What is UV radiation?

UV (ultraviolet) radiation is light with wavelengths shorter than that visible by the human eye. The human eye responds to light with wavelengths from about 790 nm (red) to 430 nm (violet). Light with shorter wavelengths is called ultraviolet (beyond violet). Energy is inversely proportional to wavelength. Thus, UV light is very high in energy. Humans are not designed to be exposed to large amounts of UV radiation.

UV light is contained in the range of wavelengths produced by the sun. Most UV light is absorbed by the ozone layer or reflected back into space, only a small amount reaches the earth's surface.

Scientists divide UV radiation into three categories by wavelengths: UVA (315 - 400 nm), UVB (290 - 315 nm) and UVC (220-290 nm). UVA radiation is the largest component to reach the earth's surface. This radiation contributes to photochemical smog, and the fading and damage to plastics, paints and fabrics. UVC radiation is totally absorbed by the ozone and other gases, and does not reach the Earth's surface. Only 1% of solar radiation is within the UVB band, and most of this is absorbed by ozone. Nevertheless, UVB wavelengths are those that can cause the most damage to human skin. Thus, small doses of this radiation can cause significant harm. In addition, small changes in the ozone layer can cause significantly more UVB radiation to reach the earth's surface.

UV light and humans?

Sunburn is induced mostly by the 300 - 320 nm light. This is mostly UVB light with the lower wavelength UVA light. Sunburn is evidence that a person has been exposed to too much UVB too quickly. UV exposure also causes skin cancer, premature aging of the skin and wrinkling, and cataracts and other eye damage. Even a tan is just a sign of sun damage to your skin. Precautions such as sunscreen and sunglasses must be used to protect oneself from the damaging radiation.
How do we measure UV radiation?

The UV index is a measurement of the amount of skin damaging UV radiation that is reaching the earth's surface. It ranges from 0 (at night) to 15 or 16 (in the tropics at high elevations under clear skies). The higher the UV index, the greater the dose rate of skin and eye damaging UV radiation.

<table>
<thead>
<tr>
<th>UV index number</th>
<th>Exposure Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 2</td>
<td>Minimal</td>
</tr>
<tr>
<td>3 to 4</td>
<td>Low</td>
</tr>
<tr>
<td>5 to 6</td>
<td>Moderate</td>
</tr>
<tr>
<td>7 to 9</td>
<td>High</td>
</tr>
<tr>
<td>10+</td>
<td>Very High</td>
</tr>
</tbody>
</table>

The UV index indicates your risk of skin damage for that day. The amount of skin damage an individual will receive depends on your skin type. But, everyone can receive skin damage on any given day unless adequate protection is taken.

By taking into account your skin type and the UV index, it is possible to get an estimate of the time in the sun it takes for sun damage to occur.
Lab Experiment

For this experiment, you will use a UV meter that measures the UV index for the current conditions. Using the meter we will do a series of experiments to see how much protection sunblock, sunglasses and clothing provide. Some of the questions you will be able to answer are:

- How waterproof is “waterproof” sunblock?
- Do you need to spend a lot of money on sunglasses to protect your eyes?
- How much protection does clothing provide?

Your instructor will assign you to a lab group. For each group, you will need one SunSafe Sensor meter, sunscreen samples, sunglasses, a data collection sheet, and a pencil.

Thinking ...

How would you design an experiment to see if a given sunscreen protects you against UV radiation? What are the variables? What are important conditions that you have no control over?
UV Facts

★ UV light is invisible and cannot be easily detected without a scientific instrument.

★ Even on a cloudy day, you can sunburn. In some cases, UV radiation can penetrate clouds, mist and fog.

★ Human skin is particularly affected by the sun's UV-B radiation. Exposure to UV-B results in reddening of skin and sunburn.

★ The risk of skin cancer grows with every sunburn.

★ Protecting the skin during the first 18 years of life is likely to reduce the risk of cancer by more than 50%.

★ Staying in the shade does not provide complete protection from UV radiation. A considerable amount of UV does not come directly from the sun, but is scattered by the atmosphere.

★ UV is scattered by the atmosphere to a greater degree than is visible light.

★ Physicians associate eye cataracts with UV exposure.

★ Sunburn is not connected with the sensation of heat. In fact, one can get serious sunburn in winter despite the feeling of cold.

★ Fresh snow reflects up to 80% of the sunrays. Such "snow, water and concrete mirrors" significantly increase sunburning. Skiing enthusiasts should be particularly careful to protect their eyes and exposed skin.
UV Radiation Crossword Puzzle

(Clues

Across
5: An electric light that mimics the sun's harmful rays
8: With a wide brim, it protects your face, neck, and ears
10: EPA's program to help teach kids about sun safety
11: Skin ___: One of the worst health effects of too much sun
12: People get ___% of their sun exposure by age 18
14: Only amount of sun exposure that's safe
15: Daily forecast of UV exposure

Down
1: Clouding of the eye's lens
2: After too much UV, this system can't fight off disease as well
3: With SPF of 15 or more, protects skin against the sun
4: Sun___: Shades for your eyes
6: Sunglasses, sunscreen, and hats do it
7: Chemical in CFC's that destroys ozone
9: Layer that protects the Earth from the Sun's UVB
13: Type of UV that's especially harmful

Words
Immune Glasses UV Index Sunlamp Sunscreen Tiny UVB
Sunwise School Eighty Cataract Cancer Ozone Protect Hat
Chlorine
DATA COLLECTION SHEET

I. ENVIRONMENTAL CONDITIONS:

DATE ________ TIME ___________ TODAY'S WEATHER ________________________

How should the weather, season, and time of day effect the UV reading?

II. INSTRUMENT CALIBRATION:

UV READING _____________ UV READING THROUGH PETRI DISH _____________

Does the petri dish absorb any UV radiation? Why was this reading necessary? What did it show?

III. DATA COLLECTION:

Part I. Sunblock

1. Pick 3 sunblocks (at least one waterproof)
2. List each Sunblock, the SPF Factor, and if it is waterproof in the table
3. Spread a THIN even layer on the petri dish.
4. Record the UV reading in the table

Part II. Waterproof Test

1. Rinse each of the petri dishes with water from the squirt bottle and record UV.
2. Dunk the petri dish in water and record UV.
<table>
<thead>
<tr>
<th>Name of Sunblock</th>
<th>SPF Factor</th>
<th>Waterproof?</th>
<th>UV Intensity</th>
<th>UV Intensity after 5 second rinse with water.</th>
<th>UV Intensity after 10 second rinse with water.</th>
<th>UV Intensity after dunk.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How is this experiment different from how sunblock really works on your skin?

Part III. Clothing

1. Get a piece of the thin white t-shirt provided.
2. Hold it over your UV meter and take a reading.
3. Pick someone from your group who is wearing a shirt.
4. Describe the fabric. Record the thickness and color in the table.
5. Hold it over your UV meter and take a reading.

<table>
<thead>
<tr>
<th>Description of Fabric:</th>
<th>Color:</th>
<th>Thickness:</th>
<th>UV Intensity:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Question: Does wearing clothing mean that you’re safe from UV rays?
Part IV. Sunglasses

1. Get 2 pairs of sunglasses.
2. Record the Brand, price and color of each pair.
3. Record what the stickers on each pair of sunglasses say.
4. Record the UV intensity.
5. If you have your own pair of Sunglasses repeat steps 2-4 on them.

<table>
<thead>
<tr>
<th>Price:</th>
<th>Color:</th>
<th>Claims made on sticker</th>
<th>UV Intensity:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Questions: Does price matter for protection against UV rays? What about Color? Did the glasses measure up to what the stickers claimed?