

Your **E C O L O G I C A L** footprint

Managing Your Fun in the Sun on an Ozone-Depleted Planet



After reading this chapter you may be alarmed by reductions in stratospheric ozone and increased skin cancer rates. In response you may want to manage your time in the sun. Before going out, you can check the local weather forecast for the UV index. But what does this number mean? How can you use it to reduce the negative health effects that are associated with too much sun exposure?

The UV index measures the intensity of ultraviolet radiation at Earth's surface that can affect human health. The UV index varies between 1 and 11+. Values represent the maximum exposure during a thirty-minute period. For sunny days, a single number is reported. But users should remember that the UV index varies over the day. Exposure is greatest a couple of hours before and after noon. For the first and last hours of daylight, UV exposure can be low. For example, the UV index may be extreme (11+) at noon and low (1–2) at 9:00 A.M. and 5:00 P.M. A range of values is reported for cloudy days.

Values are grouped to represent the degree of exposure. Values below 2 indicate that the sun's rays pose relatively little danger. At the other extreme, the value 11+ signifies extreme exposure. The UV index simply represents the degree of exposure. The index designers specifically caution against using the index as burn times. They worry that you will interpret index values as the time that you can spend safely in the sun. They warn that extending exposure time is unacceptable—damage is determined by cumulative exposure and skin type. We list burn times to help identify your skin type (see Table 1).

What damages are you trying to avoid? UV radiation affects your skin, eyes, and immune system. The immune system protects you against invading microorganisms (infections) and incipient tumors. Both of these capabilities are reduced by prolonged exposure. Prolonged exposure also can reduce the effectiveness of vaccinations. Many vaccinations inject a weakened form of a potentially invasive microorganism. These agents allow the immune system to recognize the invader and produce antibodies—responses that are reduced by exposure to UV radiation.

TABLE 1 Skin Types and Sun Exposure

Skin Type	Skin's Reaction to One Hour of Summer Midday Sun	Characteristics	Time to Redden (Minutes)		
			UV 6	UV 8	UV 10
I	Always burn; no tan	Pale skin, blue/green/hazel eyes, blond/red hair	28	21	17
II	Usually burn; minimal tan	Fair skin, blue/green/hazel eyes, blond/brown hair	33	25	20
III	Mild burn; moderate tan	Average Caucasian skin	44	33	27
IV	No burn; good tan	Light brown skin	58	44	35
V	Never burn; usually tan	Brown skin	89	67	53
VI	Never burn; always tan	Black skin	167	125	99

official banner of the United Nations. These committees were dedicated to the implementation of the protocol, and it was in their interest to make sure the protocol did not fail.

To ensure the environmental and political success of the protocol, the number of participating nations needed to expand. The Montreal Protocol was signed by forty-nine nations, twenty of which were developing nations. China and India did not sign because they feared the treaty would stifle efforts to increase their standard of living. The absence of China and India was a major impediment. (Does this issue sound familiar? The Kyoto Protocol does not require China and India to reduce their emissions of greenhouse gases; see *Policy in Action: Why Was the Solution to the Reduction in*

Stratospheric Ozone Simple Relative to Global Climate Change?)

Increasing production and consumption by these nations threatened to overwhelm the reductions made by the signatories, thereby reducing the environmental effectiveness of the protocol. Furthermore, the absence of China and India sent a strong political signal to other developing nations to stay out.

To overcome these political and environmental impediments, at the 1990 London meeting developed nations established a fund that would help developing nations pay for new ozone-friendly technologies. These efforts convinced China and India to join the protocol. Their cooperation enhanced the global standing of the protocol so that the number of participating nations rose to sixty-six. The London

Elevated exposure to UV radiation also can damage your eyes. Your eyes reduce exposure to bright light by squinting and narrowing your pupils. These reactions are less effective when UV radiation is elevated. Allowing more UV radiation to enter your eyes can cause sunburnlike effects such as photoconjunctivitis. Although painful, these conditions are reversible.

Irreversible damage comes in the form of cataracts. Increased levels of UV radiation accelerate the rate at which proteins in your eye unravel. Once they unravel, the proteins tangle and accumulate pigments that cloud the lens. Eventually these clouds block light and cause blindness. Cataracts are responsible for blindness in 12–15 million people; about 20 percent of these cases are due to elevated exposure to UV radiation.

Many people extend their exposure to get a suntan. A tan is an increase in the production of protective pigments that impart “a healthy glow.” Many try to get a tan without burning. Your ability to do so depends on your skin type (Table 1). Very light-skinned people, known as melano-compromised (skin types I and II), always burn and rarely tan in the sun. Slightly darker skin, known as melano-competent (skin types III and IV), occasionally burns and usually tans in the sun. Naturally brown or black skins, known as melano-protected (skin types V and VI), never burn and usually tan. You should use Table 1 to identify your skin type.

Contrary to popular opinion, a tan does not protect you or your skin from exposure. A dark tan on white skin is equivalent to a skin protection factor of about 4. “Skin protection factor” is a term that appears on suntan lotions and clothing and refers to the reduction in exposure. Specifically, skin protection factor refers to the increased time to reddening associated with that product. This definition is vague but can be clarified with a simple example. Suppose you have skin type II; it takes you about twenty minutes to redden when the UV index is 10. Applying a suntan lotion with a skin protection factor of 4 would increase the time until you redden fourfold to eighty minutes. Clearly a tan would not help much if you were spending the day at the beach.

Long-term exposure can increase skin’s thickness, reduce its elasticity, increase wrinkling, and generate freckles. The greatest health concerns focus on UV exposure and skin cancer. Your vulnerability to skin cancer depends on your skin type. People with skin types I–IV suffer over 90 percent of nonmelanoma skin cancers. Nonmelanoma skin cancers are rarely fatal, but removing them can be painful and leave you permanently disfigured. Even more dangerous are malignant melanoma skin cancers, which can be fatal. The incidence of these cancers has increased by about 4 percent annually since the 1970s. These cancers are more frequent among skin types I–II.

Consult your local newspaper for today’s UV index. If it does not appear in your local newspaper, you can get it from the NOAA Web site listed below. Use the information in Table 1 to calculate how long it would take you to redden. Calculate the skin protection factor that you would need to prevent reddening if you were exposed to the sun all day. This is just an exercise—you should not try to maximize your time in the sun. Even if you do not redden on a single day, the risk of skin cancer is determined by cumulative exposure.

ADDITIONAL READING

World Health Organization. *Global Solar UV Index: A Practical Guide*. Geneva, Switzerland, 2002.

NOAA Web site for current UV indexes: www.cpc.ncep.noaa.gov/products/stratosphere/uv_index/uv_current_map.shtml.

STUDENT LEARNING OUTCOME

- Students will be able to explain their vulnerability to damage from the sun’s rays and how they can evaluate the potential for damage on any given day.

meeting also expanded the number of chemicals regulated and accelerated the phase-out of CFCs—production would be banned by 2000. Expanding the chemicals regulated and accelerating the timetable for stopping their production continued at subsequent meetings in Copenhagen (1992), Vienna (1995), Montreal (1997), and Beijing (1999). As a result the concentration of some CFCs in the troposphere is declining (Figure 14.15).

FIGURE 14.15 Declining Concentrations (a) After increasing steadily, the atmospheric concentration of CFC-11 started to decline in 1995. (b) On the other hand, the atmospheric concentration of CFC-12 appears to be stabilizing.

