**[Understanding UVA and UVB](http://www.skincancer.org/prevention/uva-and-uvb)**

**For a six billion-year-old star, the sun is certainly in the news a lot lately, mainly because it is still a source of uncertainty and confusion to many of us.**

The center of this confusion is the sun's ultraviolet A (long-wave) and ultraviolet B (shortwave) rays. Our understanding of exactly what kinds of damage each causes to the skin, and how best to protect ourselves, seems to shift every year as new research comes out. For example, it was once thought that only UVB was of concern, but we keep learning more and more about the damage caused by UVA. And new, improved forms of protection against UVA keep emerging. Keeping up with these new developments is a worthwhile challenge that can help all of us prevent sun damage.

**What is Ultraviolet Radiation?**

UV radiation is part of the electromagnetic (light) spectrum that reaches the earth from the sun. It has wavelengths shorter than visible light, making it invisible to the naked eye. These wavelengths are classified as UVA, UVB, or UVC, with UVA the longest of the three at 320-400 nanometers (nm, or billionths of a meter). UVA is further divided into two wave ranges, UVA I, which measures 340-400 nanometers (nm, or billionths of a meter), and UVA II which extends from 320-400 nanometers. UVB ranges from 290 to 320 nm. With even shorter rays, most UVC is absorbed by the ozone layer and does not reach the earth.

Both UVA and UVB, however, penetrate the atmosphere and play an important role in conditions such as premature skin aging, eye damage (including cataracts), and skin cancers. They also suppress the immune system, reducing your ability to fight off these and other maladies.



**UV Radiation and Skin Cancer**

By damaging the skin's cellular DNA, excessive UV radiation produces genetic mutations that can lead to skin cancer. Both the U.S. Department of Health and Human Services and the World Health Organization have identified UV as a proven human carcinogen. UV radiation is considered the main cause of nonmelanoma skin cancers (NMSC), including basal cell carcinoma (BCC) and squamous cell carcinoma (SCC). These cancers strike more than a million and more than 250,000 Americans, respectively, each year. Many experts believe that, especially for fair-skinned people, UV radiation also frequently plays a key role in melanoma, the deadliest form of skin cancer, which kills more than 8,000 Americans each year.

**UVA**

Most of us are exposed to large amounts of UVA throughout our lifetime. UVA rays account for up to 95 percent of the UV radiation reaching the Earth's surface. Although they are less intense than UVB, UVA rays are 30 to 50 times more prevalent. They are present with relatively equal intensity during all daylight hours throughout the year, and can penetrate clouds and glass.

UVA, which penetrates the skin more deeply than UVB, has long been known to play a major part in skin aging and wrinkling (photoaging), but until recently scientists believed it did not cause significant damage in areas of the epidermis (outermost skin layer) where most skin cancers occur. Studies over the past two decades, however, show that UVA damages skin cells called keratinocytes in the basal layer of the epidermis, where most skin cancers occur. (Basal and squamous cells are types of keratinocytes.) UVA contributes to and may even initiate the development of skin cancers.

UVA is the dominant tanning ray, and we now know that tanning, whether outdoors or in a salon, causes cumulative damage over time. A tan results from injury to the skin's DNA; the skin darkens in an imperfect attempt to prevent further DNA damage. These imperfections, or mutations, can lead to skin cancer.

Tanning booths primarily emit UVA. The high-pressure sunlamps used in tanning salons emit doses of UVA as much as 12 times that of the sun. Not surprisingly, people who use tanning salons are 2.5 times more likely to develop squamous cell carcinoma, and 1.5 times more likely to develop basal cell carcinoma. According to recent research, first exposure to tanning beds in youth increases melanoma risk by 75 percent.



**UVB**

UVB, the chief cause of skin reddening and sunburn, tends to damage the skin's more superficial epidermal layers. It plays a key role in the development of skin cancer and a contributory role in tanning and photoaging. Its intensity varies by season, location, and time of day. The most significant amount of UVB hits the U.S. between 10 AM and 4 PM from April to October. However, UVB rays can burn and damage your skin year-round, especially at high altitudes and on reflective surfaces such as snow or ice, which bounce back up to 80 percent of the rays so that they hit the skin twice. UVB rays do not significantly penetrate glass.



**Protective Measures**

Protect yourself from UV radiation, both indoors and out. Always seek the shade outdoors, especially between 10 AM and 4 PM. And since UVA penetrates glass, consider adding flat, tinted UV-protective film to your car's side and rear windows as well as to house and business windows. This film blocks up to 99.9 percent of UV radiation and lets in up to 80 percent of visible light.

Outdoors, dress to limit UV exposure: Special sun-protective clothes with UPF (ultraviolet protection factor) indicate how much UV radiation can penetrate the fabric; the higher the UPF, the better. A shirt with an UPF of 30, for example, means that just 1/30th of the sun's UV radiation can reach the skin. Laundry additives can also be washed right into regular fabrics to provide higher UPFs. However, you can enhance your sun safety simply by learning to evaluate everyday fabrics' sun protection qualities and choosing those with the best protection. For instance, bright- or dark-colored, lustrous clothes reflect more UV radiation than do pastels and bleached cottons; and tightly woven, loose-fitting clothes provide more of a barrier between your skin and the sun. Finally, broad-brimmed hats and UV-blocking sunglasses help shield the sensitive skin on your head, neck, and around the eyes - areas that usually sustain a lot of sun damage.

**Sun Protection Factor (SPF) and UV Radiation**

Since the advent of modern sunscreens, a sunscreen's efficacy has been measured by its sun protection factor, or SPF. SPF is not an *amount* of protection per se. Rather, it indicates how long it will take for UVB rays to redden skin when using a sunscreen, compared to how long skin would take to redden without the product. For instance, someone using a sunscreen with an SPF of 15 will take 15 times longer to redden than without the sunscreen. An SPF 15 sunscreen screens 93 percent of the sun's UVB rays; SPF 30 protects against 97 percent; and SPF 50, 98 percent. The Skin Cancer Foundation maintains that SPFs of 15 or higher are necessary for adequate protection.

**Sunscreen Ingredients**

Since both UVA and UVB are harmful, you need protection from both kinds of rays. To make sure you're getting effective UVA as well as UVB coverage, look for a sunscreen with an SPF of 15 or higher, plus some combination of the following UVA-screening ingredients: stabilized a avobenzone, ecamsule (a.k.a. MexorylTM), oxybenzone, titanium dioxide, and zinc oxide. You may see the phrases *multi spectrum, broad spectrum or UVA/UVB protection* on sunscreen labels, and these all indicate that some UVA protection is provided. However, because there is no consensus on *how much* protection these terms indicate, such phrases may not be entirely meaningful.

There are currently 17 active ingredients approved by the FDA for use in sunscreens. These filters fall into two broad categories: chemical and physical. Most UV filters are chemical: They form a thin, protective film on the surface of the skin and *absorb* the UV radiation before it penetrates the skin. The physical sunscreens are insoluble particles that reflect UV away from the skin. Most sunscreens contain a mixture of chemical and physical active ingredients.



**Common FDA-Approved Active Ingredients in Sunscreen Include:**

* UVB absorbers/blockers: Padimate O (Octyldimethyl PABA), Homosalate, Octisalate (Octyl salicylate), Octinoxate (Octyl methoxycinnamate or OCM)
* UVA absorbers/blockers: Avobenzone (Parsol 1789), Zinc Oxide, Ecamsule (Mexoryl)
* UVA and UVB absorbers/blockers: Octocrylene, Titanium Dioxide, Zinc Oxide

**Prevention Guidelines**

* Seek the shade, especially between 10 AM and 4 PM.
* Do not burn.
* Avoid tanning and UV tanning booths.
* Cover up with clothing, including a broad-brimmed hat and UV-blocking sunglasses.
* Usa a broad spectrum (UVA/UVB) sunscreen with an SPF of 15 or higher every day. For extended outdoor activity, use a water-resistant, broad spectrum (UVA/UVB) sunscreen with an SPF of 30 or higher.
* Apply 1 ounce (2 tablespoons) of sunscreen to your entire body 30 minutes before going outside. Reapply every two hours, or immediately after swimming or excessive sweating.
* Keep newborns out of the sun. Sunscreens should be used on babies over the age of six months.
* Examine your skin head-to-toe every month.
* See your physician every year for a professional skin exam.

[**UVA Radiation: A Danger Outdoors and Indoors**](http://www.skincancer.org/media-and-press/Press-Release-2010/uva-radiation-a-danger-indoors-as-well-as-out)

While it's understood that taking sun safety precautions during the summer months is a must, many people don't realize they need to protect their skin year-round - even when indoors. The temperature may drop and the sunlight may be less intense, but the amount of ultraviolet (UV) solar radiation that reaches earth remains very strong, even during cooler weather.

While ultraviolet B (UVB) rays, the main cause of sunburn, are the strongest in the summer, ultraviolet A (UVA) rays remain constant throughout the year. UVA rays account for up to 95 percent of the UV radiation reaching the Earth's surface. Although they are less intense than UVB, UVA rays are 30 to 50 times more prevalent, and go through glass, making sun protection necessary indoors as well as out.

"Our knowledge of the dangers associated with the sun's longer-wave UVA rays has grown significantly over the last few decades," said Perry Robins, MD, President, The Skin Cancer Foundation. "We now know that UVA radiation can penetrate windows to reach the skin, accelerating skin aging."

The need for sun protection indoors was reinforced in a recent report published in *Clinical Interventions in Aging*. Eight women and two men had significantly more wrinkles, brown spots, and sagging skin on one side of the face, even though they worked indoors. The side of the subjects' faces that was regularly closer to a window exhibited more signs of sun damage ("asymmetrical facial damage"), and UVA rays are believed to be the culprit. While both UVA and UVB rays can harm the skin and lead to skin cancers, UVB is effectively blocked by glass. However, at least 50 percent of UVA radiation can pass through windows. (Car windows have been proven to let in more than 60 percent.) This is important news for people who habitually sit near a window - whether at work, at home, or during a long commute by car, train, or bus.

**Tips for Everyday Sun Protection**

Be sure to use a broad-spectrum sunscreen with an SPF (Sun Protection Factor) of 15 or higher and one or more of these UVA-protective ingredients: avobenzone, ecamsule, oxybenzone, titanium dioxide, and zinc oxide. Window film, which can be applied to home, office and car windows, blocks almost 100 percent of UVA and UVB radiation.

**Sun Protection Tips for Winter**

Use a broad-spectrum sunscreen with an SPF of 30 when spending extended time outdoors, and don't forget areas such as underneath the nose and chin. Snow reflects up to 80 percent of the sun's UV light, so the rays hit you twice, further increasing your risk of skin cancer and premature aging. Wear protective clothing such as a broad-brimmed hat, gloves and UV-blocking sunglasses with wraparound or large frames. Also, reapply sunscreen every two hours, and immediately after sweating or significant exposure to wind and snow which can wear away sunscreen. Activities such as skiing and snowboarding call for just as much sunscreen as you would use at the beach, since UV exposure increases 8 to 10 percent with every 1,000 feet above sea level.

Remember to be mindful of time spent in the sun, regardless of the season. Sun protection is a part of a healthy lifestyle.

[**Landmark Research Links Melanoma to UV Radiation**](http://www.skincancer.org/prevention/uva-and-uvb/landmark-research-links-melanoma-to-uv-radiation)

**Mark Teich, Executive Editor**

In December 2009, a remarkable new study made perhaps the strongest case ever that some melanomas are caused by exposure to ultraviolet (UV) radiation.

Scientists at The Wellcome Trust Sanger Institute, in Hinxton, UK, mapped the complete genetic material (the genome) that composed a melanoma taken from a patient with the disease. Using new molecular technology, the researchers identified thousands of mutations, the vast majority of which were caused by UV radiation. Many mutations, changes or errors that occur in genes due to radiation, viruses, and other causes, can ultimately lead to cancer.



**"The melanoma genome contains more than 33,000 mutations, many of which bear the imprint of the most common cause of melanoma - exposure to ultraviolet light."**

Over the years, evidence has added up that most skin cancers are caused by damage to the skin cells' DNA by the sun's UV radiation, but this was the first time UV damage could be seen all through a melanoma's genetic material. According to the Sanger Institute, "The melanoma genome contains more than 33,000 mutations, many of which bear the imprint of the most common cause of melanoma - exposure to ultraviolet light."

In the study, the genomes of both normal and melanoma tissue were decoded. When the tissues were compared, scientists were able to pinpoint precisely where in the melanoma genome mutations occurred.

"With this genome sequence, we have been able to explore deep in the past of each tumor, uncovering with remarkable clarity the imprint of these environmental mutagens [causes of the mutations] on DNA, which occurred years before the tumor became apparent," the study's coauthor, Professor Mike Stratton, MD, PhD, explained. "We can see the desperate attempts of our genome to defend itself against the damage from ultraviolet radiation. Our cells fight back furiously to repair the damage, but frequently lose that fight."

It's not clear to just what extent UV radiation influences the development of melanoma, but this research strengthens the link between them. While 90 percent of all basal and squamous cell carcinomas (the two most common skin cancers) are known to be associated with exposure to UV radiation (UVR), some investigators have disagreed about the role of UVR in melanoma development. Research has established that genetics are an important component in melanoma (a family history of the disease increases one's risk of developing it), and some scientists have maintained there was no convincing proof of UVR's involvement. But this new cataloging of mutations, the results of which were published in *Nature*, all but confirms UV radiation as a cause of melanoma.

The link between melanoma and UV radiation is further reinforced by information gleaned from a companion study of a patient's lung cancer genome, also recently mapped by scientists at the Wellcome Trust Sanger Institute. The pattern of mutations in both cancer genomes is extremely similar; just as the vast majority of mutations in the melanoma genome were caused by UV damage, a significant majority of the mutations in the lung cancer genome were caused by cigarette smoking. "The profile of mutations we observed [in the lung cancer genome] is exactly that expected from tobacco, suggesting that the majority of the 23,000 we found were caused by the cocktail of chemicals found in cigarettes," according to Dr. Peter Campbell, senior author of the lung cancer study. Most lung cancer deaths are known to be caused by smoking, and it could well be that most melanoma deaths are caused by UV.

"These are the two main cancers in the developed world for which we know the primary exposure," Dr. Stratton said. "For lung cancer, it is cigarette smoke and for malignant melanoma it is exposure to sunlight."

Not all mutations cause cancer, so the scientists will next try to determine exactly which mutations contribute to melanoma development. "The knowledge we extract over the next few years will have major implications for treatment," said Dr. Campbell. "By identifying all the cancer genes, we will be able to develop new drugs that target specific mutated genes, and work out which patients will benefit from these novel treatments."