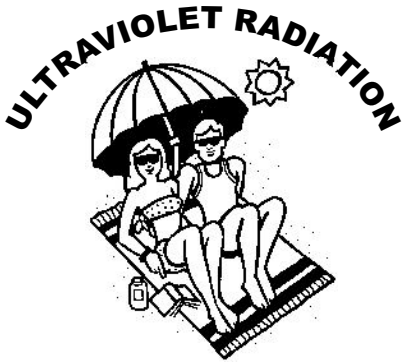
In this chapter

CHAPTER 6



Although energy from the sun sustains all life on earth, some forms of the sun's energy can be harmful. Ultraviolet (UV) rays, for example, cause sunburns and skin cancer.

As a result of ozone depletion, much attention has been focused on UV in recent years, but UV rays have always been dangerous. About 76,000 new cases of non-melanoma skin cancers and 4200 melanoma skin cancers are now diagnosed each year in Canada. This is largely a result of poor sun protection practices.

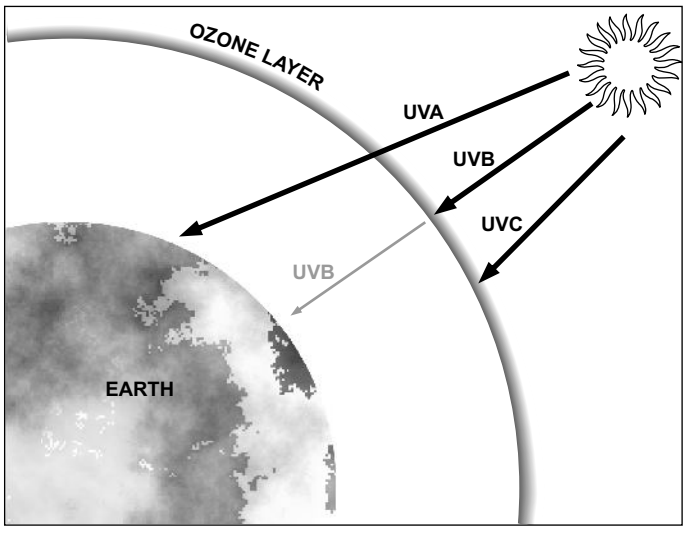
TIPS

You may want to cover UV topics in spring as the associated activities work better when UV rays are stronger. Also, learning about UV in April or May would encourage sun protective practices leading up to the time of year when they're needed most.

What is UV?

The sun radiates energy that travels through space like a wave. Some of this energy — about 45% of it — reaches us as visible light. The rest is invisible radiation. One form of invisible solar radiation is Ultraviolet or UV. It has a shorter wavelength than visible light but carries more energy. UV is classified into three types, by decreasing wavelength: UV-A, UV-B, and UV-C.

Much of the sun's UV-A reaches the earth's surface. However, most of the UV-B, and all of the UV-C, are filtered out by the earth's atmosphere, primarily by the ozone layer.



The ozone layer absorbs some but not all types of ultraviolet radiation.

Factors Affecting UV

Factors that affect the amount of UV radiation reaching the earth's surface include:

- height of the sun in the sky, which depends on latitude, time of year and time of day — when the sun is most directly overhead, its rays have the least distance to travel through the atmosphere and the rays are more intense, being focused on a smaller area
- ozone layer thickness — the thicker it is, the more UV it can absorb
- altitude — at higher altitudes, there is less atmosphere above to absorb UV rays
- cloud cover and atmospheric pollution — both can reduce UV levels.

You may want to revisit Activity number 1 on page 8-1 to demonstrate how the strength of the sun's rays — including UV rays — varies depending on the angle at which they hit the earth.

THE OZONE CONNECTION

The Ozone Layer

Ozone is a noxious, colourless gas with a harsh odour. Fortunately, ozone occurs in greatest concentrations in the stratosphere, forming the ozone layer at an altitude of 15 to 35 km.

The ozone layer is produced naturally, by the reaction of UV rays on ordinary oxygen. Ozone, in turn, will also break apart as it absorbs UV. This cycle of forming, then breaking up ozone molecules maintains a natural balance of ozone in the atmosphere, protecting us from harmful UV radiation. Most ozone is made above the tropics where the sun is strongest, but it is transported around the globe by high level winds.

Ozone Depletion

The natural balance between the production and destruction of ozone has been tipped in the direction of destruction since about 1980 by manufactured chemicals such as chlorofluorocarbons (CFCs). These chemicals have long atmospheric lifetimes, and when they reach the stratosphere, they react with UV to create new ozone-destroying products like chlorine.

A single chlorine atom can destroy thousands of ozone molecules, and bromine is about 50 times more destructive!

Although much of the earth is affected, thinning of the ozone layer has been most severe over the poles in spring. That means less UV is absorbed by the ozone layer and more reaches the earth's surface.

A Look Ahead

As ozone is made from atmospheric oxygen, the ozone layer can repair itself once the quantity of destructive chemicals in the stratosphere is reduced. However, scientists are concerned that rising levels of greenhouse gases will affect ozone loss, and even with international cooperation, it will likely be at least 2050 before any substantial recovery occurs. Higher than normal UV levels, then, will be with us for decades to come.

UV EFFECTS

Human Health Effects

The thinning of the ozone layer over southern Canada has resulted in an average 5% increase in sunburning UV. In the spring, though, UV increases are often much higher. UV can affect human health because it penetrates into the skin and can cause skin cancer. The number of new cases of skin cancer diagnosed each year in Canada has more than tripled over the past 20 years. Since these develop

over time, most new cancers have likely been caused by sun exposure which occurred decades ago, prior to any serious ozone thinning. Ozone depletion may worsen the problem unless the effects of increased UV are offset by better sun protection habits.

Sunburn is a short-term, or acute effect of UV radiation. When you get a sunburn, cells in the skin are damaged, resulting in pain. The body responds by increasing blood flow to the small vessels of the skin, causing the redness associated with sunburn. There is a link between repeated, severe (blistering) sunburns and skin cancer later in life.

More than 1 in 7 Canadians over the course of their lifetimes can expect to develop some form of skin cancer.

In addition to skin cancers and sunburns, over-exposure to UV rays can also lead to other health problems, such as premature aging of the skin, weakening of the immune system and eye problems such as cataracts.

Other Effects of UV

Plant growth is affected by increased UV levels. Some agricultural crops, such as canola, oats, and even cucumbers, show reduced yields at higher levels of UV. Effects on forests are harder to measure, as trees may be exposed over many decades.

Ultraviolet radiation also has an effect on natural communities. Increased UV exposure in lakes and oceans can damage tiny single-celled plants called phytoplankton, that provide food for fish and other animals. Sudden, brief UV increases during early spring can damage young vegetation or the eggs of fish and frogs which are laid in shallow water.

Increased UV also reduces the lifetime of the construction materials used in our homes and other structures.

To see the effect of UV on ordinary newspaper, have your students do Activity number 19 on page 8-20.

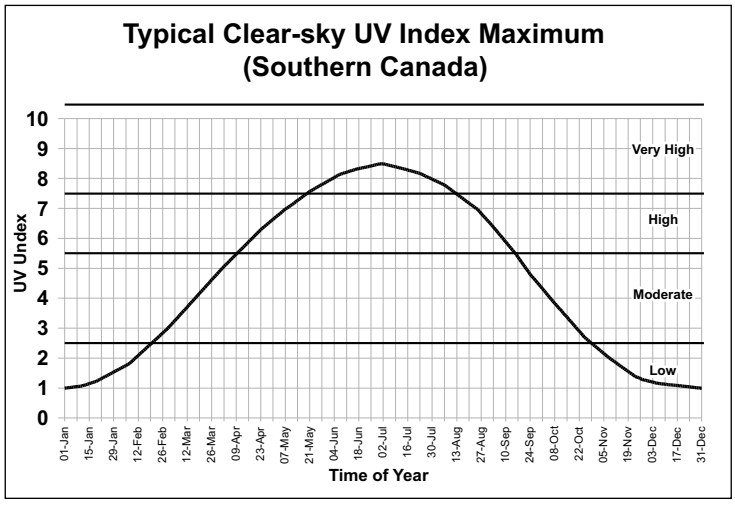
THE UV INDEX

Environment Canada's UV Index program was launched in 1992, the first of its kind in the world.

The UV Index was designed to measure the burning effect of UV radiation on human skin. The simple numerical scale runs from 0 to about 11 in Canada. As you go further south, the Index can go considerably higher,

Activity:

Ask your students for details of their last sunburn experiencewhen it happened, when they noticed it, what time they were in the sun that day, and what they were doing. Prepare a log of the results and have your students look for behaviour patterns that contribute to over- exposure.



sometimes reaching the teens in places like Florida. The higher the number, the faster you'll burn.

Activity:

If any of your students are going to Florida for March break, you could compare UV readings in the 2 locations. Each day during the week prior to March break, have a student record the UV and amount of cloud at noon. Ask the student going to Florida to do the same while on holiday. Compare the differences and discuss the effect of latitude and sun angle on UV strength.

Environment Canada computers produce a daily UV Index forecast for specific locations, based on the angle of the sun at midday, the predicted amount of ozone overhead and the forecast cloud amount. The UV Index forecast is produced for Canadian cities and for holiday destinations as well. The UV Index forecast is often included in the public weather forecast, especially during the spring and summer. You may see it on your local newspaper's weather page, and may hear it in radio, television or Weatheradio Canada broadcasts. The UV Index forecast can also be found on the Internet.

Activity:

To locate the UV Index forecast for Canadian locations, visit http://www.weatheroffice.ec.gc.ca and select Regional Forecast Text from the menu on the left. If your community is not listed in the Daily UV Forecast bulletin, then check your public forecast through that web site instead. The UV Index is included from mid-April to mid-September.

The UV Index forecast represents the maximum value expected during the day. Under clear skies, this will occur at midday when the sun is at its highest point in the sky. In the summer, this generally occurs from 1 to 2 p.m.

Starting in 2004, Canada will follow the Global UV Index guidelines of the World Health Organization. Under these guidelines, there are five categories: Low, Moderate, High, Very High, and Extreme. Learning the significance of each category will help you take appropriate sun protection measures during your outdoor activities.

UV Index	Category
11+	Extreme
8 to 10	Very high
6 to 7	High
3 to 5	Moderate
0 to 2	Low

If you're planning a day outdoors with your class, take along a UV meter and do the graphing exercise on page 8-21 in the Activities section.

UV PROTECTION

You can still enjoy being outside if you remember to take a few precautions. First, take a moment to find out the weather forecast and the UV Index forecast. If there will be sunshine during your outing, the UV Index forecast will give you some guidance on the appropriate level of sun protection.

The higher the sun is in the sky, the shorter your shadow, and the stronger the UV. A rule of thumb is that, if your shadow is shorter than you are, then the UV will be 4 or higher and students should protect themselves from too much sun.

When the UV Index is low (0-2) . . .

- Minimal sun protection required for normal activity
- Wear sunglasses on bright days. If outside for more than one hour, cover up and use sunscreen
- Reflection off snow can nearly double UV strength. Wear sunglasses and apply sunscreen

When the UV Index is moderate (3-5) . . .

- Take precautions - cover up, wear a hat, sunglasses and sunscreen especially if you will be outside for 30 minutes or more
- Look for shade near midday when the sun is strongest

When the UV Index is high (6-7) . . .

- Protection required - UV damages the skin and can cause sunburn
- Reduce time in the sun between 11 a.m. and 4 p.m. and take full precautions - seek shade, cover up, wear a hat, sunglasses and sunscreen

When the UV Index is very high (8-10) . . .

- Extra precautions required - unprotected skin will be damaged and can burn quickly
- Avoid the sun between 11 a.m. and 4 p.m. and take full precautions - seek shade, cover up, wear a hat, sunglasses and sunscreen

When the UV Index is extreme (11+) . . .

- Values of 11 or more are very rare in Canada. However, the UV Index can reach 14 or more in the tropics and southern U.S.
- Take full precautions. Unprotected skin will be damaged and can burn in minutes. Avoid the sun between 11 a.m. and 4 p.m., cover up, wear a hat, sunglasses and sunscreen
- White sand and other bright surfaces reflect UV and increase UV exposure

Activity:

If you have a UV meter, your students can evaluate the protection offered by shade, clothing, and sunglasses by doing the UV experiments that begin on page 8-9 of the Activities section. Not all fabrics are created equal, nor does all shade offer the same amount of protection.

Remember that reflection off snow, white sand, or reflective paint — especially light coloured — can greatly increase the amount of UV reaching the skin and eyes. The unprotected eye is particularly vulnerable to reflected radiation.

Sunbeds and sunlamps generally use UV-A, and are not safe alternatives to natural tanning. A tan, like a sunburn, is a sign that the skin has already been damaged.

TIPS

Listen for Environment Canada's UV Indexit's included in your local weather forecast whenever it is forecast to reach 3 (moderate) or more that day.

It is important to adopt good sun protection strategies at an early age, because most skin cancers and other sun-related disorders are preventable.

Here are a few things that can be done at school to reduce exposure to UV:

- schedule outdoor sports and other activities early in the day to avoid the peak sunshine hours of 11 a.m. to 4 p.m., especially in May and June
- provide shaded play areas and encourage their use
- make hats and protective clothing mandatory for outdoor recesses and outside activities
- encourage the use of sunscreen with a sun protection factor (SPF) of 15 or higher and with both UVA and UVB protection
- develop a formal school sun safety policy
- post or announce the daily UV Index forecast