

## Key Stage 4 Worksheet

# Earth LIVE Lessons: Glowing Puffin Bills & More



### What is it about?

In this video, Jamie Dunning, a PhD researcher at Imperial College London studying birds including the house sparrow, talks about the use of colour by birds and the different ways colours are produced in bird's bodies and how they are seen by other birds.

### Watch video here:

[www.youtube.com/  
watch?v=muYZ-7h26EM&  
feature=youtu.be](https://www.youtube.com/watch?v=muYZ-7h26EM&feature=youtu.be)

Open file in your web  
browser to click on the  
links.

### Colour and light

When we see a colour what we are seeing is generated by the absorption and reflection of **different wavelengths of visible light**. You can read more about wavelengths of light **here**.

Visible light exists in a spectrum from longer wavelength 'red light' to shorter wavelength 'violet light' – so when we see 'red' we are seeing longer wavelengths of light and when we see 'purple' colours we are seeing shorter wavelengths of light.

Ultraviolet light has even shorter wavelengths and cannot be perceived by humans with the naked eye. Sunlight contains UV wavelengths, but we only 'see' the visible white light. The shorter UV wavelengths in sunlight have the **potential to damage our skin**.

Like us, birds are able to see in colour, but they can see a wider range of colours than us because their eyes can see shorter wavelengths of light, as well as the 'visible spectrum'. Some species are able to perceive ultraviolet, or near-ultraviolet, wavelengths of light.

## Colour and light continued...

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Image: Cynthia Tedore via ScienceAlert.com. On the left is how we would see leaves, as a big, green mess. On the right is how scientists discovered some birds can see leaves when they can also detect a difference in how UV light bounces around the tops and underside of the leaves. It makes the leaves much easier to see in detail. You can read more about this study [here](#).

Birds use colour for finding food and as part of attracting a mate (sexual selection). It has been suggested that some fruits have developed their colours in order to attract birds, and male birds use colourful feathers to indicate their health and fitness in order to attract females.

## Colourful feathers

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Most of the colour in birds' feathers comes from compounds called carotenoids and melanins. You can read more about these animal pigments [here](#).

Birds get carotenoids from the food they eat. They tend to create colours such as yellow, beige and brown. Melanins are made in the bird's body and are used to generate darker colours such as black.

Blue feathers are created structurally, rather than using pigments. Green feathers are particularly special as they take a lot of energy to produce including structuring the feather to make it blueish and then adding in carotenoids to make green.

## Did you know...

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Most people know that the dinosaurs went extinct 66 Million years ago when an asteroid hit the Earth. But not all the dinosaur groups were wiped out. One group, the avian dinosaurs, survived and evolved into modern day birds. All birds, from chickens to eagles, are, in fact, dinosaurs and, just like modern birds, many dinosaurs had coloured feathers.

**In his dinosaur books**, Professor Ben Garrod explores how palaeontologists found out that dinosaurs had coloured feathers too. Melanosomes are small structures that are used to give colour to hair and feathers. Scientists looked at fossilized dinosaur feathers under a scanning electron microscope. When scientists explored the range of feather patterns the fossilised melanosomes indicated they found out that some dinosaurs, especially the Therapod dinosaurs, had really elaborate feather patterns and colours including striped tails, ginger feathers, and orange cheek feathers!

You can read more about this **here**.

## Special puffin bills...

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Puffins have colourful bills, which are not believed to be sexually selected because both male and female birds have them. Jamie's and his research team wanted to find out more about the bright colours in a puffin's bill and so they one, carefully, under ultraviolet light to observe the appearance of the bill. The team observed something called fluorescence – the bill absorbed the short wave ultraviolet radiation and re-emitted it as longer wave radiation, in the green and yellow part of the visible light spectrum. This is better known as 'glow in the dark'!

Researchers don't yet know why puffins have 'glow in the dark' bills. Ongoing research is investigating how the bill colours might be seen by puffins, and what function they might have. They might help to produce greater contrast between different parts of the bill, or to draw attention to particular areas or they might just be a side effect of the particular structure the keratin of the bill is made from.

## Find out more!

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- Find out about the structure of birds' eyes in species that are able to perceive ultraviolet light [here](#).
- Explore the electromagnetic spectrum, including the wavelengths of ultraviolet light absorbed by the ozone layer [here](#).
- Discover more about how fluorescence works [here](#).
- Investigate the role sexual selection plays in determining the colours of male birds [here](#).
- Explore some of the other physical and behavioural adaptations of male birds that have arisen through sexual selection [here](#).

## Questions

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**Interactive: Click on box to start typing**



How is colour used by birds? Name two different ways colour is given to feathers.

Why has fruit evolved to be colourful?

Why do plants need birds to consume their fruits?

Why are brown birds very common but green birds are relatively rare?

How are different colours formed in birds' feathers?

## Spicy fact!

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An interesting example of a plant whose seeds are dispersed by birds is the chilli pepper. The “heat” of a chilli is produced by a chemical that birds are not affected by; they can eat as many chilli seeds as they like and they won't feel any spiciness. Mammals, however, experience a heat-like painful sensation when they eat chilli pepper fruit and seeds. The chilli has evolved to deter mammals from eating its fruits because the seeds would be destroyed as they passed through the mammalian digestion. Chilli seeds emerge intact when birds eat them, and are dispersed.

## Try an exercise!

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Jamie's research into how puffins see, and use, fluorescence is ongoing, but many other animals also use fluorescence. Conduct some online research and create a list of the examples of fluorescence in the plant an animal and fungus kingdoms, and suggest your own theory for how the puffins might be using fluorescence, what might it be for in these charismatic little sea birds?

# For teachers and home schoolers

Links to Science in the National curriculum for Wales (KS4)

[hwb.gov.wales/storage/779c7300-574d-4a12-a518-c873557d6a7a/science-in-the-national-curriculum.pdf](https://hwb.gov.wales/storage/779c7300-574d-4a12-a518-c873557d6a7a/science-in-the-national-curriculum.pdf)

Science: Organisms and Health [1. Organisms are interdependent and adapted to their environments] – the use of colour by birds, and plants whose fruits are consumed by birds, to adapt to their environment, for example through the use of camouflage. The adaptation of some species of birds to perceive ultraviolet light, and the advantages this confers.

Science: Energy, Electricity and Radiations [3. Radiations, including ionising radiations, can transfer energy] – electromagnetic radiation, particularly the spectrum of visible and ultraviolet light, including different wavelengths, and the property of fluorescence.

Science: Organisms and Health [4. Chemical and electrical signals enable body systems to respond to internal and external changes, in order to maintain the body in an optimal state] – the perception of colour by cone cells in the human eye, and the possession of a fourth cone cell in the eyes of birds, enabling them to perceive a wider range of colours.



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