The science in our skies

Ultraviolet Vision

This worksheet accompanies our **'The Science in our Skies'** module.

To watch the videos, **sign in** to the S4 portal:

www.s4scienceportal.co.uk

And click on the 'Online Science Workshops' button!

What are we learning?

Unlike humans, birds can see **ultraviolet (UV) light.**

Ultraviolet light is a type of light that has a shorter **wavelength** than we can see.

However birds have **adaptations** (special features) that allow many to see ultraviolet light: -

1. Complex **retinas** – the part of the eye responsible for receiving light.
2. Highly developed image processing in the brain.

Some birds of prey use this ability to see **ultraviolet light** to help them find and catch prey.

We will be looking at these **adaptations** and the properties of **ultraviolet light.**

Draw or write about what you already know about UV light.

What is ultraviolet light?

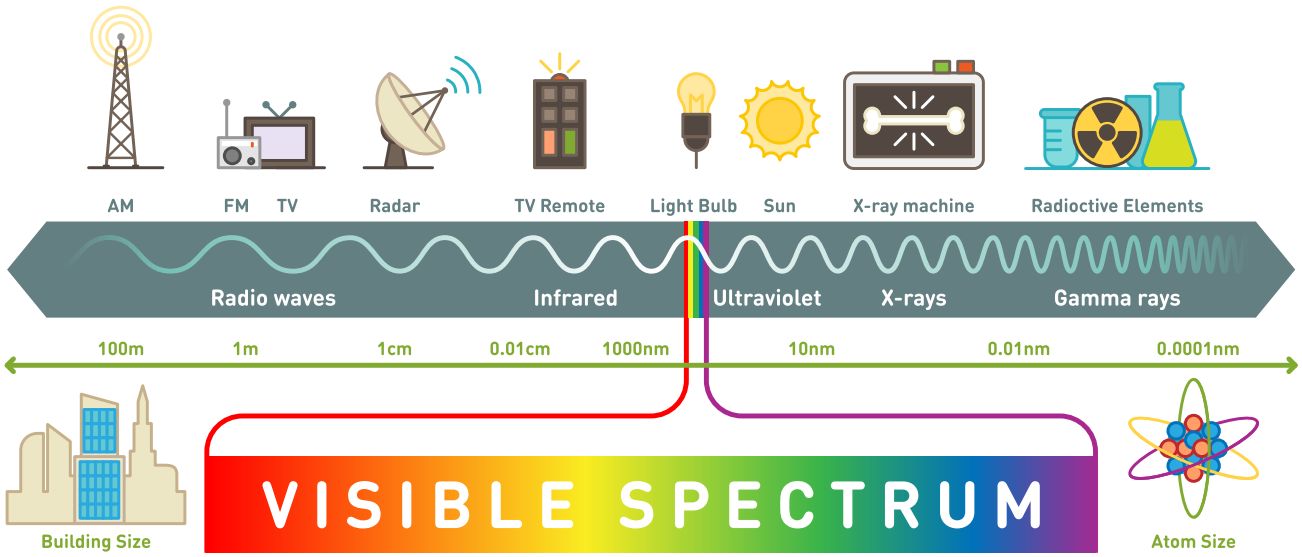
When we talk about light, we are normally referring to the visible light that we can see, but there is a lot of light that we **can't** see.

The **electromagnetic (EM) spectrum** is used to describe the whole range of light and other electromagnetic radiation that exists. It organises electromagnetic (EM) radiation based on its **wavelength.**

EM radiation travels as waves; the wavelength of EM radiation is the distance between a point on one wave and the same point on the next wave.

EM radiation with shorter wavelengths have more energy and can be harmful to humans.

Electromagnetic Spectrum



For some types of EM radiation, such as radio waves, the distance between waves is very long and is measured in metres. For others, the distance is very short and is measured as thousandths of a nanometre (nm) – that is 0.0000000000001 metres!

The light we can see is in the middle of the EM spectrum with wavelengths between 400nm and 750nm. We call it visible light because it is visible to us, but other species, for example birds, can see a wider range of wavelengths than us.

Ultraviolet (UV) light is immediately next to visible light in the EM spectrum, it has wavelengths from 100-400nm.

Quick Quiz

Use the words below to fill the gaps and complete the sentences to see what you've learnt about **Electromagnetic radiation.**

400-750nm | Radio waves | Gamma Rays | 100-400nm | UV

_____ have the shortest wavelength.

_____ have the least energy.

Visible light has wavelengths from _____.

Birds can see _____ light.

UV light has wavelengths from _____.

Tell me more!

Just like visible light can be split into colours based on its wavelength, UV light is split into 3 bands based on its wavelengths. They are UVA, UVB and UVC.

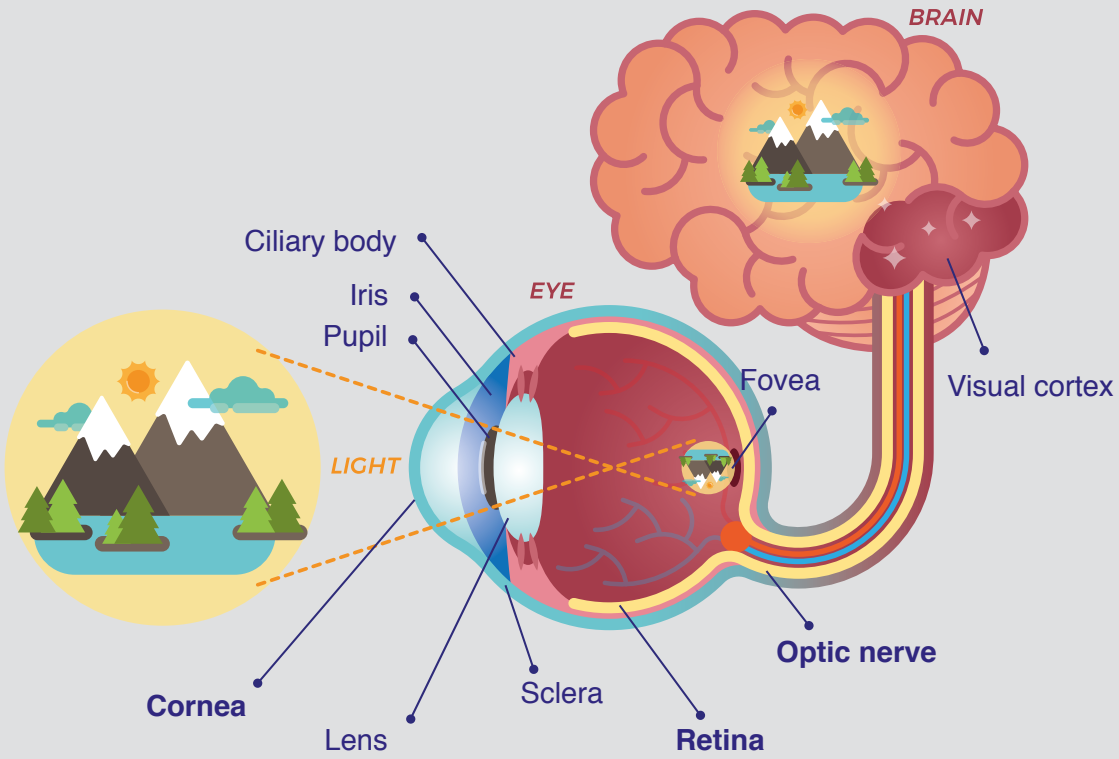
- UVA has the wavelengths closest to visible light, 320-400 nm. It is the UV light that causes us to tan, although prolonged exposure causes ageing and skin cancer. **It is also the UV light that birds see.**
- UVB has shorter wavelengths, 290-320 nm, it causes sunburn.
- UVC has wavelengths from 100-290 nm, it would be very dangerous to us, but it doesn't reach the Earth because of our atmosphere.

Why can birds see UV light?

The **retina** is a thin layer of tissue at the back of the eye that receives light.

Visual information is projected onto the **retina** by the lens and **cornea** (below).

The **retina** then sends nerve impulses to the brain through the **optic nerve**, allowing the image to be processed.



In the retina there are **photoreceptors** – specialised cells that detect light and convert that information into nerve impulses to the brain.

There are two types of photoreceptor. **Rods** and c**ones.**

- **Rods** are used for seeing in the dark. The more rods an animal has the better it can see at night.
- Rods don't process colour. That's why when we see things at night, they seem black and white.
- **Cones** process light at different wavelengths. Different wavelengths of light are different colours.

Humans have three types of cone that allow them to process red, blue and green light. Birds have a fourth type of cone that means they can see ultraviolet light We say that birds have **tetrachromatic** colour vision.

True or false?

Are the following statements true or false?

	TRUE	FALSE
Ultraviolet light is a type of purple light that people can see.	☐	☐
The retina receives light and sends that information to the brain.	☐	☐
Photoreceptors are specialised cells for detecting light.	☐	☐
Humans have cones that allow them to see orange, purple & green light.	☐	☐
Ultraviolet light is part of the electromagnetic spectrum.	☐	☐
Ultraviolet light has a longer wavelength than red light.	☐	☐

How do birds of prey use UV light to help catch their prey?

The urine of these mammals contains proteins that reflect **ultraviolet light.**

Kestrels have **photoreceptors** for ultraviolet light and can see the urine trails of their prey while hovering above the ground.

- Sparrowhawks are also able to see UV light.
- Sparrowhawks hunt small birds, including sparrows (of course!).

Many small birds have markings on their feathers that reflect **Ultraviolet light.**

Being able to see **Ultraviolet light** allows sparrowhawks to see these markings on their prey, which are invisible to humans.

Kestrel

Sparrowhawk

Activity

Foraging for food

ACTIVITY SHEET

Some smaller birds of prey, like little owls, feed on insects they find on the ground using their excellent vision to help find them. In this activity, you will pretend to be a little owl foraging for insects amongst leaf litter.

Materials

- A large plastic container filled with leaf litter
- UV pen
- UV torch
- Plastic counters (or plastic bugs if you have them!)
- Stopwatch

Instructions

1. Mark all the counters with the UV pen.
2. Mix the marked counters into the leaf litter.
3. Turn off the lights, set your stopwatch for 30 seconds and try to find as many counters as you can. At the end of the 30 seconds, record how many you found below.
4. Mix the counters you found back into the leaf litter.
5. Repeat the investigation but this time you can use the UV torch to help you find the counters. Record your results below.

Insects caught...

Without UV pen:

With UV pen:

Was it easier to find the insects with the UV pen? Why?

Questions

How does the ability to detect UV light help birds of prey to successfully hunt?

How does the ability to detect UV light help birds of prey to successfully hunt?

What is the difference between rods and cones?

Activity

UV Vision Word Search

ACTIVITY SHEET

Find the words below in the wordsearch.

P	H	O	T	O	R	E	C	E	P	T	O	R	E
L	U	R	W	I	L	V	E	S	N	V	T	E	A
W	U	P	A	S	R	E	R	V	R	A	I	T	B
T	L	R	V	O	V	R	C	E	L	S	U	A	A
V	T	V	E	P	I	T	I	C	T	V	T	A	V
A	R	R	L	T	S	E	R	V	C	I	I	R	O
L	A	O	E	I	P	B	N	C	T	I	N	E	T
T	V	N	N	C	E	R	B	V	C	U	C	A	T
C	I	P	G	N	C	A	L	E	E	A	O	E	L
T	O	E	T	E	T	T	R	R	C	R	T	T	A
O	L	L	H	R	R	E	O	E	O	L	O	A	A
E	E	N	T	V	U	P	L	E	N	S	L	O	E
P	T	T	R	E	M	A	W	R	E	L	L	E	O
A	R	R	A	E	N	R	O	C	G	C	C	O	P

Spectrum

Lens

Cornea

Photoreceptor

Wavelength

Optic Nerve

Retina

Ultraviolet

Vertebrate

Teacher information

Curriculum links

This worksheet is designed to complement the National Curriculum for Wales, with links provided to the former KS3 science curriculum as well as the new Science and Technology AOLE.

Key Stage 3 Science (Interdependence of organisms): 1. the basic structure and function of some cells, tissues, organs and organ systems and how they support vital life processes; 4. the interdependence of organisms and their representation as food webs, pyramids of numbers and simple energy-flow diagrams.

Area of Learning and Experience: Science and Technology: *The world around us is full of living things which depend on each other for survival.*

- The structure of the eye and the function of photoreceptors in the retina.
- The physical adaptations of the eyes of birds of prey to enhance their vision to enable them to hunt successfully.
- The diversity of birds of prey and the prey items they take.
- The role of colour and camouflage in the natural world to aid survival and reproduction.

Equipment needed:

- Black light torches
- Assortment of birds' feathers (including some that show up hidden markings using the black light)
- Invisible markers
- Trays for the game – beige plastic maggots and wood shavings as the substrate should work well

(S4) Funded by the European Social Fund and the Welsh Government.