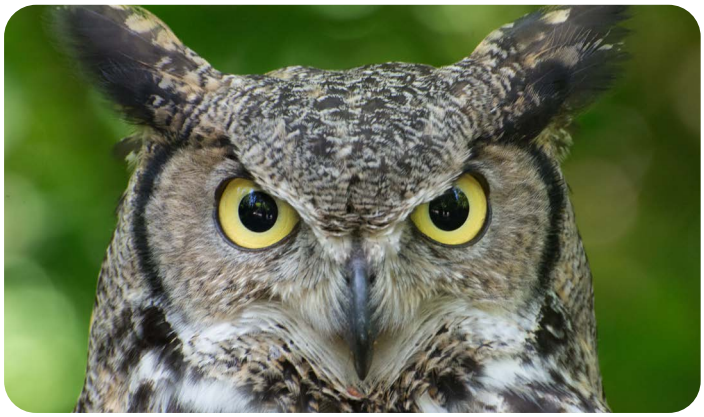
The science in our skies

Incredible Eyesight



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?

Owls have very large eyes to help them see at night. Their eyesight is specially adapted to help them see:

1. in the dark
2. at long distances.

To help protect their huge eyes, owls have three eyelids:

1. Top eyelid – like ours.
2. Bottom eyelid – like ours.
3. **Nictating membrane** – underneath the top and bottom eyelids. It closes diagonally to clean and protect the eye. Cats and dogs also have these, so you may have seen them on your family pet!

Cat showing Nictating membrane

Why do you think owls need good eyesight at night?

Activity

Nocturnal owl species

ACTIVITY SHEET

Owls that hunt at different times of day have different coloured eyes:

1. **Nocturnal (**night) – black eyes – helps owls blend in with the darkness.
2. **Crepuscular** (dawn and dusk) – orange and yellow eyes – helps owls to see well in red light.
3. **Diurnal** (daytime) – bright yellow eyes – helps owls to see when the sun is brightest.

Using the photos below match the owl species to the time of day they hunt.

Tawny Owl

Snowy Owl

European Eagle Owl

Little Owl

Barn Owl

Great Grey Owl

Photoreceptors

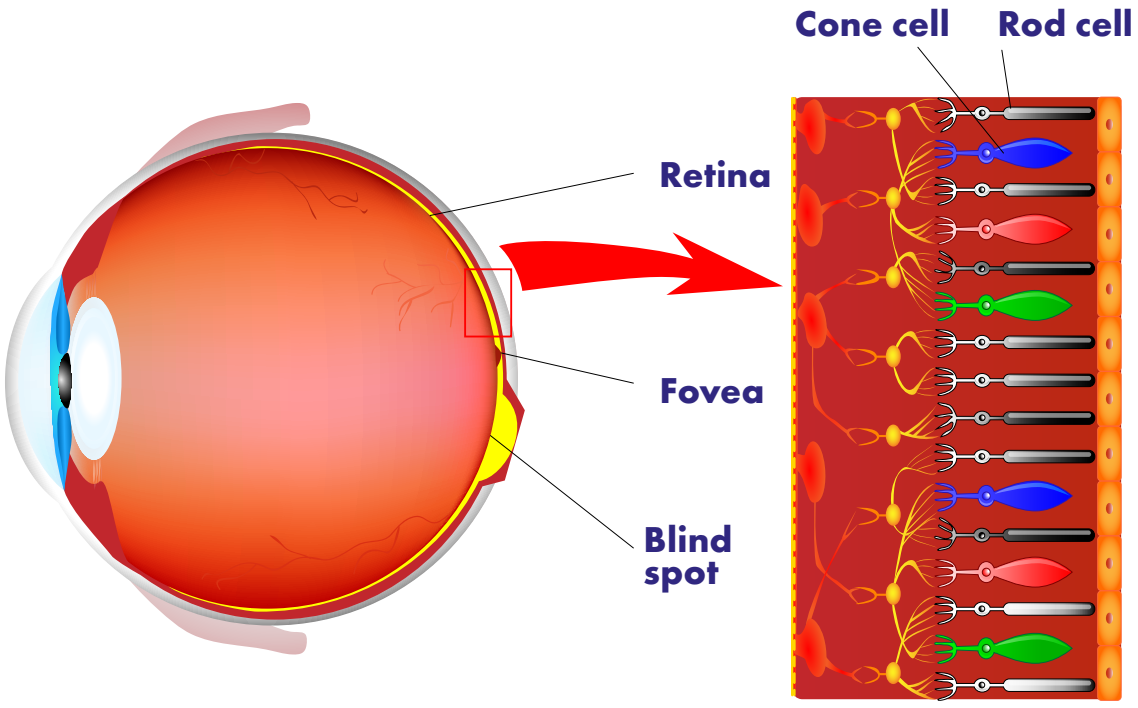
Photoreceptors are specialised cells in the eye for sensing different kinds of light.

Vertebrates (animals with spines), such as mammals and birds, have two types of photoreceptors:

1. **Rods** – for light and motion
2. **Cones** – for colour

Rods and cones are found in the retina, a thin layer of tissue at the back of the eye that receives light.

Photoreceptor Cell



Human eyes have more **rods** around the outside of the **retina**, and more **cones** towards the centre.

Owl eyes are full of light-sensitive **rods** that help them to see in the dark.

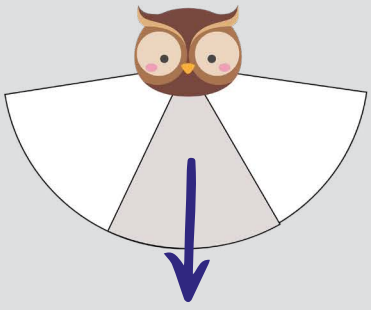
Because **rods** also detect movement, owls are great at spotting prey moving around in the darkness.

The more **rods** a species has the better its eyesight.

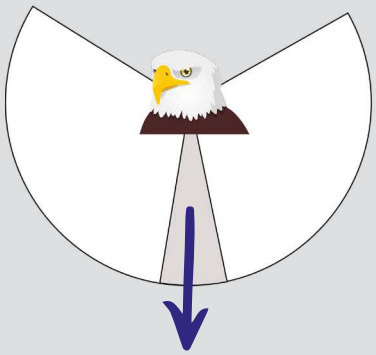
Owl eyes have so many **rods** that there isn't much space for **cones** - they mostly see in black and white!

Photoreceptors - Tell me more!

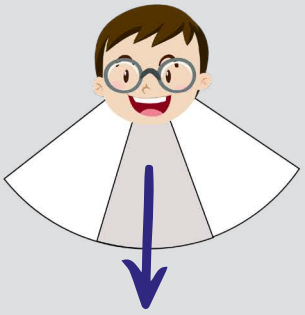
Binocular Vision



Binocular Vision
70°



Binocular Vision
33°



Binocular Vision
50°

As well as having lots of **rods**, the part of the owl's eye that has the sharpest image – the **fovea** - is in a different position to human **fovea.**

The **fovea** is a small spot at the back of the retina that is the centre of the field of vison. This is where our vision is its sharpest or best.

Humans have one fovea at the centre of our eye – **fovea centralis.** It is in the centre of our retina. We see things that are straight in front of us clearly and things to our side – in our **peripheral vision** aren't as focused.

Humans have a field of vision of only **180°** but we can compensate for this by moving our eyes.

Owls can't more their eyes, but their fovea isn't at the centre of their retina it's off to the side. This is called the **fovea temporalis.**

Light enters the fovea temporalis from a different angle giving owls a broader field of vision.

An owl's field of vision is **201°**

An owl's field of vision is still relatively narrow compared to other birds of prey which have a **fovea centralis** and a **fovea temporalis** that give them a field of vision of up to 260°.

But owls have very flexible necks that they can turn 270° meaning they have **360°** vision.

Experiment

Test your vision!

In pairs, you will test how well you can see things in your peripheral vision. This is when you see something out of the corner of your eye.

You will need:

- Coloured card shapes

Instructions

1. Stand facing forwards.
2. Have your partner stand behind you and move one of the card shapes forward past the side of your head. Keep looking straight forward and try not to move your eyes while doing this.
3. Say stop as soon as you can see something.
4. What was the first thing you were able to see?

   Shape ☐ Colour ☐ Movement ☐

5. Repeat step 2 but this time keep bringing the card forward until you can see the movement, shape and colour of it clearly.
6. How much further forward did the card have to be?

How do you think the position of rods and cones in your retina affects your peripheral vision?

Swansea University Science for Schools Scheme

Swansea University Prifysgol Abertawe

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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

Key Stage 3 Science (Interdependence of organisms): 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

Area of Learning and Experience: Science and Technology: Forces and energy provide a foundation for understanding our universe.

- The role of owls as predators within a food web.
- How owls are adapted to successfully hunt at night and camouflage during the day.
- The structure of the retina and the function of rods and cones.
- Field of vision and visual acuity.
- How parabolic reflectors have been designed and deployed by engineers.

Resources to be sourced:

- Coloured objects (these could just be e.g. different shapes cut out of different colours of card)

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