STUDENT SHEET 5

# HOW SAFE IS YOUR SUNSCREEN?

When the Australian summer hits it's essential we protect our skin by covering up, seeking shade, and liberally applying sunscreen. How sunscreens protect our skin from damaging effects of ultraviolet (UV) radiation depends on what active ingredients are in the cream.

## So, which sunscreen will you choose?

There are two main options: sunscreens made with organic ingredients such as avobenzone or oxybenzone; and suncreens made with inorganic ingredients such as titanium dioxide ($TiO_2$) and zinc oxide (ZnO). These ingredients work differently to protect skin from damaging effects of UV radiation.

Organic compounds in sunscreen absorb UV radiation through a chemical reaction, and by doing so protect our skin from harmful UV radiation. Inorganic compounds work by reflecting, scattering or absorbing UV radiation, preventing harmful radiation from reaching the skin. Inorganic compounds are generally considered to deliver better protection.

Organic sunscreens have a few disadvantages: they can cause skin irritations and allergies, and they need to be reapplied more often as they breakdown when they're exposed to UV. On the other hand, inorganic metal oxides titanium dioxide and zinc oxide generally don't make you itch and don't need to be reapplied as often.

## What about nanoparticles in sunscreen?

Since the 1990s nano-sized particles of both titanium dioxide and zinc oxide have been used as active ingredients in many sunscreens. Nanoparticles have a much larger surface area relative to their volume when compared to micro or macro-sized particles of the same substance, and are more effective at absorbing UV radiation. As nano-sized titanium dioxide is most effective in absorbing UV-B radiation, and zinc oxide most effective for UV-A, a mixture is often used.

Sunscreens made with nanoparticles have a cosmetic advantage as they can be virtually invisible upon skin, avoiding that ghostly sheen. Sunscreen smears on your car and clothes are also avoided, providing protection with no visible evidence of nanoparticles to the naked eye.

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## What's the evidence for and against the safety of nanoparticles in sunscreen?

In 2014 Australia's pharmaceutical safety watchdog, the Therapeutic Goods Administration (TGA), reviewed all available scientific evidence concerning the health risks of nanoparticles in commercially available sunscreens. This extensive review concluded that there was no measurable evidence of nanoparticles penetrating human skin and being absorbed by the body.

One of the most important findings is what actually happens to nanoparticles of zinc oxide and titanium dioxide when placed on human skin. Nanoparticles work by creating a physical barrier that prevents penetration of UV radiation. This barrier is what makes them so effective at UV protection, absorbing and reflecting dangerous UV radiation away from our sensitive skin.

Nanoparticles sit on the outermost layer of skin, known as the stratum corneum. This layer of skin isn't living – the cells are actually dead and will eventually fall off naturally as dust.

Scientific research indicates that nanoparticles in sunscreens remain on the outer layer of skin. They're unable to penetrate the skin surface into living cells beneath, nor are they absorbed into the body. Where they're applied is where they stay.

## Why are some people worried?

Some people are concerned about the safety of nano-sized particles in consumer products. Nanoparticles are small enough to penetrate the cells of organisms, but how they interact with chemicals within cells is not completely understood.

In 2008 concerns about nanoparticles in sunscreens were raised when roofing company Bluescope Steel released a report that linked sunscreen residue with damage to paint coatings on roofing panels. Rapid degradation was evident where workers' sunscreen-soaked fingers had touched panels.

At the nano size both titanium dioxide and zinc oxide are known to create free radicals when exposed to UV radiation. These are highly reactive molecules with unpaired valence electrons. In the human body, excessive free radical production has been linked with aging, inflammation and diseases like cancer. It was these reactive oxygen compounds that quickly stripped paint off building materials. Free radicals in the body are counteracted by the presence of antioxidants which our body produces or we consume through diet.

But don't wash off your nano sunscreen just yet! Paint coatings and human skin are quite different, and interactions between nano sunscreen and human skin are likely to be equally different.

Research with animals and live tissue cultures has also revealed that excessive doses of titanium dioxide and zinc oxide nanoparticles can damage DNA. Mice regularly fed nanoparticles of titanium dioxide developed significant chromosomal and DNA damage.

It sounds scary, but we're not eating or drinking our sunscreen; instead we're putting it on our skin, where it works differently. And don't forget those mice were ingesting very large doses over time, much more than you'd ever be exposed to by applying sunscreen.

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## What's the verdict?

The body doesn't absorb sunscreen nanoparticles: this means our cells, and DNA, are protected from damage. They're not turning into a seething mass of dangerous free radical monsters on our skin's surface either. Many manufacturers coat particles with a protective layer which stops free radicals forming. Phew!

And there's more good news, whilst your sunscreen might contain nanoparticles, often these particles clump together to form aggregates and agglomerates that are even less likely to penetrate our bodies.

## So, does your sunscreen contain nanoparticles?

That's a tough question to answer in Australia, as our labelling laws don't require manufacturers to tell us if their products contain nanomaterials. It's different in New Zealand and Europe, where nanoparticles must be identified on product labels by law.


## Sun or science?

We might not know everything about the way nano-sized titanium dioxide and zinc oxide particles interact with our cells, but the overwhelming scientific evidence is that nanoparticles in sunscreens are safe. When you consider the alternative, irreparable damage to our skin from the sun, nano sunscreens are probably the safer option.

For further information and opinions about nanomaterials in sunscreens, check out the following:

- Therapeutic Goods Administration (government regulator, www.tga.gov.au)
- Friends of the Earth (environmental activist group, www.foe.org.au)
- Choice (Australian consumer organisation, www.choice.com.au)
- Bluescope Steel (manufacturer of Colorbond, www.bluescopesteel.com.au)
- Cosmetics Info (searchable database maintained by the USA cosmetics and personal care industry that explains the role of cosmetic ingredients, cosmeticsinfo.org).

Questions you might have:

- Should sunscreens containing nanomaterials be controlled?
- Should labels show whether products contain nanomaterials?
- How can risks and benefits of nano-based sunscreens be compared?
- There is less discussion of risks of organic-based sunscreens in the media — is this justified?