How Your Skin Tans

Tanning 101: How Your Skin Tans and Why It's Natural

Tanning is the human body's natural and intended response to ultraviolet light exposure. Throughout human evolution a tan has served as the body's natural acquired protection against sunburn and overexposure. Today we know that a suntan achieved in a non-burning fashion, combined with proper use of sunscreen outdoors when sunburn is a possibility, is the best way to maximize the potential benefits of regular sun exposure while minimizing the risks that are associated with overexposure.

This section will explain how your skin develops a tan by first introducing ultraviolet light, introducing parts of the skin and then showing how UV light works with the skin to develop a tan.

Part 1: Understanding UV Light

Natural light actually is composed of energy waves that are transmitted 93 million miles from the sun to the Earth. Each energy wave (or light ray) occurs in a different part of a complex light spectrum based on its length in nanometers (nm), which is one-billionth of a meter.

- Light is energy.
- Light travels in waves.
- Different forms of light are differentiated by the length of the waves – the wavelength.

That means that no two types of light are the same. For example, ultraviolet light used in tanning salons cannot possibly be the same as an X-ray because of the difference in the length of their energy waves. Therefore, these two waves will behave and affect the human body in completely different ways.

For our purposes, let's divide light into three categories: infrared, visible and ultraviolet. Not all light waves reach Earth, however. Many are filtered out by the atmosphere, which protects us from harmful rays. The light waves that tan people are invisible, but let's briefly look at all three categories for comparison.

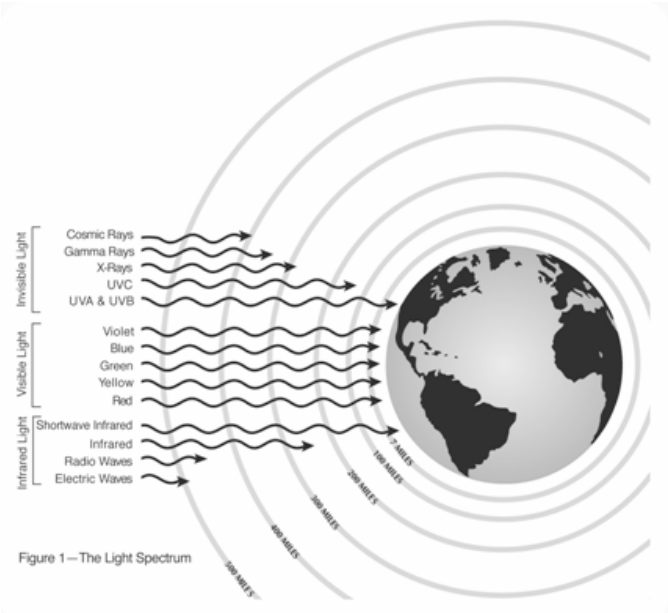

Figure 1—The Light Spectrum

- The Vitamin D Council
- The Vitamin D Society
- Sunshine Vitamin Alliance

Infrared Light: Infrared waves (above 700nm) include electric waves, radio waves, infrared and shortwave infrared, but only this last type reaches the Earth. Shortwave infrared waves, which give us heat, make up about 49 percent of the solar radiation we receive on Earth.

Visible Light: Visible rays (400nm to 700nm) cause illumination we can see as colors, including red, yellow, green, blue and violet. These account for about 46 percent of the Earth's solar radiation.

Ultraviolet Light: Ultraviolet rays (200 nm to 400 nm) comprise the remaining 4 or 5 percent radiation we receive on Earth. Of all invisible rays—including cosmic rays, gamma rays, X-rays and three forms of ultraviolet light—only two of the ultraviolet light rays actually penetrate the Earth's atmosphere. These are the same two invisible light rays used in tanning equipment.

Ultraviolet light rays are energy waves that are shorter in length than visible light rays. Because of this, the human eye cannot see ultraviolet light. However, we can see the effects of ultraviolet light, such as tan skin, on the human body. Three categories of ultraviolet light exist:

- Ultraviolet A. UVA rays are the longest (320nm to 400nm).
- Ultraviolet B. UVB rays are shorter than UVA rays (290nm to 320nm).
- Ultraviolet C. UVC rays are the shortest (200nm to 290nm).

Of these three categories of UV rays, only UVA and UVB pass through the Earth's atmospheric filter. More UVA hits Earth than UVB because the filter prevents the passage of shorter wavelengths of UVB that resemble UVC. If UVC light also passed through, it would have devastating effects on this planet, which is why the depletion of the ozone layer in the atmosphere is of great concern.

UVA and UVB light waves cause skin to tan. As previously mentioned, these same light rays can be replicated in special lamps used in tanning equipment. How they work together to create a suntan is a process we'll discuss after we introduce the parts of the skin.

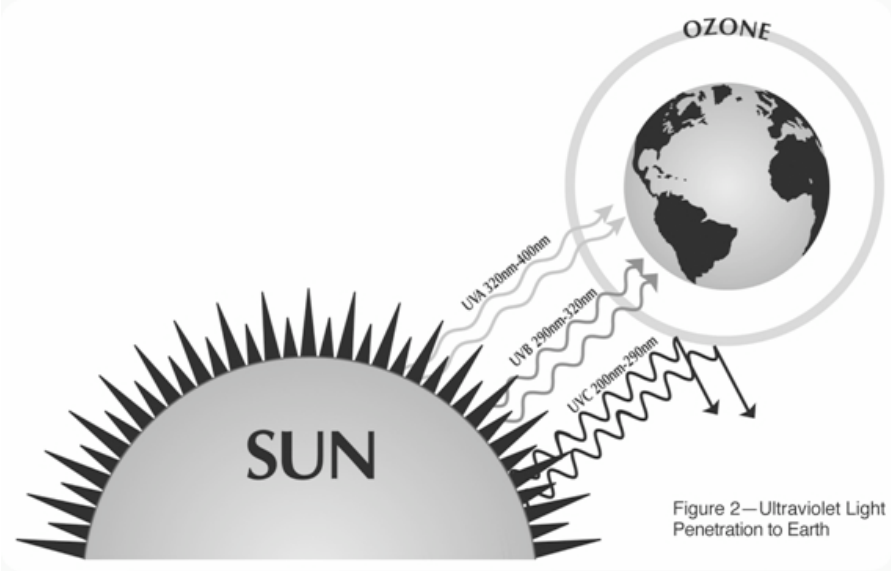

Figure 2—Ultraviolet Light Penetration to Earth

UV Concentration in Sunlight

The ultraviolet portion of outdoor sunlight is approximately 95 percent UVA and 5 percent UVB, although atmospheric, seasonal and geographic variables change that ratio each time you step outside.

So although UVA is the predominant ultraviolet light ray in sunshine that hits Earth, there is still an important percentage of UVB in sunshine.

Today's indoor tanning units utilize a carefully controlled mix of both rays to help prevent indoor tanners from burning as easily or as quickly as they could by tanning outside, and also to create cosmetic tans in a controlled environment that minimize the risk of sunburn.

Note that we said that outdoor light is approximately 95 percent UVA and 5 percent UVB. The problem with stating this exactly is that the percentage of UVA and UVB outdoors is always changing. Here is why:

The earth's ozone layer is an invisible barrier that protects us from many forms of radiation from the sun that would otherwise harm us. The ozone layer is just that – a layer. And, depending upon the angle in which sunlight hits the ozone layer, the ozone can block more or less UVB light.

At noontime, when the sun is highest in the sky, sunlight is hitting the ozone layer at a straight "up and down" angle. If you think of the light waves from the sun as arrows, it is easiest for those arrows to pierce the ozone layer when they are shot from a straight "up and down" angle. So at noontime, the ozone layer is least efficient at stopping the most intense rays, so more UVB light gets through near noon.

In contrast, in the late afternoon, when the sunlight is hitting the ozone layer on an angle, the ozone layer is thicker in relationship to the sun's angle to your position. Because the layer is thicker, more UVB gets filtered out, so very little UVB hits your location late in the day. In fact, when the sun is on the horizon, virtually no UVB light is getting through the ozone to you at all.

- At noon, more UVB gets through the ozone layer.
- At dawn and dusk, virtually no UVB gets through the ozone, and all you receive is UVA light.

The other factor that affects the angle in which sunlight hits the ozone layer above your position is the time of year. In June, for example, the sun is higher in the sky in the Northern Hemisphere than it is in December, when the sun is very low in the sky in the Northern Hemisphere.

- In December, very little UVB light penetrates the ozone layer in the Northern hemisphere because sunlight is hitting the ozone layer at a low angle, making the ozone more efficient.
- In June, when the sun is high in the sky, the ozone is less efficient, which means more UVB light penetrates through to your position.

Very few people realize that UVA emissions outdoors are virtually unchanged throughout the year. That is because the ozone layer does not block UVA rays at all.

Why is the ratio of UVA to UVB important? While UVB is the portion of sunlight responsible for natural Vitamin D production in the body, it is also more intense than UVA light. Being more intense, UVB is significantly more effective at causing a sunburn than UVA, which is why noontime sunshine is more intense than sunshine at dawn or dusk.

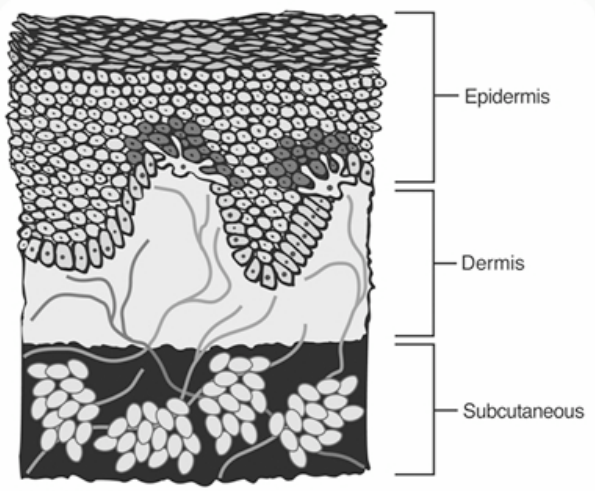

Figure 4—The Three Skin Layers

Part 2: Understanding Your Skin

Skin is the largest organ in the human body. Weighing roughly nine pounds on the average adult, it protects the body from harmful pollutants found in air, water and other things people come in contact with every day. Skin performs many other functions, too. It helps regulate body temperature, houses sensory receptors that help you feel things and synthesizes various body chemicals necessary for life. That's why the condition of the skin is so important to good health.

Skin has many sections, but it basically is divided into three layers:

- The top layer, or epidermis, is the one that produces a tan.

- The middle layer, or dermis, contains collagen and other elastic materials important to the skin's strength, and to its ability to fight off infection and repair itself. Blood vessels, nerve fibers and other structures are embedded in this layer.
- The bottom layer, or subcutaneous tissue, primarily is composed of fat that binds the skin to the body. Subcutaneous tissue serves as the body's food reserve, insulation and shock absorber.

Skin cells in the epidermis are constantly reproducing and pushing older cells upward to the surface of your skin – an outer mantle of dead skin cells (sometimes called the horny layer) where they are sloughed off in about one month. There are three main types of cells in the epidermis:

1. Basal cells — the oblong cells that line the base of the germinative layer — are parent cells, giving "birth" to keratinocytes.
2. Keratinocytes are the "daughter" cells that serve as your skin's sealant, making up most of your epidermis.
3. About 5 percent of the skin cells in the epidermis are special cells called melanocytes, which lie on the bottom of the epidermis. Melanocytes are pigment cells that help the skin tan.

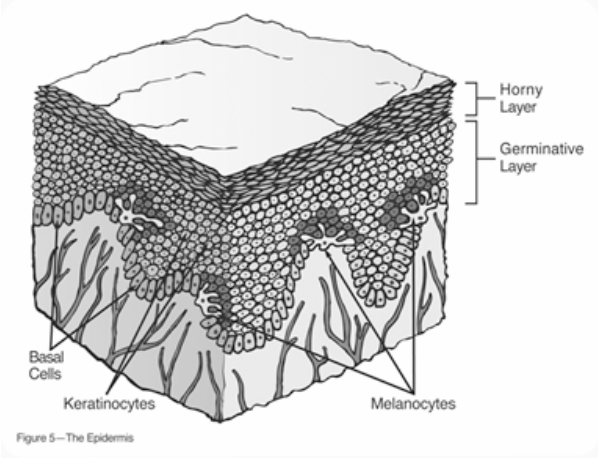

Figure 5—The Epidermis

Melanocytes produce melanin – a protein pigment which performs the very specific body function of protecting skin from overexposure to ultraviolet light. Thus, the presence of melanin in the skin colors it and protects it.

Everyone has roughly the same number of melanocytes in the body—about five million. Your body's melanocytes naturally will produce a certain amount of melanin based on your heredity, which is why people have different skin colors. For example, the skin of African-Americans contains more melanin, creating a black or brown color, while the skin of Caucasians has less melanin and is pale.

UVA, UVB and the Tanning Process

Melanocytes are prompted to produce additional melanin whenever ultraviolet light waves touch them, thereby making the skin darker to protect the body from additional exposure. This produces a tan—literally, a browning of the skin. The color of the tan ultimately depends on heredity and previous exposure to ultraviolet light, two factors which predetermine the amount of melanin your skin will contain. This explains why some fair-skinned people can get dark tans and others cannot.

Of course, ultraviolet light can affect the skin in other ways. In excessive doses, it can cause sunburn – a reddening caused by the swelling or bursting of tiny blood vessels in the skin. Repeated burning is believed to be the greatest risk factor for long-term skin damage, which is why it is so important to prevent sunburn.

UVA and UVB waves have specific roles in the tanning process which are determined by their effects on skin. Although all ultraviolet light is capable of tanning skin, UVA is more efficient at certain functions in the tanning process and UVB is more efficient at certain parts of tanning. For instance, melanin produced when your skin is exposed to UV light is naturally pinkish in tone. But ultraviolet light also oxidizes the melanin, turning it brown.

- UVB is more efficient at signaling melanocytes in your skin to begin producing more melanin.
- UVA is more efficient at oxidizing the melanin your skin has already produced, turning it brown.

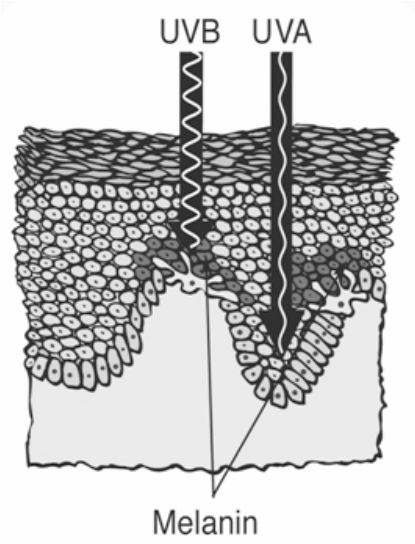

Figure 6—Melanin Production

What Is Skin Damage?

You need to understand that technically, on the micro-level, any ultraviolet light exposure causes “skin damage.” But you also need to know that, on the macro-level, UV exposure is natural and necessary to lead a healthy life and simply calling UV exposure “damage” to your skin is more misleading than it is true.

What is sometimes called “damage” to the skin from non-burning UV exposure is actually just the skin’s way of protecting itself from sunburn. If your body can develop a tan, doing so is natural. It is what your body is designed to do. It is one of the ways your body protects itself.

- Saying that UV light damages the skin, and therefore you should avoid UV light, is like saying that water causes drowning, and therefore you should avoid water. Just like water, we need UV light to live. So calling UV exposure “damage” is an oversimplification that misrepresents what your body as a whole is designed to do.
- The sum of research conducted to date indicates that repeated overexposure and sunburning are the primary sun-related factors responsible for an increased risk of permanent skin damage. That’s why the prevention of sunburn and overexposure are so important.