STEM Program

Slim Shady Sunnies

Light Waves and Refraction

Sunglasses are an important part of caring for your body in the Australian Sun. They're the slide part of the Australian Cancer Council's Slip, Slop, Slap, Seek, Slide approach to sun safety.

Suited to Section

Joey Scouts | Cub Scouts | Scouts | Venturer Scouts | Rover Scouts

Challenge Area

COMMUNITY | PERSONAL GROWTH | OUTDOORS | CREATIVE

Key SPICES Growth

SOCIAL | PHYSICAL | INTELLECTUAL | CHARACTER | EMOTIONAL | SPIRITUAL

Likely Scout Method Elements

COMMUNITY INVOLVEMENT | LEARNING BY DOING | NATURE AND THE OUTDOORS | PATROL SYSTEM

PERSONAL PROGRESSION | PROMISE AND LAW | SYMBOLIC FRAMEWORK | YOUTH LEADING, ADULTS SUPPORTING

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Plan

You have acquired some new cool looking sunnies ready to enjoy your next scout camp. But just how good are they really? Are they protecting your eyes effectively? Let's find out.

There are two key ways sunglasses provide protection from the sun.

1. UV light (block harmful UV light)
2. Glare (block excess light entering eye that can cause pain or in extreme situations blindness)

Do

Testing UV protection

1. UV blacklight torch (can be sourced from online retailers, electronic stores, and some pet stores – in the aquarium/reptile sections)
2. Australian currency – notes
3. Sunglasses (sunnies)

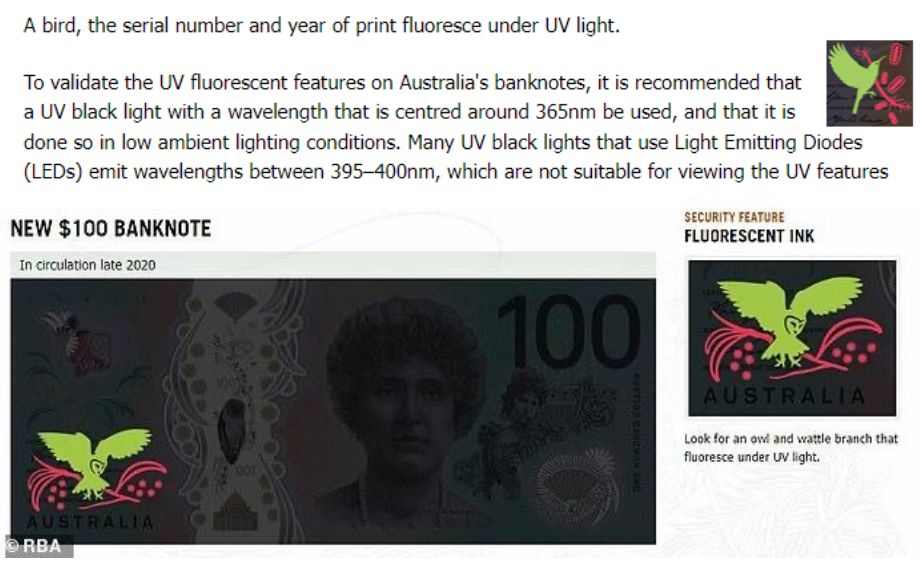
Internet resource: Test different glasses
https://www.eyeweargenius.com/how-to/test-sunglasses-uv-protection/

Part 1. Visualising the effects of UV light

1. Carefully shine your blacklight torch onto different Australian Bank notes.
2. Can you see things that weren't visible under normal light?
3. Are there parts that glow?

Each Australian bank note has UV fluorescent ink images sections as part of their security features. Each of the notes has a native Australia bird image, the serial number and the year the note was printed. Can you find them? ($5 has an Eastern Spinebill, $10 has a Cockatoo, $20 has a Kookaburra, $50 has a Black Swan, $100 has a Masked Owl).

https://banknotes.rba.gov.au/counterfeit-detection/security-features-overview/



Part 2. Changes when viewing UV light through Sunglasses

1. Take your sunglasses and carefully shine your blacklight torch through your sunnies onto the bank note. You need to get a narrow beam of UV light that only goes through the lens.
2. Does the amount of fluorescence change?

The better the UV protection the more light the lens should block and the less the images will fluoresce (glow under UV light).

Testing Effective Glare blocking ability

1. Rope
2. Cake cooling rack (2 x vertical grill and or 1 x vertical and 1 x cross hash grill)
3. LCD screen — optional (digital watch or monitor screen)
4. Different types/styles of sunglasses; get everyone in your unit to bring some in to test
5. Lens known to be polarised and/or polarized film sheets/filters

Internet resources:
https://www.sciencefacts.net/polarization-of-light.html
https://www.physicsclassroom.com/class/light/Lesson-1/Polarization
https://www.scienceworld.ca/resource/polarizing-filters/#:~:text=Light%20is%20a%20wave%20and,go%20through%20a%20polarizing%20filter
https://www.mcgill.ca/oss/article/technology/what-kind-sunglasses-do-i-really-need

Part 1. Light Waves demonstration

1. Choose two volunteers to stretch out the rope between them
2. One volunteer hold the rope still (as an anchor point)
3. The second volunteer needs to move their hand up and down quickly to make the rope wiggle. Then move your hand side to side quickly to make the rope wiggle in a different direction.

Observation: You should be able to see that light (the rope) forms a wave that can go in all different directions. A light beam is made up of lots of light waves at different angles to each other.

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Do

Part 2. How a polarizer works

This is a demonstration that represents how a polarizer works.

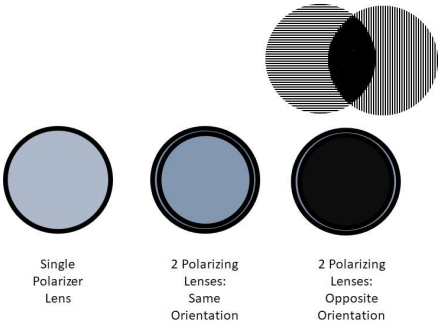
1. Have one or two volunteers hold up two vertical grill cake cooling rack. Make sure the grills are parallel to each other. This represents a magnified version of a polarising filter.
2. Thread your rope through the cake grill and have two volunteers hold one end each.
3. Repeat the part 1 light wave demonstration.
4. What did you observe that was different after it goes through one grill? Observation: You should see that when the wave is parallel to the grill it will be able to travel through the grill. When the wave is perpendicular to the grill it will be very limited.
5. Repeat the part 1 light wave but turn one of the grills 90 degrees so it is at right angles (alternatively you could use a single grill that is cross hashed).
6. What did you observe about the light wave after it goes through the grill? Observation: This demonstration represents when you have two polarizers at opposite angles, no light will get through the pair. What this looks like with the rope is that it doesn't move much on the opposite side of the rack to where you created the wave.

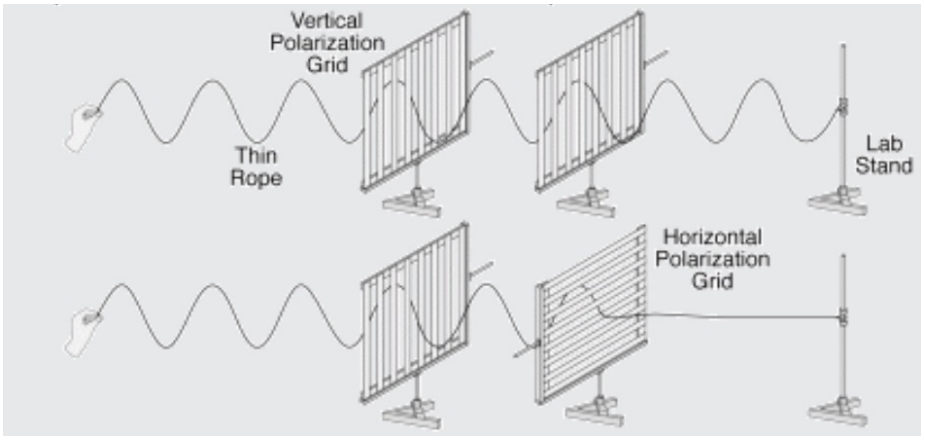
Part 3. Exploration

Now let's test how this principle works with actual sunglass lenses.

1. In pairs or patrols, each have two pieces of polarized surface (film, sunglass lens, camera filter etc)
2. Overlap the two pieces and look through them. What do you see?
3. Rotate one of the filters against the other while looking through them. What happens?

Now let's find out whether everyone's sunglasses are polarized. Take one polarized surface (a known polarized sunglass lens, a polarized filter or film). Overlap this with the lens of your sunnies – can you see through or is it black? Rotate the lens about 60 degrees. Does the overlapping area darken a lot? If your sunnies are polarized you will see a darkened area. If your sunnies are not polarized the overlapping area will not change.





Review

1. Do your sunglasses protect you from UV light?
2. Do your sunglasses protect you from glare?
3. What are the most important factors to consider when buying a new pair of sunglasses?

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Variations

- Try using a dedicated UV test – international sellers via online stores
- Look at a black and white liquid crystal display (LCD) such as a digital watch through a polarizing filter/lens. Rotate the filter slowly 90º. What happens?
- What about mirrored lenses? Does the same amount of light or UV get through? Remember that mirrors reflect light (right onto your nose) – is that an issue for skin sun safety?
- The principle of polarization is used in the photography industry to take better images. If you have access to a polarized camera lens, explore taking the same photos with and without the polarizer. What differences can you see?

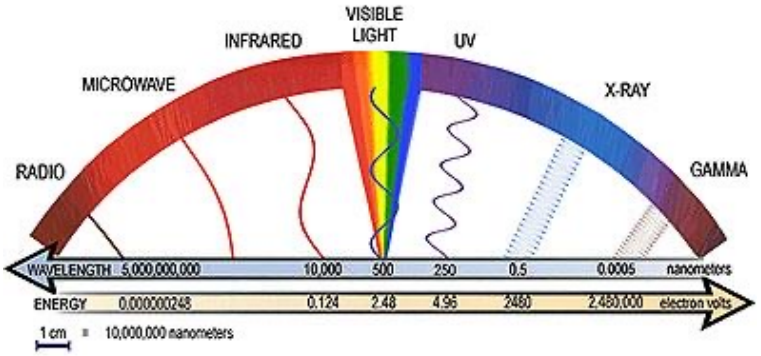
Safety Tips

- Black lights produce ultra-violet (UV) light. You can't see the UV light waves with the naked eye (though black lights usually also produce a purple glow). Minimise the amount of exposure your skin or eyes have to this light as it is damaging. Definitely no shining a black light torch directly into eyes either.

Why Does This Happen?

Science Concepts

Ultra violet light waves - The naked eye cannot see ultraviolet light rays (UVA, UVB or UVC) but these can affect your eyes and body in different ways – anything from mild sunburn, skin cancer and even blindness in extreme circumstances.



UV Protection - Sunglasses sometimes have labels indicating what light waves they block. E.g. UV400 blocks all light wavelengths up to 400 nanometres (this includes UVA and UVB). This protection comes from the material sunglasses are made of (such as polycarbonate or Trivex) or a coating added to the surface (for CR-39 plastic or optical glass).

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Glare – when too much light enters your eye and affects how the eye sees. It can be anything from distracting to blinding.

Polarisation – blocks sunlight that is concentrated (polarised) by flat surfaces such as roads, water, or snow. They increase colour and clarity of what you are looking at.

Lens tint (colour) – this does not provide UB protection or polarisation. It controls how much light will go through the lens and into your eye.

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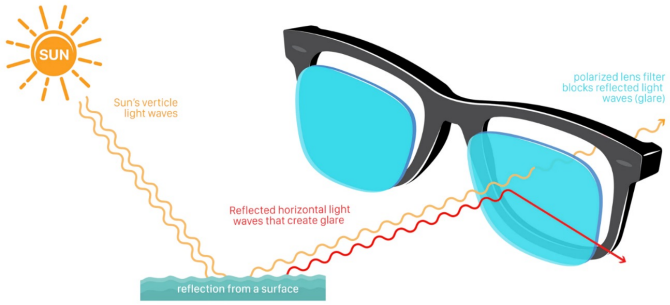

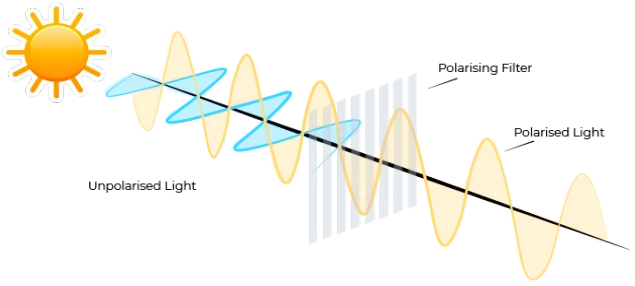

https://www.visiondirect.com.au/optical-centre/sunglasses/polarized-sunglasses

So the key take home is that sunglasses have 2 properties that are very different but both important. They need to block UV light to protect your eyes from damage and they're better if they polarise as this will reduce glare. The tinted colour of your lenses is purely personal preference.

As of July, 2019, all sunglasses sold in Australia must be tested and labelled according to the Australian/New Zealand standard AS/NZS 1067.1:2016.
https://www.productsafety.gov.au/product-safety-laws/safety-standards-bans/mandatory-standards/sunglasses-fashion-spectacles

When buying sunglasses, look for a lens category of at least 2 or preferably 3.
Look for these types of stickers →

SciScouts Physics of Waves

The SciScouts Physics of Waves is a National Science Week project, undertaken in collaboration with Fizzics Education. These instructions were prepared by Scouts for Scouts. This National Science Week project is supported by the Australian Government.

Scouting has always been strong on STEM skills. Maths to calculate catering quantities and navigate, the science of water purification, the physics of abseiling, and the engineering of pioneering structures – they all have their place. In the current program for our youth members, STEM and Innovation forms one of six Special Interest Areas that enable Scouts to set goals and pursue their own ideas.