article.cfm?id=how-does-sunscreen-protec
http://environment.about.com/od/healthenvironment/a/sunscreen.htm
http://www.ewg.org/whichsunscreensarebest/2009report
http://www.grand-illusions.com/acatalog/UV_Beads.html

Independent Variable: Level of SPF

Dependent Variable: Color change in UV beads

Hypothesis:

If the **level of SPF** is **increased**, then the **color change in the UV beads** will **decrease**.

Experimental Design:

Independent Variable:	Level of SPF			
Levels:	None	15	30	50
Number of Trials:	3	3	3	3

Constants: As best as possible ensure the beads are exposed to the same amount of sunlight (brightness and duration); use the same amount of suntan lotion on all beads; make sure the beads are the same color.

Control: No sunscreen lotion

Materials:

No Ad SPF 15 Sun Block Lotion UVA/UVB
No Ad SPF 30 Ultra Sun Block Lotion UVA/UVB
Banana Boat Baby Tear Free SPF 50 UVA/UVB Sun Block

3 – Lotion applicators (one for each level)
12 - UV sensitive beads color blue
4 - Pieces of string each approximately 8" long
1 - Stop watch

Procedure:

1. Thread 3 beads onto each of the 4 pieces of string and knot the string so they won't fall off
2. Set one string aside, this will be your control (no sun block lotion)
3. Take another string of beads and apply SPF 15 lotion to the beads using the applicator. Be sure to cover all surfaces evenly but not too heavily. You must be able to observe the color of the bead through the lotion.
4. Mark this set of beads as SPF 15 and set aside.
5. Repeat step 3 with the other 2 strings using SPF 30, then 50 and mark appropriately. Try to use the same amount of lotion on all beads.
6. Allow the lotion to dry for 15 minutes
7. At the same time expose all the beads to direct sunlight and start the stop watch
8. After 5 minutes record the color of each bead in your data table. Observe the color as carefully as possible since you are looking for variations in color change.

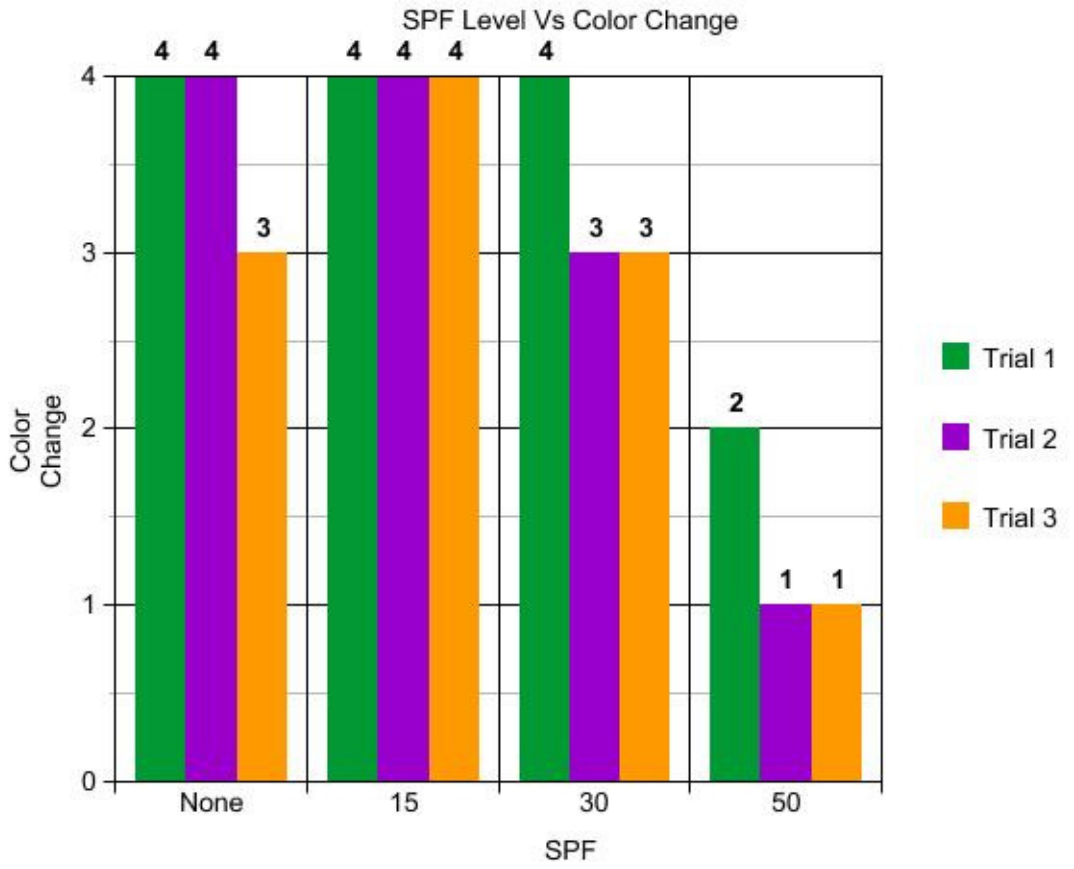
Safety Concerns:
As in all laboratory activities there is no horse play, stay with and work cooperatively with your group. Be careful not to get sun block in your eyes as this may cause burning and irritation. Wash your hands. Follow teacher's directions. Talk in low voices.

Bob Marley

Qualitative and Quantitative Data Collection:

SPF Level	Color Change				
	Trial 1	Trial 2	Trial 3	Mean	Range
No Lotion	Dark blue	Dark blue	Blue	Dark Blue	Slight variation
SPF 15	Dark Blue	Dark Blue	Dark Blue	Dark Blue	No variation
SPF 30	Dark Blue	Blue	Blue	Blue	Slight variation
SPF 50	Light Blue	No Change	No Change	No change	Slight variation

Results Graph:



Color change scale: 1= No Change; 2= Light Blue, 3= Blue 4= Dark Blue

Conclusions and Analysis:

The effect of SPF level on the color change of UV beads is summarized in the data table and graph above. Our data showed a decrease in color change for SPF 30 and above but no decrease in color change when SPF 15 was applied. There is slight variation in observed color changes within levels but not sufficient to question the results.

Our hypothesis that increased SPF levels would decrease the color change in the UV beads was supported except for SPF 15 where there was actually an increased change in color.

One anomaly was the observation in trial 3 of the control group. This bead did not change color as much as the others. This may be explained by variations in the beads themselves or somehow it received less UV rays (shadows, position of bead).

If someone were to do the lab again I would suggest taking all the beads outside before applying sun block to ensure all beads change the same amount. This might reduce anomalies like what we observed in the control group.

I learned that you can't just accept what is written on labels, you should check to make sure manufacturer's claims are true. I also learned what Mr. Grant expects in a lab and that I can design an investigation.

I think more research needs to be done to answer our key question. This could be done by finding a way to measure UVA rays separate from UVB and then testing the lotions again.