

# Activity 5: UV radiation and vitamin D exposure

## Aims

- To increase knowledge of how UV radiation levels change during the day and months of the year.
- To increase understanding about the amount of UV radiation needed to produce recommended levels of vitamin D in the human body.

**Assessment outcomes** English 4.3, 4.12; H&PE 4.7; D&T 4.2 (Worksheet 5C)

**Reference fact sheets** Fact sheet 4: Ultraviolet radiation  
Fact sheet 5: Sun exposure and vitamin D  
Fact sheet 12: Fake tanners

**Worksheets** Worksheet 5A: Sun exposure and vitamin D  
Worksheet 5B: UV radiation research task  
Worksheet 5C: Design a UV radiation alert postcard

## Vitamin D production

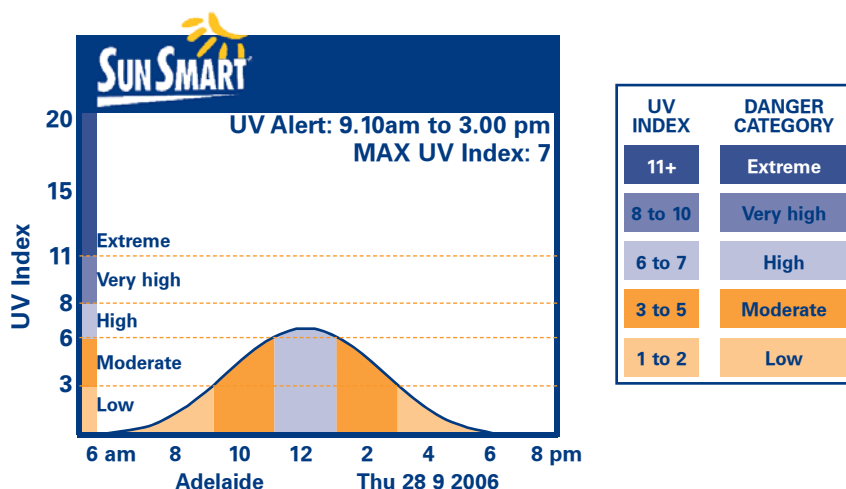
Vitamin D is made in the skin after exposure to the UV radiation in sunlight. Vitamin D is important for the regulation and absorption of calcium for the development of strong healthy bones. Most people receive enough vitamin D from sunlight exposure simply by going about their day-to-day lives. However there are some people who are at risk of vitamin D deficiency due to their skin colour, health circumstances or cultural traditions.

## Ultraviolet radiation

Ultraviolet radiation levels vary throughout the year. The *SunSmart UV Alert* graph shows the amount of UV radiation produced by the sun on a typical September day in Adelaide.

**When the UV radiation level reaches 3 or above skin damage can occur and therefore skin protection is recommended.**

The amount of UV radiation not only varies over a day, but also over the year. In South Australia UV radiation levels are highest from September through to April. It is important to check the daily SunSmart UV Alert <[www.bom.gov.au/weather/uv](http://www.bom.gov.au/weather/uv)> when planning outdoor activities to ensure adequate skin protection is used.



# Activity 5: UV radiation and vitamin D exposure (cont.)

## Teacher guidelines

- 1 Discuss the above information about vitamin D and UV radiation with students and then go through the following questions with the class.

*Note: Most of the answers to the questions can be accessed from the Reference Fact Sheets (see above) or from general biology or nutrition text books. Also see*

*<[www.osteoporosis.org.au/html/aboutosteo\\_prevention.php](http://www.osteoporosis.org.au/html/aboutosteo_prevention.php)>*

*<[dietary-supplements.info.nih.gov/factsheets/vitamind.asp](http://dietary-supplements.info.nih.gov/factsheets/vitamind.asp)>*

*<[www.mja.com.au/public/issues/182\\_06\\_210305/dia10848\\_fm.html](http://www.mja.com.au/public/issues/182_06_210305/dia10848_fm.html)>*

- What is the function of vitamin D? How long is it stored in the body and what are the effects of vitamin D deficiency?
  - Would people with fake tans need more or less sunlight to achieve their recommended levels of vitamin D? Explain why.
  - Would people with black skin need any more or less sunlight to achieve their recommended levels of vitamin D? Explain why.
  - Some groups of people are at risk of vitamin deficiency due to their skin colour, health or cultural traditions. Think of three groups of people who may be at risk and explain why.
- 2 Distribute Worksheet 5A: Sun exposure and vitamin D.
    - a) Analyse the table on Worksheet 5A and ensure that students understand the information.
    - b) Students could complete worksheet either individually or in groups.
  - 3 Distribute other Worksheets 5B: UV radiation research task and 5C: Design a UV radiation postcard as required.

## Extension activities

- 1 Work with your teacher to organise a meeting with your Principal or SRC/Student Voice to develop a sun-protection policy to protect students from UV radiation. Questions to consider:
  - What information would need to go into a policy? i.e.
    - hats
    - sunscreen
    - clothing
    - shade
    - all-day events
    - school programs
    - organisation of outdoor lessons and breaks.
  - How would you go about implementing your policy?
    - What steps would need to happen to ensure the policy was successfully adopted?
    - Who would need to be involved?
    - How would you promote it?
    - How would you monitor the success of the policy?
- 2 Design a range of SunSmart clothing that would appeal to teenagers. Consider the following:
  - type of fabric
  - coverage of arms and legs
  - fashion/ style
  - comfort



# Worksheet 5A: Sun exposure and vitamin D

Vitamin D is important for the development of strong healthy bones. Vitamin D is a vitamin that is found in some food but is best made in the body from exposure to the sun. Sunshine is a significant source of vitamin D as ultraviolet radiation hitting the skin begins the process of vitamin D production in the body. While the sun helps the body to produce vitamin D, only a little exposure is needed to get the benefit. Most people receive enough vitamin D simply by going about their day-to-day lives and don't need to make a special effort to go outside to increase their "dose" of UV radiation for vitamin D production. Recent studies have found that some groups of people who have limited exposure to the sun don't produce enough vitamin D.

Study the table before attempting to answer the questions.

## Sun exposure needed to produce adequate amounts of vitamin D in South Australia

(The Cancer Council South Australia 2006)

	September to April	May to August
UV radiation levels in these months	UV levels average 3 and above, so skin protection is recommended.	UV radiation levels are below 3 on most days.
Sun exposure needed to produce adequate vitamin D	Expose face, arms, and hands to the sun for 10 minutes either before 10.00 am or after 3.00 pm on most days of the week.	Expose face, arms and hands to the sun for 2–3 hours per week.

### Discussion questions

- 1 a) How is vitamin D made?

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- b) What is the main function of vitamin D?

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- c) Are there any times of the year that you would expect vitamin D to be lower in the body? Explain why.

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- d) At what UV radiation level should skin be protected?

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- e) What is the difference between UV radiation levels in September to April compared with May to August?

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- f) At which time of the year would more sun exposure be needed to obtain the recommended amounts of vitamin D? Explain why.

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- 2 A parent in Adelaide has concerns about their child not receiving adequate amounts of vitamin D. Write a letter to this parent on the back of this worksheet explaining the recommended amounts of sunlight required at various times of the year, according to this table.

# Worksheet 5B: UV radiation research task

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**Use the following websites to research the questions below about UV radiation:**

- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA): Radiation Basics – Ultraviolet Radiation <<http://www.arpansa.gov.au/basics/uvr.htm>>
- Bureau of Meteorology: Forecasts for Sun Safety <[http://www.bom.gov.au/info/about\\_uvb.shtml](http://www.bom.gov.au/info/about_uvb.shtml)>
- The SunSmart website <[www.sunsmart.org.au](http://www.sunsmart.org.au)> – skin protection information – UV radiation. There is also information on the UV Alert on this page.
- WHO information on UV radiation - <http://www.who.int/uv/en/>

**Answer the following questions about UV radiation:**

1 What is UV radiation?

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2 How does it reach us?

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3 How does UV radiation differ from infrared radiation (heat)?

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4 What time of the year is the sun's UV radiation most intense in South Australia?

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5 What is the SunSmart UV Alert and how can it help us? (Hint: Check the weather page of your daily newspaper)

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6 At what UV Index level do we need to start using sun protection?

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7 What effect does overexposure to UV radiation have on your skin?

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8 What combination of five skin protection measures are necessary to protect your skin from the sun's UV radiation?

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# Worksheet 5C: Design a UV radiation alert postcard

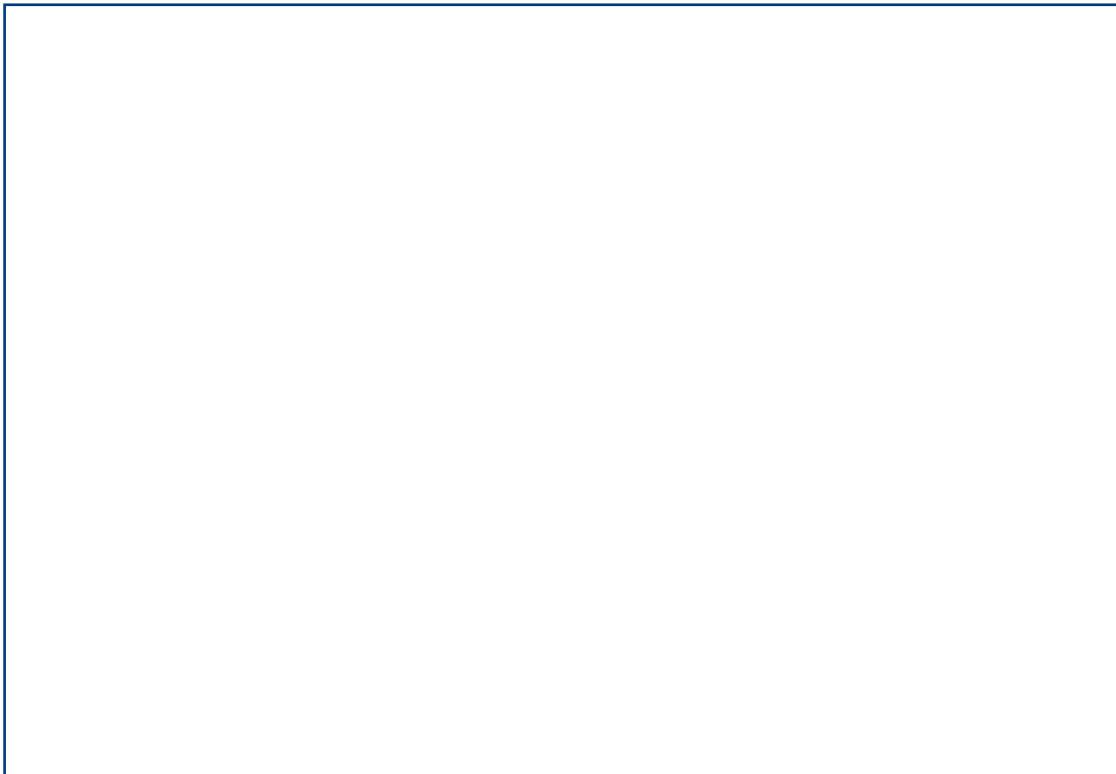
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Use what you have learnt about UV radiation to develop a UV radiation alert postcard. Consider the following points when designing your postcard:

- **Target audience:** 14–16 year olds
- **Purpose:** to inform young people about the dangers of UV radiation
- **Distribution points:** surf shops, sports stores and cafes in coastal towns

As you design the postcard, remember that you have limited space and need to create something that presents the information clearly and succinctly and that also appeals to your target audience. You want teenagers to actually pick it up and read it!

How would you convince someone that exposure to something we can't see or feel, can be harmful to our skin and possibly lead to skin cancer?

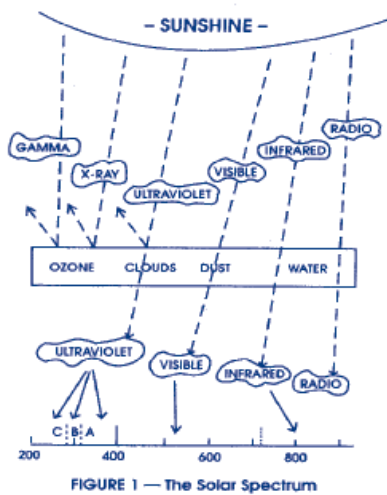


# Fact sheet 4: Ultraviolet radiation

## What is Ultraviolet Radiation (UVR)?

Ultraviolet radiation is the part of sunlight which causes sunburn and skin damage leading to premature ageing and skin cancer.

Sunshine is made up of different rays which travel in waves. The distance between the waves [the wavelengths] for each ray is different and allows us to categorise them. The diagram below shows the different rays arranged according to their wavelengths. The wavelengths are measured in nanometres.



Visible rays are the light-giving rays of the sun while infrared rays provide heat. There are three types of ultraviolet rays, UVA, UVB and UVC.

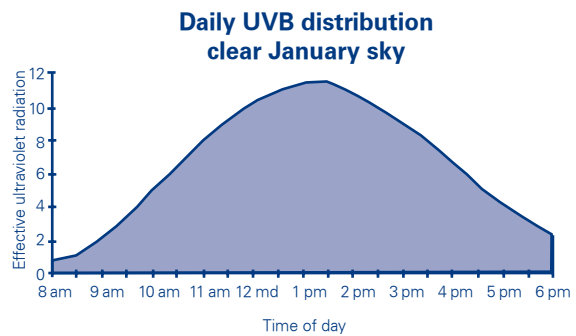
Naturally occurring UVC does not reach the earth's surface as it is absorbed or scattered in the atmosphere. However UVC can be produced artificially by arc welders and sterilising lamps and people working with such equipment should protect themselves.

UVA and UVB are the naturally occurring ultraviolet rays which are of concern because of their potential to cause skin cancer.

## The danger period for UVR is between 10 am and 2 pm (11 am and 3 pm daylight saving)

The amount of UVR reaching the earth's surface varies throughout the day. On a cloud-free day, maximum UVR occurs when the sun is directly overhead at solar noon,

12 midday (1 pm daylight saving time). High levels of UVR also occur during the two hours before and after solar noon. So the danger period for UVR is between 10 am and 3 pm. These are the hours when skin damage occurs fastest. Damage can also occur before and after these hours - it just takes longer!

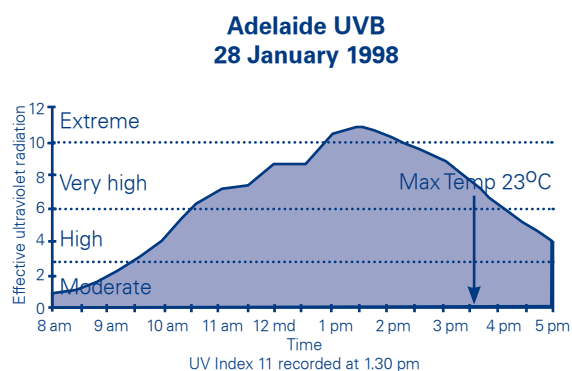


Source: Australian Radiation Protection & Nuclear Safety Agency

## UVR levels are not related to the air temperature

UVR cannot be seen or felt and the intensity of such radiation is not related to the air temperature. The air temperature rises during the day as a result of the earth being heated by the sun's infrared rays. The maximum daily temperature usually occurs during the mid to late afternoon whereas maximum UVR occurs at around midday. There can be high levels of UVR on cool days.

A cool front which will cause a sudden drop in temperature has no effect on the level of UVR unless it is accompanied by substantial cloud cover.



Source: Australian Radiation Protection & Nuclear Safety Agency

## Fact sheet 4: Ultraviolet radiation (cont.)

### You can still get burnt while under shade

About 50% of UVR reaches you directly from the sun while the remaining 50% is scattered about the sky and reaches you indirectly. Light coloured and shiny surfaces such as concrete, sand and water reflect UVR which can reach you even if you are in the shade. Reflected UVR can reach your face under a hat.

### You can still get burnt on cloudy days

Skin damage can still occur on days with a thin cloud cover. The cloud scatters the UVR in all directions and although you receive less direct UVR you may receive more indirectly. Heavy cloud does decrease the amount of UVR but scattered cloud has little or no effect on UVR levels.

### More UVR at high altitudes

At high altitudes where the atmosphere is thinner, the amount of UVR reaching your skin can be as much as 20% higher than at sea level.

Fresh snow reflects up to 80% of UV, thereby increasing the amount of UVR which reaches skiers' faces and other exposed areas.

UVR levels are higher during the summer months than in the winter months. In winter the UV rays have to pass through more of the atmosphere because of the angle of the sun in relation to the earth's surface. However UVR levels do vary from day to day and a high UVR day in April or October may be more damaging than an overcast day in January.

### What are the risks from UVR?

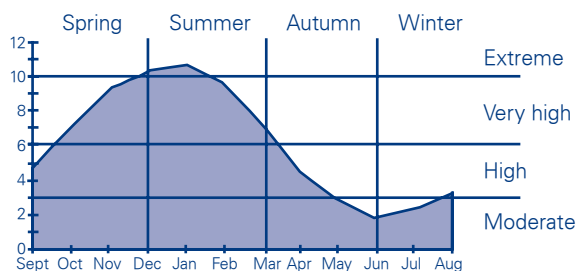
The immediate risk from over-exposure to UVR is sunburn. The more serious, long-term risk is skin cancer. UVR also causes premature ageing, causing the skin to become leathery, wrinkled and blotchy.

The eyes can also be damaged from long-term exposure to UVR.

### Be SunSmart - protect yourself from UVR!

- Take particular care the sun between 10 am and 2 pm (11 am and 3 pm daylight saving) if possible.
- Wear a broad brimmed hat - this will reduce the UVR reaching your face and eyes by 50%. Sunglasses will also protect your eyes.
- Wear cover-up clothing - shirts with long sleeves and a collar, made of closely woven fabrics give good protection.
- Apply a SPF 30+ Broad Spectrum sunscreen on any exposed skin that cannot be protected with clothing.
- And remember: you can still get skin damage on cool, slightly overcast days.

**Average monthly UV Index  
Adelaide 1997-1998**



Source: Australian Radiation Protection & Nuclear Safety Agency

# Fact sheet 5: Sun exposure and vitamin D

Australia has the highest rates of skin cancer in the world with one in two Australians developing skin cancer sometime during their life. Over-exposure to the sun's ultraviolet (UV) radiation is the major cause of skin cancer. UV radiation exposure is also important to the body for the production of vitamin D which is needed for healthy bone growth and development. So how much sun do we need for vitamin D production?

## UVR exposure and skin cancer

The link between exposure to the sun's UV radiation and skin cancer is well known. Ultraviolet radiation is the part of sunlight that causes sunburn and skin damage. This can lead to premature ageing and skin cancer.

Australia has high levels of UV radiation because the country is close to the equator. UV radiation levels vary throughout the year. This can depend on:

- The height of the sun (the higher the sun in the sky the higher the UV radiation levels)
- Whether you're in the north or the south of Australia
- The amount of cloud cover
- The altitude
- Ozone levels
- UV reflective surfaces (light coloured concrete, water, snow).



The higher the UV radiation levels, the less time it takes for skin damage to occur. Generally UV radiation levels are most intense around the middle of the day (10 am to 3 pm).

UV radiation intensity is reported on an index called the UV Index (UVI). It divides UV radiation levels into:

- low (1–2)
- moderate (3–5)
- high (6–7)
- very high (8–10)
- extreme (11 and above).

UV radiation is strong enough at a UV Index of 3 to cause skin damage, therefore skin protection is recommended when the UV radiation level is 3 and above.

In Australia, the Bureau of Meteorology forecasts the highest UV level for the following day on their website [www.bom.gov.au](http://www.bom.gov.au). When the UVI forecast is 3 or above, you need to protect yourself because the UV radiation is intense enough to damage the skin.

## Vitamin D and sun exposure

Vitamin D is needed for the development of strong healthy bones. Recent studies have found that some groups of people who have limited exposure to the sun don't produce enough vitamin D.

While the sun helps your body produce vitamin D, you only need a little exposure to get the benefit. Most people receive enough vitamin D simply by going about their day-to-day lives and don't need to make a special effort to go outside to increase their "dose" of UV radiation for vitamin D production.

## How much sun exposure is needed in South Australia for adequate vitamin D?

### September to April

- UV radiation levels are, on average, 3 and above from September to April in South Australia. Skin protection is recommended during these months.
- From September to April expose your face, arms and hands to the sun for 10 minutes either before 10 am or after 3 pm on most days of the week.

### May to August

- UV radiation levels are lower.
- Expose your face, arms and hands to the sun for two to three hours per week.

Those travelling or living in the north of Australia should protect themselves all year round.

## Will sunscreen stop you getting enough vitamin D?

Sunscreen filters out most but not all UV radiation. Regular use of sunscreen when the UV radiation level is 3 (moderate) or more does not greatly decrease vitamin D levels over time.

## Fact sheet 5: Sun exposure and vitamin D (cont.)

### Most people are not at risk of low vitamin D

Only some people living in Australia have low levels of vitamin D.

They include:

- The elderly, especially those who do not go outdoors very often — older people also don't produce vitamin D as well as young people.
- People with dark skin, who naturally have more melanin, the pigment that reduces the amount of UV radiation getting through the skin.
- People who cover their skin and heads with clothing and veils for cultural or religious reasons, so less skin is exposed to UV radiation.
- Babies of mothers who have low levels of vitamin D.

These people generally have little exposure to the sun, especially during winter if they live in the southern half of Australia. This is usually why they may not get enough vitamin D.

People concerned with their vitamin D status should discuss this with their doctor.

### How to protect yourself when the UV radiation levels reach 3 (moderate) and above

- Minimise your time in the sun between 10 am and 3 pm when UV radiation is strongest.
- Use shade wherever possible.
- Wear clothing that covers as much skin as possible.

- Wear a hat that protects the face, ears and neck.
- Wear close fitting sunglasses that meet the Australian Standard 1067.
- Use broad spectrum, water resistant SPF 30+ sunscreen, and reapply it every two hours.

When in alpine regions or near highly reflective surfaces like snow or water, use sun protection at all times of the year, anywhere in Australia.

### References

P Gies et al. "Global Solar UV Index: Australian measurements, forecasts and comparison with the UK." *Photochem Photobiol* 2004; 79(1):32–9

R Marks, PA Foley, D Jolley, KR Knight, J Harrison, SC Thompson. "The effect of regular sunscreen use on vitamin D levels in an Australian population. Results of a randomised controlled trial." *Arch Dermatol* 1995 Apr;131(4):415–21.

J Farrerons, M Barnadas, J Rodriguez, A Renau, B Yoldi, A Lopez-Navidad, J Moragas. "Clinically prescribed sunscreen (sun protection factor 15) does not decrease serum vitamin D concentration sufficiently either to induce changes in parathyroid function or in metabolic markers." *Br J Dermatol* 1998 Sep;139(3):422–7

J Farrerons, M Barnadas, A Lopez-Navidad, A Renau, J Rodriguez, B Yoldi, A Alomar. "Sunscreen and risk of osteoporosis in the elderly: a two-year follow-up." *Dermatology* 2001; 202(1):27–30.

Australian and New Zealand Bone and Mineral Society, Osteoporosis Australia, Australasian College of Dermatologists and the Cancer Council Australia: Risks and benefits of sun exposure. Position Statement 2005.



# Fact sheet 12: Fake tanners

There is a wide range of fake tanning products promoted commercially.

## Lotions - skin dyes

Fake tanning lotions, sprays and creams contain dihydroxyacetone (DHA), a chemical or vegetable dye that temporarily stains the skin, giving a tanned appearance. The dye binds to the skin and comes off when the dead skin cells flake off. Although some brands include a sunscreen they do not provide adequate protection from UV radiation.

## Tablets

There are also tablets commercially available. The tablets contain beta-carotene, a Vitamin A related chemical responsible for the orange colour of a number of fruit and vegetables. These tablets produce an orange skin colour that may remain for several weeks on the palms and soles after use of the tablets has stopped. The tablets offer no protection from UV radiation.

## Protection from UV radiation

Lotions and skin dyes offer no protection against UV radiation. Although some brands do include a sunscreen, the protection from the sunscreen does not last for the length of time the tan remains on the skin. The sunscreen will only provide a few hours of protection from the time

of application. To prevent sun damage a SPF 30+ broad spectrum sunscreen should be applied prior to sun exposure.

The Cancer Council strongly recommends that people using a fake tanning product protect themselves when outdoors with SPF30+ broad spectrum sunscreen, a shady hat, sunglasses and protective clothing if they are going to be exposed to UV radiation.

## Recommendations

- 1 People who have a strong desire to change their skin colour should choose a fake tanning product in preference to UV radiation (direct sunlight or solarium).
- 2 Fake tanning product users should continue to protect their skin by:
  - Taking particular care to cover up between 10 am and 3 pm,
  - Wearing a broad brimmed hat, sun protective clothing, sunglasses and seeking shade,
  - Using a broad spectrum SPF 30+, water resistant sunscreen.

