Know more

MiniExpo COLORÍN COLORADO

A Story in Full Colour

TEA Tenerife Espacio de las Artes
Department of Education

What is colour?

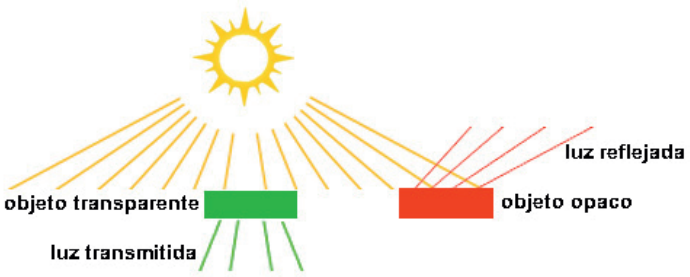
Colour is the **visual perception** of what is produced in the brain when it decodes and interprets the nerve impulses sent by the photoreceptors that are found in the **retina** of the eye, the cones and rods, which distinguish between the different wavelengths of light reflected by all objects.

What is a wavelength?

White light is composed of light of different **wavelengths** which our brain interprets as different colours.

When an object is illuminated, it absorbs part of the **electromagnetic waves** (light) which strike it, and reflects the rest. The wavelengths reflected or, more precisely, those that our eyes capture by means of the cones in the **retina**, are interpreted by our brain and translated into different colours. We have three types of **cones** in the retina: those sensitive to red light, green light, and blue light. For this reason, the primary colours of light are **red**, **green**, and **blue**. If we mix these three colours of light we obtain white.

This means that, for example, when we see a red object, we are really looking at the surface of material that contains a **pigment** which is able to absorb all the wavelengths that compose light, **except** red. As it can't absorb red, it reflects it, and our eyes capture it by means of the cones in the retina, and our **brain** interprets it as the colour red.



So, is light necessary to see colours?

Absolutely. The eye only perceives different wavelengths of light when the **illumination** is bright. In dim light, we cannot see colours.

Since when has it been known that light is actually composed of beams of light of different colours?

Since **1665**, when the English physicist and mathematician, Sir **Isaac Newton**, discovered that when sunlight passes through a transparent prism it is separated into **six** colours: violet blue, sky blue, yellow, orange red, and purple red.

Isaac Newton (1643-1727)

Newton's experiment on the refraction of light

Aren't these the colours of the rainbow?

Yes, the same ones. The phenomenon of the **refraction** of light can be seen in many ways apart from with a prism, such as at the edge of glass or plastic, and also when it rains and the sun's rays pass through the clouds. The drops of water in the clouds act in the same way as Newton's **prism** and split the light into a **rainbow**.

And before Newton, had no one ever shown any interest or curiosity in the different colours?

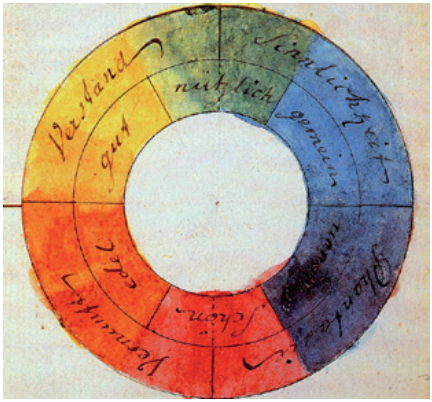
Yes, throughout history, colour has been studied analysed and defined by scientists, physicists, philosophers, poets, artists, even back in ancient Greece. **Aristotle** stated the four basic colours corresponded with the four principle elements from which it was then understood that the world was composed: earth, water, fire, and air.

In the Renaissance, Alberti and **Leonardo da Vinci** also took an interest in studying colour. As well as defining it, Leonardo referred to it as a property of matter and spoke for the first time of the difference between primary and secondary colours.

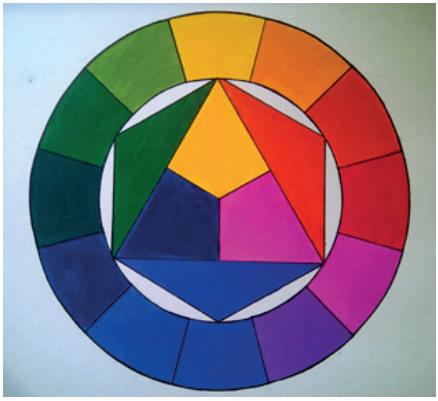
And after him?

At the beginning of the nineteenth century, **Goethe** theorised on the emotional impact that colour had on individuals. His book, *Theory of Colours*, published in 1810, distinguished between colours that produce positive and negative **emotions**, and although it was not received well in the scientific world, it established the basis of the subsequent field of colour **psychology**.

A little later, in 1839, the French chemist **Chevreul**, proposed the "law" of **simultaneous contrast of colours**, which states that any colour is perceived differently, varying its tone value and saturation, according to the colours which surround it, which was corroborated by science sometime later.



Colour Circle designed by Goethe



Colour Circle designed by Johannes Itten

By the twentieth century, **Johannes Itten**, a teacher at the Bauhaus, the famous German school of art and design, developed his theory of colour based on Goethe's work, and designed a **colour circle** comprising 12 colours, which has become the most influentially wide ranging so far.

So far, we've spoken about colours of light, but the colours of the colour circle are a different kind of colour, aren't they?

Exactly. They are not colours of light, like those discussed so far, but **pigment colours** which are used to colour, dye, or **paint** things, by changing the appearance of their surface. There are, therefore, two types of colour, colour of light and pigment colour.

Different coloured pigments

But what's a pigment?

A pigment is a material, generally in fine powder form, that acts as a colourant, changing the colour of the light that an object reflects. Pigments are used to colour or dye paint, ink, textiles cosmetics and foods, etc.

And since when have pigments existed?

Forever, because there are naturally occurring pigments that were known and used to make **prehistoric paintings** more than 35,000 years ago. Natural pigments can be of mineral or biological origin. Some mineral examples include vegetable charcoal, **clay**, or haematite, one of the most common minerals in the world and responsible for most red and brown rocks. These minerals of natural origin are mixed with **animal fat** and vegetable resins which act as natural binding agents with which to create paints for painting caves. Regarding those of biological origin, they are obtained from **botanical substances**, and animal, insect and mollusc waste.

Are there any particularly notable examples?

Tyrian purple, a pigment produced from a variety of **snail** that was first used by the Phoenicians, and later the Greeks and the Romans. it's a pigment so expensive and complex to produce, that to own objects dyed with it was synonymous with power and riches.

The same was true of the colour ultramarine blue, which was obtained by the use of **lapis lazuli**, a hard to obtain semi-precious stone. For this reason, a painter as well-known as Van Eyck hardly ever used it in his works at all, and when he did, he added the cost to the price of the commission in order to pay for its use.

The conquest of the Americas permitted the use in Europe of another colour, **carmine red**, obtained from the **cochineal beetle**, a parasitic insect native to Central and South America, which the Spanish began to import into Europe after invading the Aztec Empire, soon converting it into the second most valuable export from the region after silver. The pigment produced from the cochineal beetle is that responsible for the intense red of the characteristic robes of the **cardinals** of the Catholic Church at that time.

Woman working in cochineal beetle
production in the Canary Islands (1920s)

Wasn't cochineal beetle production common in the Canary Islands?

Yes, cochineal production was introduced into the **Canary Islands** from America in the first third of the nineteenth century, with the aim of fighting the crisis in the agricultural sector and an attempt to find substitute crops for sugar and grapes. It also coincided with the rise of the **textile** industry in Europe and the enormous demand for fabric dyes, one of which was carmine red. The production of cochineal beetles in the Canary Islands peaked in 1869, but didn't last much longer, owing to the introduction of **synthetic** dyes: aniline and fuchsine, against which this natural colourant could not compete.

So apart from those obtained from natural sources, are there other kinds of pigments?

Yes, **synthetic** pigments, which appeared specifically because of the necessity to obtain cheaper pigments and a greater a variety of colours. The production process requires quite complicated chemical reactions and the first was developed in England at the end of the nineteenth century by **WH Perkin**, who discovered the process by coincidence while working on research to develop a drug for malaria.

What's the biggest difference to those of natural origin?

Synthetic pigments are considerably more **permanent** than those deriving from natural sources, and this is a highly valued characteristic in the use and application of colour, above all in the artistic world. In **Oriental** culture, for example, painters have always considered the permanency of colour as an **essential requirement** in any work of art, which is why they have made such an effort to protect their works from the impact of direct sunlight.

And in the history of Western art, was there a decisive moment in the use of colour?

A pivotal moment was the general use of oil paint (the mixing of coloured pigments with an oil base, from which the name derives), because it permitted the production of much more **brilliant**, saturated, striking and permanent colours than with any other earlier technique (such as temple, fresco or tempera). In fact, the oil technique had been known for some time, but its use was not generalised until the beginning of the **fifteenth century** by the Flamenco painters.

By the sixteenth century, the **Venetian school** gathered a group of artists notable for their use of colour and the special treatment that they gave it, in contrast to the Florentine and Roman schools, in which a prevalence for drawing prevailed. In Venice, masters like Giorgione and **Tintoretto** experimented extensively with colour, opening enormous possibilities to painting which would later be exploited by the artists of the Baroque.

Saint Mark Freeing the Slave. Tintoretto c.1548

And in modern and contemporary painting?

At the end of the nineteenth century, **Impressionism** marked the beginning of modern art then gave way to the so-called *Historical Avant Garde*, making very special use of colour. Thanks to recent **industrialised** production, and the invention of tubes for better paint preservation, and influenced by Chevreul's *theory of simultaneous contrast of colours* already mentioned, the impressionist painters no longer mixed their colours on a palette. Instead, they applied **pure** colour directly to the canvas using little brush strokes, with the idea but it was the sight of the spectator that

would effect the "mixing" when the picture was **viewed** from a certain distance. Additionally, they maintained that colour is only a momentary **impression** that varies according to how light strikes objects and elements in nature.

Sunset in Venice. 1908. C Monet

After impressionism, different movements of the Avant Garde followed, some of which are notable for the interest in the colour spectrum, such as **Fauvism**, Expressionism and Abstract Art. At the beginning of the century, the so-called *Fauves* (wild beasts, in French) let colour take the lead completely and they were notable for using it in a very passionate and **violent** way. In their works, the colours, flat and striking, without detail, and very **expressive**, initiated the process of independence with respect to objects and reality.

Restaurant "La Machine" at Bougival. 1905. M Vlaminck

Also in the first decade of the twentieth century, the German expressionists, for their part, used colour as a resource to portray the emotions and suffering of human beings, converting their states of animation into pictures. To do this, they opted for dark and "tragic" colours, which they applied **energetically** to the canvas.

Nude Girls Talking. 1910. Kirchner

Finally, it would be in the work by **Kandinsky** that colours would reach complete independence from reality, giving rise, in 1910, to **Abstract Art**. This painter, of Russian origin, composed his works managing the colours as if they were shapes with which to construct his compositions. Together with this form of Abstract Art, known as Lyrical Abstraction, Geometric Abstraction was also born, of which the Dutch **Mondrian** (representative of the neo-Plasticist movement) is the best-known exponent. His works based on quadrangles in the three primary pigment colours: red, blue, and yellow, have since become recognised all over the world.

Watercolour with a Red Stain. 1911. Kandinsky

Composition with Large Red Plane, Yellow, Black, Grey and Blue. 1921. Mondrian

The range of artists that gave way to colour as the as the principle feature in their works is, nonetheless, very wide. Joan **Miro**, Paul **Klee**, Sonya and Robert **Delauney**, Mark **Rothko**, and the creator of his own colour, Yves **Klein**, just a few which exemplify the momentous role played by colours in artistic representation.

White Centre. 1950. Mark Rothko

Yves Klein Exhibition