Introduction
Solar radiation is more than the light and heat that we perceive from the sun. The sun is a star and it produces energy in many forms, from perceptible heat, visible and invisible spectrums of light, radiation, and more. Life on earth would be impossible without the sun, but our atmosphere also protects us from the more dangerous aspects of solar radiation.

Humans tend to have a love-hate relationship with the sun. On the one hand, sunlight keeps us warm, creates food and shelter for us via plant life, and gives us light. On the other hand, as greenhouse gases trap more heat and the ozone layer allows more dangerous ultraviolet (UV) light through, the sun’s rays can be distinctly dangerous (American Cancer Society). UV rays cause skin cancer in humans and animals, but can contrastingly improve other skin conditions like psoriasis (Psoriasis-Aid.Com). Humans need the sun biologically, as well, as it causes our bodies to produce vital Vitamin D (About.Com).

The Sun is the center of our galaxy both literally and figuratively. This giver of life is approximately 149 million kilometers away, sending its energy to the Earth in about 8 minutes. This energy is a combination of both light and UV rays. Known as a yellow dwarf star in the astronomy world, it is busy converting hydrogen to helium at its core by way of nuclear fusion. The result of this action is energy (Suntan.Com).

Solar radiation and sunlight make it possible for the earth to house life (NASA). The negative aspects of our relationship with the sun are primarily the result of human irresponsibility: we develop skin cancer when we ignore our bodies’ signals to avoid sunlight, while we rather struggle with global warming because we have ignored the environmental concerns of our actions. When we do not give solar radiation the respect it deserves, we are literally playing with fire (Solarradiation.Net).

Solar Radiation
Solar radiation is thermal radiation emitted from the surface of the sun, which is powered by nuclear fusion. It is radiant energy emitted by the sun which comprises mostly of electromagnetic energy. About half of the radiation is in the visible short-wave part of the electromagnetic spectrum. This is the part of light that can be seen by the human eye. The other half of solar radiation is mostly in the near-infrared part, with some in the ultraviolet (UV) part of the spectrum (WordIQ.Com).

Some of the UV rays are absorbed by the atmosphere – the portion of this UV radiation that is not absorbed by the atmosphere produces a suntan or a sunburn on people who have been in sunlight for extended periods of time.
Classification of Electromagnetic Energy

The electromagnetic spectrum is divided into several parts:

- **Electric Power** – electric power covers the low-frequency, long-wavelength end of the spectrum. It is usually ducted along 2-wire and 3-wire transmission lines and is what we use to power up items in our homes.

- **Radio Waves** – radio waves are generally utilised by antennas of reasonable size, so their wavelengths range from hundreds of metres to about one millimeter. The different parts of the radio spectrum are called bands. Television (TV), mobile phones, wireless networking and amateur radio all use Radio Waves.

- **Microwaves** – microwaves are waves which are typically short. It is produced with Klystrom and Magnetron tubes. Microwaves are absorbed by molecules that have a dipole moment in liquids. In a microwave oven, this effect is used to heat food. Low-intensity microwave radiation is used in Wi-Fi. An average microwave oven in active condition is, in close range, powerful enough to cause interference with poorly shielded electromagnetic fields such as those found in mobile medical devices and cheap consumer electronics.

- **Infrared Radiation** – the infrared part of the electromagnetic spectrum covers three main parts:
  - Far-infrared
  - Mid-infrared
  - Near-infrared

- **Visible Radiation (Light)** – after infrared comes visible light. This is the range in which the sun and stars, similar to it, emit most of their radiation. The different colours that the human eye can see all have a different wavelength.

- **Ultraviolet (UV) Light** – this is radiation of which the wavelength is shorter than the violet end of the visible spectrum. Being very energetic, UV can break chemical bonds, make molecules unusually reactive or ionize them, in general changing their mutual behaviour. Sunburn, for example, is caused by the disruptive effects of UV radiation on skin cells, which can cause skin cancer by damaging the complex DNA molecules in the skin cells. The sun emits a large amount of UV radiation, which could quickly turn earth into a dead desert, but most of it is absorbed by the atmosphere’s ozone layer before reaching the surface of the earth.

- **X-Rays** – hard X-rays (highest energy X-rays) are of shorter wavelength than soft X-rays (low energy X-rays). X-rays make it possible for us to ‘see’ through some things and not others, as well as for high-energy physics and astronomy. Black holes and neutrons emit x-rays, which enable us to study them.

- **Gamma Rays** – these are the most energetic photons, having no lower limit to their wavelength. They are useful to astronomers in the study of high-energy objects or regions and find a use with physicists thanks to their penetrative ability and their production from radio-isotopes (WordIQ.Com).
Health Effects of Ultraviolet Radiation

Skin cancer is the most common cancer in South Africa with about 20 000 reported cases every year and 700 deaths. The World Health Organization (WHO) reports that between two and three million non-melanoma skin cancers and approximately 132 000 malignant melanomas occur globally every year.

According to the National Cancer Registry (2003) the lifetime risk for developing skin cancer in South Africa is as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>Risk for Basal Cell Carcinoma*</th>
<th>Risk for Squamous Cell Carcinoma*</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Males</td>
<td>1:17</td>
<td>1:40</td>
</tr>
<tr>
<td>All Females</td>
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<tr>
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<tr>
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<tr>
<td>White Females</td>
<td>1:9</td>
<td>1:29</td>
</tr>
</tbody>
</table>

*Histologically Diagnosed

Ultraviolet (UV) radiation is electromagnetic radiation of a wavelength shorter than that of the visible region (that which the human eye can see) of the electromagnetic spectrum. The name means “beyond violet”, violet being the colour of the shortest wavelengths of visible light.

The sun emits UV radiation in the UVA, UVB, and UVC bands, but because of absorption in the atmosphere’s ozone layer most of the ultraviolet radiation that reaches the Earth’s surface is UVA (WordIQ.Com). In general, UVA also contributes to the ageing of skin, DNA damage and possibly even skin cancer (Suntan.Com). It penetrates deeply and does not cause sunburn.

UVB radiation has been linked to skin cancers including melanoma. Researchers at The University of Texas M. D. Anderson Cancer Center have found that the risk of developing melanoma, the most deadly form of skin cancer, is only partially associated with exposure to ultraviolet B (UVB) radiation, the rays in sunlight that increase in summer and cause sunburn (ScienceDaily). The radiation ionizes DNA molecules in skin cells and, thereby, damaging the DNA.

South Africa has the second highest incidence of skin cancer in the world after Australia. The good news is that skin cancer can be prevented by respecting the sun. The three most common types of skin cancers are basal cell carcinoma (BCC), squamous cell carcinoma (SCC) and malignant melanoma (IOLNews).

Skin Cancer

There are three (3) most common types of skin cancers:

- **Basal Cell Carcinoma** - Basal cell carcinoma, or basal cell skin cancer, is the most common form of cancer. Most skin cancers are basal cell cancer.
Basal cell carcinoma starts in the top layer of the skin called the epidermis. Most basal cell cancers occur on skin that is regularly exposed to sunlight or other ultraviolet radiation. This includes the top of your head, or scalp.

Basal cell skin cancer is most common in people over age 40. However, it occurs in younger people, too.

You are more likely to get basal cell skin cancer if you have:
- Light-colored or freckled skin
- Blue, green, or grey eyes
- Blond or red hair
- Overexposure to x-rays or other forms of radiation
- Many moles
- Close relatives who have or had skin cancer
- Many severe sunburns early in life
- Long-term daily sun exposure (such as the sun exposure people who work outside receive).

(MedLinePlus).

- **Squamous Cell Carcinoma** - Squamous cell carcinoma (SCC) is the second most common type of skin cancer. It begins in the squamous cells, which are found in the upper layer of the epidermis (skin). Fortunately, SCC is curable in 95% of cases if detected early.

SCC primarily develops in fair-skinned, middle-aged and elderly people who have had long-term sun exposure. SCCs may also occur where skin has suffered certain kinds of injury: burns, scars, long-standing sores, sites previously exposed to X-rays or certain chemicals (such as arsenic and petroleum by-products). In addition, chronic skin inflammation or medical conditions that suppress the immune system over an extended period of time may encourage development of the disease. Finally, those who have been diagnosed with skin cancer previously are at a greater risk of recurrence. There are numerous less common risk factors for SCC as well (About.Com).

- **Malignant Melanoma** - Malignant melanoma currently accounts for approximately 1% of all cancer deaths. However, the worldwide incidence of melanoma is increasing at a faster rate than any other neoplasm, with the exception of lung cancer in women.

South Africa has one of the highest incidences, if not the highest, of malignant melanoma in the world (similar to that of Australia). To date, we do not have accurate statistics, but the estimated 2009 figure for the Cape is 69 new cases per year per population of 100 000 Caucasians, compared to 65 per 100 000 for Australia. This translates to one in 1 429 people developing a malignant melanoma. From 1990 to 1995, this figure was 22,2 per 100 000 for females and 27,5 per 100 000 for males. In the period 2000 – 2003,
Melanoma can affect all ethnic and racial groups; however, the typical melanoma patient has a fair complexion and a tendency to sunburn rather than tan, even after a brief exposure to sunlight. Although there is no conclusive evidence that exposure to sunlight is causally related to the development of melanoma, lesions are most commonly found on sun-exposed areas of the body. Other epidemiologic risk factors include the occurrence of a previous melanoma and an afflicted first-degree relative (parent or sibling) (Cancer News). There seems to be a link between the occurrence of breast cancer and melanoma (OncoLink).

[Pictures obtained from: Free Images, Bing – on 2011-11-24]

The meaning of a Sun Protection Factor (SPF)
The SPF ("sun protection factor") listed on a bottle of sunscreen is a measure of how well the product protects your skin from the sun's shorter-wave ultraviolet B (UVB) radiation. Technically, it is the ratio of how long you could spend in the sun before burning when you're protected by sunscreen, compared to when you don't have that protection. As of 2009, SPFs can range from 2 to as much as 100 or higher. A common mistake is applying too little sunscreen, which can drastically reduce the effectiveness of the product. About 30G (a palm full) of sunscreen is recommended to cover the entire body, and it should be applied half an hour before sun exposure. You should reapply every two hours if you're staying outdoors for a long period of time. Applying sunscreen properly is one of the essential recommendations to lower your risk of developing skin cancer (About.Com).

If your skin usually starts to change colour within five minutes, a sunscreen with a Sun Protection Factor (SPF) of 20 protects your skin for 20 times as long, i.e. 5 times 20, which equals 100 minutes.

All sunscreens bearing the CANSA Seal of Recognition (CSOR) have broad spectrum protection abilities, meaning they protect against ultraviolet A rays (UVA) and ultraviolet B rays (UVB).

The CANSA Seal of Recognition (CSOR)
The CSOR seal appears on sunscreen products, clothing, swimwear, hats, sunglasses and is your guarantee that the manufacturers of these UV protective products have complied with a strict set of criteria developed by CANSA in the interest of a SunSmart South Africa. Products have to comply with the South African Sunscreen Standard (SANS) 1557:2009 and/or the Australian/New Zealand standard for fabrics, to qualify for the CANSA Seal.

CANSA is currently using two sunscreen testing laboratories in South Africa to test and validate all sunscreens with the CSOR. Their testing methods and criteria are aligned to the recognised international standards and protocols.

An international working committee that includes South African representation, is presently developing a international (ISO) standard to rate all UV protection levels for sunscreen.

Sun Beds and tanning booths are not safe

this rose to 33,5 per 100 000 for females and 36,9 per 100 000 for males (South African Melanoma Foundation).
It has been proven through recent research findings that there is a relationship between the use of sun beds and malignant melanoma as well as other non-melanoma skin cancers. Sun beds predominantly emit UVA and UVB both which can cause damage in the DNA of skin cells (Cancer Research UK).

Sun beds and tanning booths deliver concentrated UVA radiation to unprotected skin and should be avoided at all costs, as it ages skin more rapidly while putting you at risk of developing skin cancer. According to Professor Werner Sinclair, a dermatologist associated with the University of the Free State: "In general, one can state that the use of an artificial tanning booth will double the melanoma risk of any particular individual."

**Spot the Spot**
Check your skin carefully every month and ask a family member or friend to examine your back and the top of your head. If you notice any of the warning signs, see a doctor or dermatologist immediately.

**Warning signs**
The following A B C D warning signs apply:

A-symmetry - a mole or mark with one half unlike the other - common moles are round and symmetrical  
B-order irregularities - scalloped or poorly defined edges - common moles have smooth and even borders  
C-colour variations and inconsistency – tan, brown, black, red, white and blue - common moles are usually a single shade of brown or black  
D-diameter - larger than 6 mm.

**High Risk Exposure**
Everyone is at risk of getting skin cancer, although people with darker skins are less susceptible because their skin contains more natural melanin that protects against sun damage. People with fair skin, especially those with red hair, moles or skin spots as well as people with a personal or family history of skin cancer, or who play sport outdoors, work in the sun or spend a lot of time driving, are considered high-risk.

At least 80% of sun-induced skin damage occurs before the age of 18 and only manifests later in life. Therefore it is imperative to take special care of children in the sun, whether it is at the pool, on the beach, at play or at school. Babies younger than one year should never be exposed to direct sunlight. When it comes to protecting the young ones, mothers of babies and toddlers; educators and caregivers can play an important role.

**How to Prevent Skin Cancer**
To prevent skin cancer, CANSA advocates the following:

- Avoid direct sunlight between 10:00 and 15:00 when the sun’s rays are most dangerous. Stay in the shade or under an umbrella as much as possible.
UV rays reflect off cement, water, sand, glass and grass and can therefore cause sunburn in the shade. UV rays are not the same as heat. You can get overexposed even in cool weather - so take care on windy or overcast days.

Cover up by wearing thickly-woven hats with wide brims and loose-fitting clothes, made of tightly-woven, fabric that is cool, but will block out harmful UV rays. Look out for UV protective swimsuits and beach wear as UV radiation can penetrate fabric. Swimwear and umbrellas bearing the CANSA Seal of Recognition should also be part of your protection kit.

Always apply sunscreen with a Sun Protection Factor (SPF) of a minimum of 20 and not higher than 50, to all exposed skin areas, preferably one bearing the CANSA Seal of Recognition (CSOR). Re-apply regularly (at least every two hours), after towel-drying, perspiring or swimming. Apply it liberally to all exposed skin; including the back of the neck, tips of ears, arms, feet and hands. The use of sunscreen lotion is not a license to “bare all” in the sun. Go under cover whenever possible, to ensure that you are SunSmart while out in the sun.

Protect your eyes by wearing sunglasses with a UV protection rating of UV400.

Use lip balm with a minimum of SPF 20 and apply regularly.

Avoid sunlamps and tanning parlours.

Take special care to protect children - babies younger than one year should never be exposed to direct sunlight.

Check your skin regularly for changes, unusual marks or moles. An annual medical examination should include a skin check. Ask a friend to check your back and the back of your legs for spots or changes you may not notice yourself.

CANSA’s SunSmart campaign takes place during the summer months (November to February) and includes talks and exhibitions as well as visits to schools, holiday resorts and beaches in South Africa.

Support
Cancer Association of South Africa (CANSA): www.cansa.org.za
Toll free line (08:00 to 16:30 on weekdays): 0800 22 66 22

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References and Consulted Sources

About.Com

American Cancer Society

Bureau of Air Quality, Department of Environmental Protection

Canadian Centre for Occupational Health and Safety

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Centers for Disease Control and Prevention

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Department of Health and Ageing, Australia

Earth Observatory, NASA


Health Physics Society

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National Aeronautic and Space Administration (NASA)


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SunSmart Australia

Suntan.Com
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World Health Organization