







LIGHTS OUT

Saving the Night Sky







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1 What is light?

Photons – the superheroes of light

If we're going to reduce light pollution, we should start by understanding what light is. Have you ever wondered where light comes from, how we see, or what our world would be like without it?

Light is complicated – but simply put, light is **energy**.

Light energy is made of photons, which are tiny particles of light that travel through space. You can picture them as energy balls zooming around at great speed – mini-superheroes whizzing around with the superpower of making things visible to us. They move faster than anything else in the universe, bounce off everything they touch, and carry **reflected** light into our eyes. Without photons, we wouldn't see anything!



Light is an energetic superhero, racing through space and only becoming visible when it reaches our eyes. (Illustration by Envisage Information Technology)

Did you know that rainbows:

- ★ can have a second, fainter rainbow on the outside of the brighter rainbow? Look closely at the one on the outside – you'll see the colours are reversed and the area between the two rainbows is darker!
- ★ are each different depending on where you stand, and how the light comes to you? So, the rainbow you see is entirely yours – no one else will see it the same way.
- ★ are not bow-shaped but form a circle? From the ground, we usually see only a semicircle, but from an aeroplane you can see a full circle.
- ★ mostly occur during the day when the Sun is shining, but that there are also moonbows and fogbows?
- ★ also exist on other planets in our solar system, such as Venus and on Saturn's moon, Titan?

↓ **Double rainbows are extra special because they mirror one another. (Credit: Olivia Kulbida via Unsplash)**



How animals see the world

Remember visible and invisible light? Humans can't see UV or infrared light, the types of light at the very ends of the light spectrum. Scientists don't really understand how other creatures see the world, but they do know that:

- ★ Butterflies use patterns on their wings to communicate with each other.



On the left is what humans see. On the right is how a butterfly sees the world. (Credit: Sweeney A, Jiggins C, Johnsen S (2003) Polarized light as a butterfly mating signal. *Nature* 423, 31–32. https://doi.org/10.1038/423031a)

- ★ Many feathers reflect UV light, helping birds spot predators and recognise mates.
- ★ Shrimp can see a wide range of colours and use **polarised** light for hunting and communication.
- ★ Jumping spiders use UV light to locate their prey and potential mates.
- ★ Scorpions **fluoresce** under UV light and might use this to detect UV light in their environment.
- ★ Salmon, trout and goldfish can see in murky waters or find food using UV light.
- ★ Some amphibians use UV light to navigate and hunt for insects at night.
- ★ Bees can spot patterns on flowers that guide them to nectar.

The rhythm of life

Twilight and the setting and rising Sun determine our regular day and night patterns. Some of us are more lively at one time of day than the other! Someone who prefers getting up first thing in the morning is known as an early bird, and those who like staying up late are called night owls. Which one are you?

Chronobiologists are scientists who study living things and how they react to light. They have worked out that we are all triggered in different ways by the colour temperature of the light we receive.

During the day when the Sun is high in the sky, light is bright and the colour temperature is cool, our bodies want to be active and alert. As the Sun sets in the evening and we enter twilight, the warm, golden colour temperature triggers our bodies to start to feel sleepy.

This pattern is called the circadian rhythm, and it acts like our body's internal clock.

Light acts like our body's natural alarm clock. Darkness makes us feel sleepy, while light tells our body it's time to wake up and be active. (Credit: elenabs via iStock)





Glowing mushrooms

There are more than 125 known species of bioluminescent fungi, also known as ghost mushrooms. These funky fungi shine bright green or blue, making their own natural light.

Scientists aren't totally sure why these fungi glow. Maybe it's to scare away animals that might want to eat them, or perhaps they use it to say 'Hello – look at me!' to other fungi nearby. This communication could help them share nutrients or find mates to reproduce.

This natural process could also be a useful tool for humans. Researchers are looking into how the fungi's properties could be used to make medicines, or how the natural glow could provide an eco-friendly lighting option for roads and paths.

Warning! Many wild mushrooms, including those that glow in the dark, are poisonous, so don't eat them – just admire from afar!

Did you know that the platypus can glow too? You read that right! This egg-laying mammal shares the quirky trait of glowing under UV light with another Australian animal – the wombat!

While we don't exactly understand why, it is thought to be related to the animals' preference for **nocturnal** or twilight activity.



Glowing mushrooms need complete darkness to fluoresce at night. (Credit: Poidabro via Wikimedia Commons)

Earthshine

Have you ever noticed a faint glow on the dark part of the Moon? That's called earthshine! It happens when sunlight reflects off Earth and lights up the darker side of the Moon, making a soft, ghostly glow. It's most visible during the crescent moon phase, when only a thin slice of the Moon is directly lit by the Sun. Earthshine lets us see the outline of the whole Moon, even when most of it is in shadow. It's a gentle reminder that our planet and the Moon are always shining on each other in space.

The Moon as a timekeeper

A moon's phase describes how we see the shape of light reflected from the Moon to Earth. It changes as the Moon orbits our planet, from new moon to full moon and back again. This takes about 29.5 days and was once called a moonth in Old English!

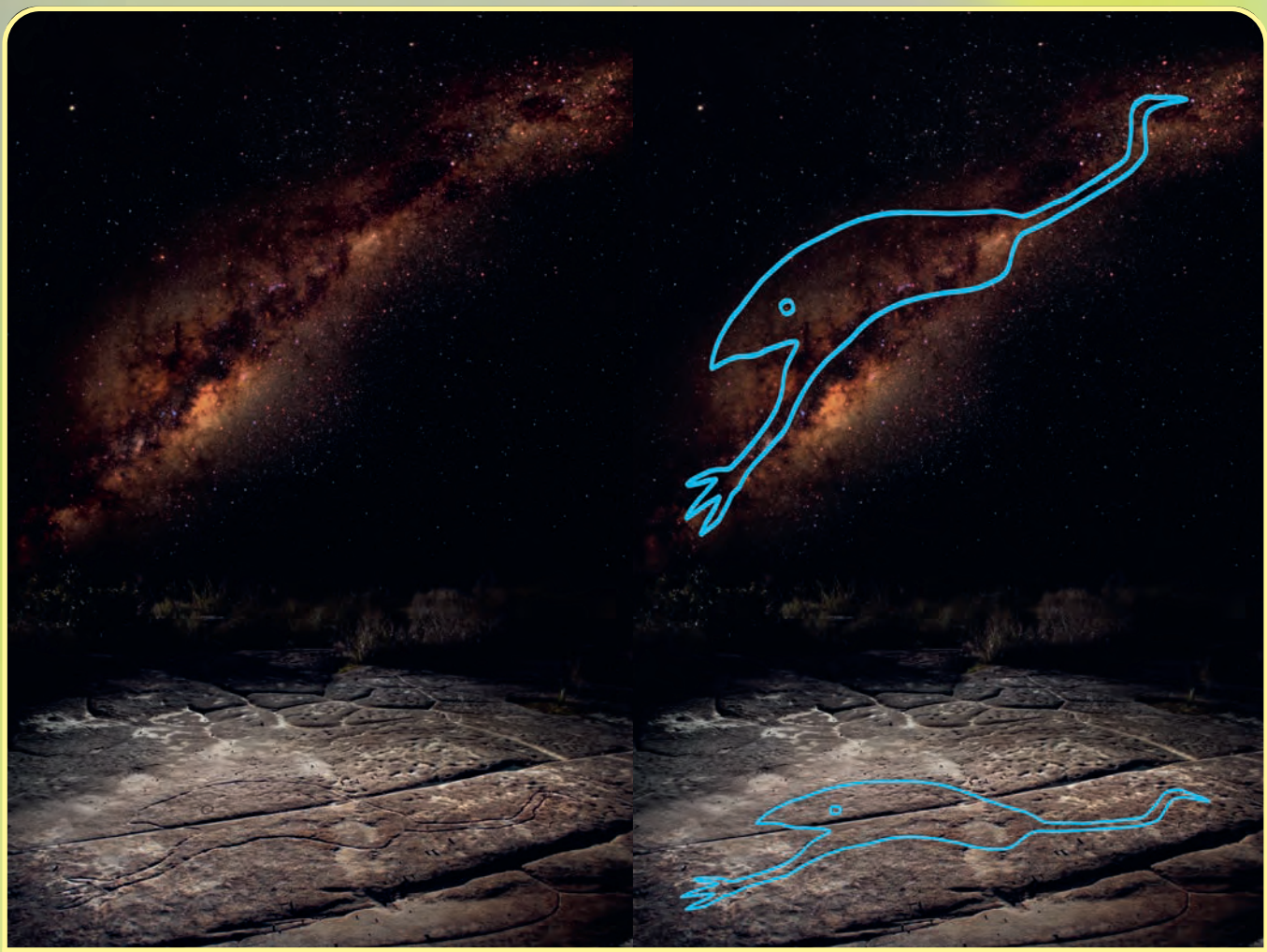
For thousands of years, people have watched the Moon and noticed its changing shapes. Different cultures around the world made calendars using the Moon's patterns to know when to plant crops or hold special celebrations. In some religious events in Islam and Christianity, the Moon helps decide when to celebrate events such as Ramadan and Easter.

↓ Earthshine happens when sunlight reflects off Earth back to the Moon. (Credit: ESO/B. Tafreshi/TWAN (twanight.org), CC BY 4.0 <https://creativecommons.org/licenses/by/4.0>, via Wikimedia Commons)

When did you last look at the Moon? How bright was it? Next time you see a full moon, grab a book and see if you can read it, or take some friends for a walk! You might be surprised how much you can do without artificial light during a full moon.



Some religions use the Moon to determine special holidays and celebrations. (Credit: Mohamed Hassan via Pixabay)



Emu in the Sky constellation (top) and rock carving of the emu in Ku-ring-gai National Park (bottom). (Credit: Barnaby Norris)

From natural to artificial light at night

Here's an overview of how light has changed over our history.



Long ago: fire

Early humans discovered how to make light by burning sticks and wood. They used these flames to light up caves and dwellings to keep warm and safe.



Candles: ancient lights

Ancient Egyptians and Romans used candles made from beeswax or animal fat called tallow. These were easy to carry around and used to brighten up temples and for special ceremonies.



Oil lamps: light in a jar

As time went on, people invented oil lamps – little jars filled with animal fat or plant oils. A wick soaked in the oil would burn, providing a steady light that lasted longer than a candle.



Gas lighting: brighter streets and homes

In the 1800s, an invention by Scotland's William Murdoch called gas lighting took off! Suddenly, streets, homes and businesses were much brighter than ever before. These lights were still not as bright as the Moon.



Electric light: a bright new world

Thomas Edison's invention of electric light arrived in the late 1800s. It was a game changer, bringing bright, safe light to homes everywhere with just the switch of a button.



LEDs: sustainable lighting

Today, we have super coloured LEDs. These tiny lights are energy efficient and can last for years. Some of these lights are 150 times brighter than the Moon!



Now: Smart lighting

Smart lighting uses Wi-Fi and computer programming to change a light's colour, intensity or when it is on. It helps the planet by using much less electricity and reduces light pollution.

Imagine living 200 years ago, before electric light at night. How would your day be different? What activities can you do now at night that you could not have done then?

The steps between fire and smart lighting as sources of artificial light at night. (Credit: haroldguevara and JV Korotkova via Shutterstock)

Quiet songbirds

Have you ever driven into the city at night and noticed buildings with all their lights on, even though nobody is inside? What a waste of power!

While these lights might look pretty, they're harmful to birds. In the United States, up to one billion birds are killed each year from collisions with brightly lit buildings at night. That's not just sad – it's a huge loss for nature.

Here in Australia, we don't have as many bird collisions with buildings, but bright city lights are still affecting our feathered friends. They are stopping our beautiful songbirds from singing to one another.

Male songbirds such as magpies, willie wagtails and lyrebirds sing to find a mate. If they are near city lights, they start singing earlier than those in darker places. This makes them tired and more likely to be eaten by cats or foxes. And their songs often don't sound as sweet because they're worn out. That isn't good for the future of these poor birds.

Do you have birds near your house? Listen out for their songs – when are they most lively? Is there a time of the day that they sing more or less? Does turning a light on at night stop their calls?



Songbirds call to find a mate, but artificial light can make it feel unsafe to sing. (Credit: danieldep via iStock)



Dark-sky-sensitive lighting

Colour temperature: warm light looks amber, while cool light looks blue or white. (Credit: Suriya KK via Shutterstock)

It may sound kind of funny to have lighting that is dark-sky sensitive, but, yes, it does exist. It can also be called dark-sky friendly. Such lights are designed to reduce light pollution, allowing us to enjoy a clear night sky and helping nocturnal animals feel safe.

It is not just the type of light used, but how we use it. Here are some questions and answers to help you use more dark-sky-sensitive tools.

Do we really need a light there?

Do you ever find yourself somewhere without knowing how you got there? When we do the same things over and over, we don't always pay attention. Sometimes we do this with lights too. We just switch one on and use it because we've always done it. If you don't need a light, don't use one – it's perfectly fine to skip it altogether!

Can we use a warm light?

Okay, so you need a light ... what colour bulb do you need?

Can we use a nice, warm, fire-coloured light? These warmer colours won't disturb our wildlife as much and will help you sleep. A win–win for everyone!

Look for the word 'warm' on packaging. Sometimes the word kelvin is also used. If so, you're looking for a kelvin or K rating between 2,200 and 3,000. The lower the number, the better it is for nocturnal wildlife and your own sleep.

Are we using light right?

Okay – we need a light, so now we need to choose the right type of light fitting. Is it a busy area with lots of people moving through? That might need a larger light placed higher up to cover more ground. If it's a small obstacle on a path, a smaller light at ground level could be enough to mark the danger clearly.

Choose lights called full cutoff or shielded that only send light downwards, and avoid placing lights over reflective areas such as swimming pools, tennis courts or white roads that send light back up into the night sky.

Remember, less is best!