Light and Art

Hello, my name's Paul Garside and I work at the Kelvin Centre for Conservation and Cultural Heritage Research, which based in Kelvin Hall and is part of the University of Glasgow.

At the Kelvin Centre, we study conservation, technical art history, dress and textile history and conservation science, to help us understand and preserve physical objects associated with our cultural heritage – particularly artworks, textiles and modern materials. Our research supports the work of museums, galleries and archives.

We're going to have a look at the ways in which light can interact with these types of objects and materials, and the sort of damage and changes it can cause. We will also think about how we can protect our cultural heritage by understanding these changes.

A particularly important feature of objects is their colour – it plays a big role in how we appreciate and understand things we see in the world around us, including objects we might look at in museum or gallery.

Objects that are exposed to light change colour over time. You've probably seen this with curtains that have faded and the spines of books that are now a different colour to the rest of the cover.

When these colours change, it can spoil our appreciation of these objects and change we way in which we can understand them.

So we've seen that colours can change and fade. Why do they do this? And why don't all colours fade in the same way?

All things change over time, and if those changes are unwanted, we tend to think of them as damage or degradation.

There are many different factors that can cause these kinds of changes, and they're often referred to as the Ten Agents of Deterioration. Light (or radiation) is one of these agents.

When materials are damaged by light, we call this photodegradation.

We've seen some examples of this happening with day-to-day objects, like books and curtains, but it can also happen with paintings and other objects in museums and galleries.

We can see some examples here, where a print, the binding of a book and a wooden surface have all suffered damage from light – we can see the colours have faded and changed.

Light is part of the electromagnetic spectrum. We can only see a small part of this spectrum – this is the part we call visible light – but we're familiar with other parts of the spectrum.

We know about ultraviolet light, for example, because we know we don't want to be exposed to too much of it when we're out in the sun. Ultraviolet light can be very damaging to museum objects, too.

We know about infrared light, because although we can't see it, we can experience it as the warmth that radiates from a hot surface.

And other parts of the spectrum are also important in our day-to-day lives: radio waves, microwaves and X-rays are all part of the electromagnetic spectrum.

We often refer to visible light as white light. Each different part, or wavelength, of visible light represents a different colour, and when we see them all together, we see this as colourless or white light.

We can split white light into the different colours that make it up using a glass prism.

This is also the effect we see when there's a rainbow – water droplets in the air act as prisms, and split the light into the different colours we see.

Coloured materials and objects interact with visible light in different ways. They absorb some of the parts of the white light, and reflect others.

We can think about this with a couple of examples.

Here we have a blue object.

And an observer.

When white light shines onto the object (and remember that white light is made up of all of the colours we can see), some of the light is absorbed by the object and some is reflected.

A blue object will absorb absorb green, yellow and red light, and reflect blue light, which is what we see.

If we think about a yellow object instead, it will absorb the blue and red parts of the light, and reflect yellow light.

Why does this happen?

The colours we see in objects are linked to their underlying chemistry, and there are different types of effects that cause colour.

If we think about organic molecules, the colours we see are a result of special chemical structures called chromophores. These are sequences of single and double chemical bonds, which can interact with visible light, absorbing some colours, or wavelengths, and allowing others to reflect.

We can see two examples of organic molecules that have a red appearance.

Lycopene is the chemical that makes tomatoes red.

And alizarin is a red dye which is made from the madder plant. Historically, this was very important for dyeing textiles.

When photodegradation occurs, the light that's absorbed by a material causes chemical reactions to occur that change the colour-giving molecules. As they change, they lose their ability to interact with light in the same way, and so their colour changes or is lost. This means that the colour of the object as a whole will fade or change. Ultraviolet light is particularly damaging.

Not all coloured materials behave in the same way when exposed to light. Some fade quickly. Others are more resistant and keep their colour even when they've been in the light for a long time.

We can look at this with a simple experiment.

For this experiment, you'll need the following:

- A colourful page from a magazine, leaflet or newspaper.
- A sunny window.
- Some adhesive tape.

Cut the page you've chosen in half – you're going to expose one half to light, but keep the other half separately so you can compare them at the end of the experiment. This second half is called a control sample. It lets us easily see what changes have occurred.

Take the first half and tape it to the inside of the window, with the image facing outward.

Put the control sample in an envelope or folder, or somewhere else safe out of direct sunlight.

You'll now need to leave it for several weeks.

As the page is exposed to sunlight, it will gradually fade and change. How quickly this happens will depend on how sunny it is. Bright light will make things fade much more quickly.

You'll probably need to leave you sample for a few weeks before you start to see any change.

If you look at your sample after a few weeks, and compare it to the control, what has happened?

You'll probably see that there are changes, like the examples you can see on screen here.

In my examples, you'll see that the yellow and red colours have faded a lot, but that the blue colours haven't changed much. Over all, they look more faded and dull, compared to the control examples.

This is what often happens – not all pigments and inks are sensitive to light, so some of them keep their colours well. For printing inks, reds and yellows are often the first to change. Blues generally fade more slowly. Black ink tends to be much more stable, and don't change very much.

What do you see with your samples? What might this tell you about the inks that have been used?

We can use this information to help look after paintings and textiles in museums and galleries.

We want to keep them for as long as possible, but we also want to be able to see them when visit exhibitions.

If we kept them in the dark, we'd stop light damage from happening, but we also wouldn't be able to see them. So, we have to come up with a compromise. How do we make these decisions?

There are different ways we can do this.

We can make sure that we use light sources that will minimise damage. The most damage is caused by ultraviolet light, so we can either use artificial light that contains no ultraviolet light, or if we're relying on sunlight, we can add filters to windows to block the ultraviolet light.

We can make sure that the light isn't too bright. The brighter the light, the more quickly fading will occur. However, we also need to make sure there's enough light that visitors can see the objects.

We can limit the length of time that a light-sensitive object is on display.

We can understand how materials change when they're exposed to light. The properties of some pigments, inks and dyes are well known, and so we can predict what's likely to happen with objects that contain these.

But we can also carry out a similar experiment to the one we thought about earlier. To do this, we use a special piece of equipment called a microfader. This exposes a tiny area of an object to a bright light for a short period of time, and measures how the colours change. Unlike our previous experiment, this change is too small for us to see, but it can be measured by the equipment.

When we know how these changes happen, we can then understand how sensitive the object is to light, and use that to make sensible decisions about how it is displayed and for how long.

This has been a quick introduction to some of the ways in which light can interact with coloured materials and artworks, and the changes it might cause.

Hopefully it's also introduced the ideas of how we can use this information to better understand these changes, and to make predictions for the future to artworks and other cultural heritage artefacts.

Thank you for watching.