Kiwrious

Light Sensor:	**Curriculum Level:** 3-5 **Difficulty:** Beginner **Duration:** 60 minutes
Overview In this second lesson, learners will be tasked to recommend a sunscreen to reduce the amount of UV light reaching the sensor. Using the Kiwrious Light Sensor and a UV torch learners will measure how effective sunscreens with varying SPFs (Sun Protection Factors) are at blocking UV. The content and context of this lesson are relevant for understanding the importance of sun safety and developing science capabilities e.g. gathering and analysing data and representing the results.	**Learning Objectives** Students will learn to: • Design an inquiry to test predictions on effective UV protection. • Gather and interpret data of different lotions to determine which provides the best protection from UV light. • Relate their findings to real life contexts.
About the Sensor The Kiwrious Light Sensor can measure the amount of light and ultraviolet radiation it receives in real time. These values are displayed as lux and UV index values. The students can shine sunlight and different other sources of light on it, making it a great tool for understanding light as a source of energy as well as sun safety. This sensor works well inside a classroom with a UV torch.	**Vocabulary** www. Electromagnetic spectrum, visible light, Ultraviolet (UV) light, wavelength, frequency, infrared, ozone, atmosphere, sunburn, Lumens, UV Index
Prerequisite Knowledge 1. Light is a broad spectrum - some of it is visible, some is infrared and some is Ultraviolet. 2. Scientists ask questions about their world and use tools to help them gain answers in their investigations. 3. Vocabulary list •	**Curriculum Links** **Nature of Science** Investigating in Science L3-5 - Using personal experience to make sense of the world around them **Science Concepts** Physical Inquiry and Physics Concepts L3-4 - Exploring light as a form of energy **Technology** Outcome Development and Evaluation of a Technological Product L3-5 - Assessing existing ideas to improve their applications
Materials 1. Internet-connected computer and a projector. 2. Computers/Chromebooks with internet access (per student) 3. Kiwrious Light Sensor 4. UV torch 5. 10cmx10cm plastic squares (to protect sensor from lotion) 6. Suggested sunscreens and lotions: SPF 70, SPF 50, SPF 30, Moisturiser (no SPF), Hand sanitiser. www.	

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Student Directions

Did you know there is huge ball of gas burning in the sky which can damage your skin in minutes? Your Principal wants you to investigate which sunscreen might be most effective in filtering out the Sun's harmful rays. Science Time! You have a special UV torch to use because you can't go outside in bright sunshine unless you are fully protected. If it is a cloudy, winter's day there won't be enough UV light anyway. Scientists might use a UV torch to model the effect of different sunscreens and lotions because they can keep the UV levels constant. This is called a controlled experiment.

Guided Lesson www.

Lesson Sequence

- Recap prerequisite knowledge highlighting that light is a broad spectrum, which includes visible light and UV light that we can't see.
- Recap the Kiwrious sensor and explain how scientists use tools to measure light intensity.
- Discuss how scientists keep some variables constant while testing the effect of another variable. In this lesson, UV light will be kept constant by using a UV torch held the same height above the sensor. Students will test different sunscreens and lotions spread on clear plastic and recommend which is most effective at reducing UV.
- Follow the prompts on the Kiwrious platform to begin the experiment.

Guided Lesson www.

Learning Questions

Questions teachers could utilize to guide student learning:

1. Can we see UV light?
2. What does UV do to us?
3. Could UV light readings be different if the torch was at a different height?
4. What does it mean to keep "variables constant" (i.e.unchanging)?
5. What variable are we going to change (SPF or amount)?

Troubleshooting:

Check that students are on-task. Students should have the chrome browser open. Look for students that are not getting any sensor data on their screen.

What if some of my students completed this at home already?

- Ask them to share their findings with the class and have a small discussion before the rest start the experiment.
- Appoint them as teaching assistants to help the rest with this experiment.
- Ask them to pick one of the follow-up experiment ideas to do instead.

Challenge

Once students understand how the sensor works and what the readings mean, challenge them to design their own inquiries at home. You may use the following prompts to start them off:

- Investigate whether the same SPF varies between different brands of sunscreen
- Is an SPF50 five times as effective as SPF10?
- Does a tanning lotion increase the UV reading?
- Does it matter how thickly or often you apply sunscreen?

- Does sunscreen wash off completely?

Background

Nature of Light

What is light?

Light is a source of energy- a form of radiation that occupies a narrow portion of the broad electromagnetic spectrum. Our experience of light on Earth is a combination of visible light, ultraviolet light as well as infrared heat. The human eye can only detect a small component of the electromagnetic spectrum known as visible light while unable to detect others like radio, ultraviolet (UV), infrared and gamma rays. We are able to see our surroundings because of light.

Where does light come from?

There are natural and artificial sources of light, including stars, bioluminescence, candles, light bulbs, fire and so on. However, the main source of light on Earth that will be explored in this lesson is the Sun, a nuclear fireball that spews electromagnetic energy in all directions.

How does light travel?

Light travels in the form of waves at 300,000 km per second. It takes an average of 8 minutes and 20 seconds to travel from the sun to the earth. The unit of measurement for light is known as lumens, which decreases and increases depending on the distance from the source of light.

Types of Light and Their Properties

The different types of light are characterized along the spectrum according to their wavelengths, how much energy they possess as well as their frequencies. The higher amount of energy means the more conscious we should be when interacting with these waves.

Visible light: Visible light waves are the only wavelengths in the electromagnetic spectrum that humans can see. The different wavelengths of visible light are seen as the colours of the rainbow: red, orange, yellow, green, blue, indigo and violet. The wavelengths range from violet being shortest (400nm) to red being the longest (700nm). Visible light is also known to have health benefits. For instance, exposure to sunlight, whether indoors or outdoors allows the skin to absorb vitamin D, a critical nutrient that prevents health risks. It is also known to improve sleep and ward off seasonal depression.

Ultraviolet (UV): UV wavelengths are shorter than 400nm but are higher in frequency. UV can be broken down into three categories, UVA (315–400 nm), UVB (280–315 nm) and UVC (180–280 nm). Although undetectable by the human eye, due to its high amount of energy, it is responsible for our tans and sunburns. Too much exposure to UV radiation is also found to be damaging to living tissue and may cause cancer.

Infrared: Infrared wavelengths are longer than 700nm but are lower in frequency. Undetectable by the human eye, they are most commonly experienced through the heat that the sun emits.

Effects of Light

Importance of Sun Protection: Although light is known to provide health benefits, prolonged exposure to the sun may have negative consequences. The effects of UV light on our skin may vary depending on where they lie in their three categories. UVC, being the shortest wavelength, is normally absorbed by the ozone before it reaches our skin; UVB rays are able to come into contact with the outer layer of our skin and cause sunburn; UVA radiation penetrates deeper into the skin.

UV Index: It becomes important to monitor the amount of UV that reaches Earth in various locations and times. The UV Index was developed to measure the intensity of UV radiation to help make predictions and warnings. Within this index, the larger number is associated with greater UV intensity. A UV Index number of 2 or less is a low exposure level, while a progressive rise to a UV Index number of 11 and beyond is considered an extreme exposure level. Interestingly, the UV index value during the summers in New Zealand is typically 12 but may exceed 13 in the far north. Meanwhile, during winter time, the peak value generally lies between 1 or 2.

The Differences Between Suntan Lotion, Sunscreen and Sunblock

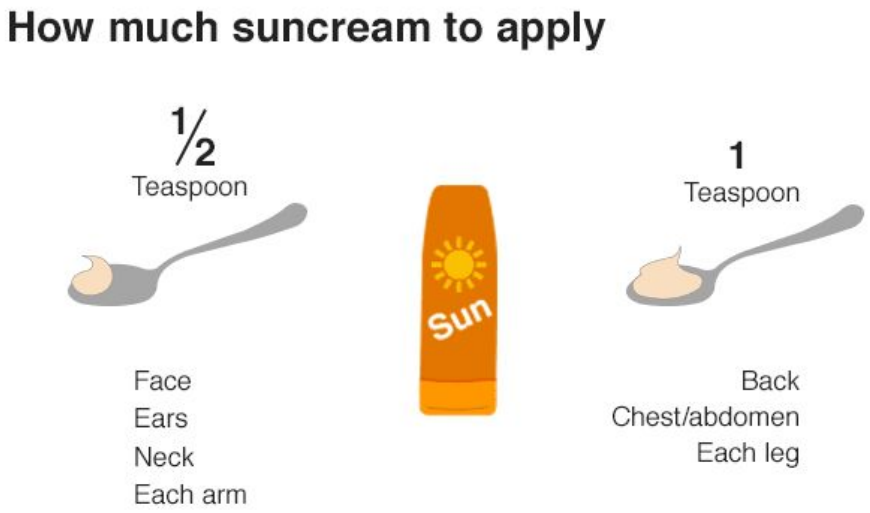
Useful sites: https://www.verywellhealth.com/suntan-lotion-versus-sunscreen-2634306

Some suntan lotions claim to increase suntans. They contain no or very low sun protection (SPF 4-8) and some may include an accelerator. They are not suitable for children if the SPF is lower than 15.

Sunscreen: Sunscreens come in different forms - gel, lotion, spray or stick. A sunscreen should have an SPF of at least 15-30. It should protect against UVA and UVB rays. Check the label. Some do not protect against UVA which is just as damaging as UVB. Water resistant means it won't sweat off. A sunscreen provides a chemical barrier filtering out the sun's rays.

Sunblock: A sunblock provides a physical barrier. They are opaque (think white zinc)

From https://www.bbc.com/news/health-44936124 Sunscreen needs to be applied thickly enough, which many of us fail to do. SPF ratings are based on the assumption that a 2mg blob will cover 1 sq cm of skin.



That means you should apply at least six full teaspoons (36g) to cover the body of an average adult. More than half a teaspoon to:

- each arm
- the face, neck and ears

More than one teaspoon to:

- each leg
- chest and abdomen
- back

Areas such as the sides of the neck, temples and ears are commonly missed, so take extra care and apply liberally.

It is also easy to forget to reapply sunscreen as often as necessary.

The British Association of Dermatologists advises:

- Put it on 15 to 30 minutes before going out in the sun, to allow it to dry
- Top up again shortly after heading outdoors, to cover any missed patches and ensure

you're wearing a sufficient layer

- Reapply at least every two hours and immediately after swimming or if it has rubbed off