

## An Introduction to Colour Theory

*Are you confused by colour theory, colour wheels and conflicting information?*

*Have you read that you can make all colours from the three primaries but found in reality that it just doesn't work?*

*Are you unsure about what is a warm or cool colour?*

*Or maybe you don't know what colours to use for shade colour s?*



### Let's start at the beginning.

If the above questions sound familiar....don't despair because you're definitely not alone! Colour Theory is a complex area of study there are lots of alternative approaches and disputes within it, which can leave both beginners and the experiences confused. I'm slightly wary of too much theory but it can be **useful if used as a guideline rather than a rule. So I run through the basics of colour but remember it's a guideline. To quote Ruskin:**

*If you need examples of utterly harsh and horrible colour, you may find plenty given in treatises on colouring, to illustrate the laws of harmony.....*

*Your power of colouring depends much on your state of health and right balance of mind: when you are fatigued or ill you will not see colours well, and when you are ill-tempered you will not choose them well.*

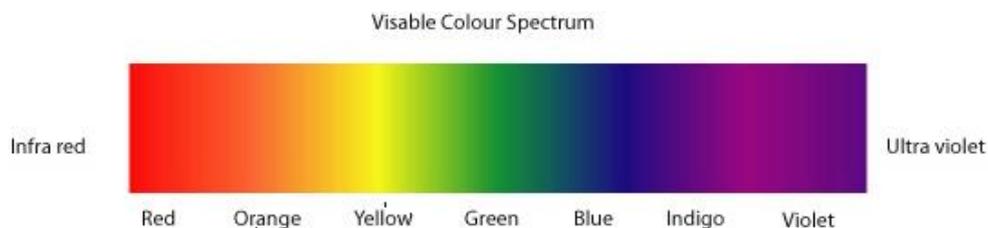
*Only observe always this, that the less colour you do the work with, the better it will always be.*

I could easily write a tutorial on colour showing you endless examples of mixes used in my paintings, which has a limited value. For me it's more important to get a broader understanding of how you **see and think about** colour which will enable you to develop your own approach and improve your ability to make judgements regarding mixes. You need to put colour into real life context when painting where you can learn to make decisions regarding what colour to use without instruction.

Unfortunately there is no easy way to learn about the subtleties of colour mixing, it just takes time.

### First of all - what is colour and how do we see it?

Colour as we see it comes from light energy from the sun. Visible light is part of the electromagnetic spectrum in which light emitted from the sun can be seen humans. Visible



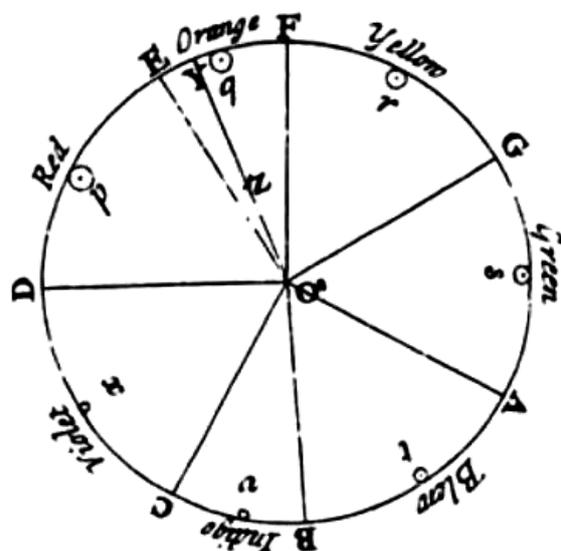
light or 'white light' comprises all the colours of the rainbow: red, yellow, orange, green, blue, indigo and violet, which collectively make 'white light'. Conversely black is the total absence of light. The light spectrum can be observed in its component colours in a rainbow or through the dispersion of white light through a prism, which separates the colours. The electromagnetic spectrum is actually much wider but we see only a small part of it. Other organisms see differently, for example, many insects, such as bees, can see ultraviolet light but cannot see red. Many flowers have evolved ultraviolet guide markings to assist pollinators in finding food rewards in flowers. This is a mutualistic relationship in which the insect finds food and flowers are cross pollinated.

When you look at an object, you can see light that is either emitted by the object or light that is reflected or transmitted by it. For example, a fire emits orange-red light while a leaf reflects green light and absorbs the remaining light. Each colour has a specific wave frequency, between 400-700 nanometres (nm) which our eyes perceive as different colours. Red has the longest wavelength and Violet the shortest. Light bends at different points because of the different wavelengths, which can be demonstrated as it passes through a prism and the colour separates. When our eye sees light from the outside world it is focused by the lens onto the retina. It is absorbed by pigments in the eye's light-sensitive cells, called rods and cones. The different cells respond to the different wavelengths of light and we 'see' the different colours.

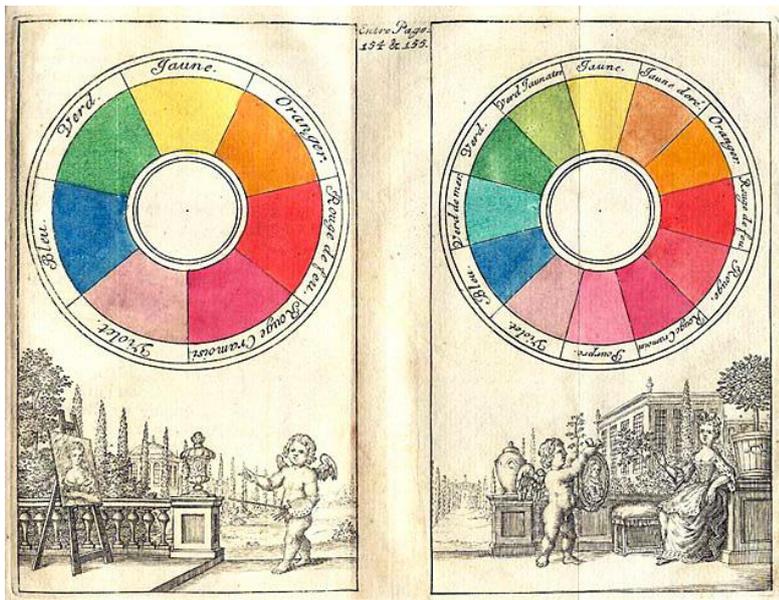
Colour: Light in the human visible spectrum	Wavelength in nm
Red	650
Orange	590
Yellow	570
Green	510
Blue	475
Indigo	445
Violet	400

### Science Meets Art, Newton's Theory of Colour

In 1672 Isaac Newton discovered that by placing a prism near his window and allowing the light to pass through, he could observe the seven separate colours on his wall. Newton hypothesized that light was made up of particles of colours, and, that the different colours of light moved at different speeds, he proposed that red light moved more quickly than violet. And therefore bends less sharply than violet as it



passes through the prism, creating a 'spectrum' of colours. He was the first person to refer to it as a spectrum and created this colour circle in his publication, *Optiks* 1704. **This concept of colour from light was grasped by artists and his arrangement of colours around the circumference of a circle allowed the painters to see the relationships between colours with three primaries (red, yellow, blue) from which all other colours could be made arranged opposite their complementary colours.** It is likely that Claude Boutet's painter's circle of 1708 was based on Newton's circle.



**Left:** Boutet's 7 and 12 point colour circles were probably based on Newton's circle. Boutet was unable to represent spectral red with any one pigment, so he substituted two reds, 'fire red' and 'crimson' and left out indigo.

**The problem of not being able to represent spectral colours with paint highlights potential for confusion because paint is simply not the same as light colour.** However colour circles are still the most useful for the painter.

The colour wheel as an arrangement of colours around the circumference of a circle is still used today. It allows painters to arrange the primaries (red, yellow, blue) to be arranged opposite their complementary colours, (e.g. red opposite green, as a way of denoting that each complementary would enhance the other's effect through optical contrast.

### Goethe's Theory of Colours

In 1810 German poet, Johann Wolfgang Goethe, wrote about his views on **the nature of colours** in his publication *Theory of Colour*. He was the first to **discuss human perception of colour under a variety of different conditions**. He considered Newton's theory and wrote about special cases, including discussions on colour in shadows, refraction and chromatic aberration. His work was influential on a number of artists, including J M W Turner and W Kandinsky.

#### **IMPORTANT: A Word of Warning: Why is it confusing?**

Boutet's difficulty in mixing the correct colours highlights a problem experienced by students of watercolour when comparing light colour with paint pigment. The biggest problem with colour theory in the wheel or circle is the fact **that there's a difference between light theory ( additive colour mixing) and colour theory involving paint pigments ( subtractive colour mixing) – they are**

**not the same and you simply can't mix everything that you need from the '3 primaries' because they are not true primaries as in light.** This doesn't mean that it's not a useful theory as a guideline and it's important to understand the limitations of colour theory demonstrated in colour wheels or circles.

A further confusion exists because of the **lack of consideration of the basic attributes of colours: hue (basic colour), saturation (intensity of colour) and tone (lightness or darkness)**

So if you have been told to work with a very limited primary palette don't be surprised if you can't achieve the vibrant colours found in nature. In reality you will need a few more paints than the basic primaries in your paint box. Having said that I do suggest keeping the palette under control, with around 12 – 20 colours. You can add more later if you wish. While it is possible to purchase a wide array of colours it is important to understand how to mix colours first. But you don't need to waste time mixing endless colour charts, instead it's more important to put colour into context.

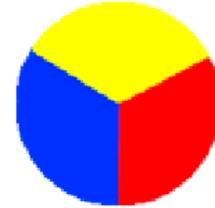
## Colour Theory Basics

We have already discussed the origins and limitations of colour theory so we will go back to basics with the colour wheel for reference and will then look at practical advice in colour mixing.

### The 12 point colour Wheel

#### Starts with 3 Primary Colours:

- Red
- Yellow
- Blue



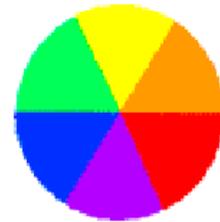
The primaries form the basis of our colour wheel. To create a 12 point colour wheel you can use any red, yellow or blue, here are a few alternatives to try in the table below. As you will realise there are many combinations!

<b>Red</b>	Permanent Alizarin Crimson	Permanent Carmine	Permanent Rose
<b>Yellow</b>	Cadmium Yellow	Aureolin	Lemon Yellow
<b>Blue</b>	French Ultramarine	Cobalt Blue	Cerulean

#### Then 3 Secondary Colours

Mixing the primaries create the 3 secondary colours seen here in the 6 point colour wheel:

- Orange – from mixing yellow and red
- Green – from mixing yellow and blue
- Violet – from mixing red and blue



#### The 6 Tertiary Colours

From the basic 6 colour wheel we can expand it by **mixing adjacent colours, which are formed by mixing a primary and a secondary colour and resulting in 6 more tertiary colours, seen below. Collectively the primary, secondary and tertiary colours make the colour wheel below.**

- yellow-orange- from yellow and orange
- red-orange - from orange and red
- red-violet - from red and violet
- blue-violet- from violet and blue
- blue-green -from blue and green
- yellow-green -from green and yellow



**Note: I have used block colour rather than watercolour for the purpose of demonstration**

**ACTIVITY: Make a colour wheels using your paints, here's how:**

Choose 3 primaries:

- Yellow e.g. Aureolin
- Red e.g. Permanent Alizarin Crimson
- Blue e.g. French Ultramarine

Draw a circle, any size you like approx. 10-15 cm diameter. Divide it into 12 parts so 360 degrees divided by 12 = 30 degrees for each section

Paint the section numbered 1 with yellow, section no. 2 with red and section no. 3 with blue

Then mix working the colours between the 3 primaries, as follows:

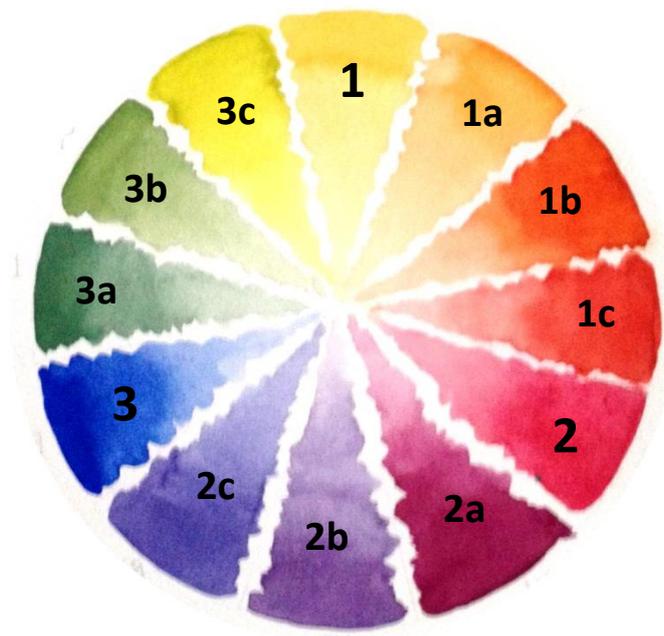
- 1a. 2 parts yellow : 1 part red
- 1b. equal parts red and yellow
- 1c. 1 part yellow :2 parts red

Continue the same approach between each primary colour

- 2a. 2 parts red : 1 part blue
- 2b. equal parts red and blue
- 2c. 1 part red :2 parts blue

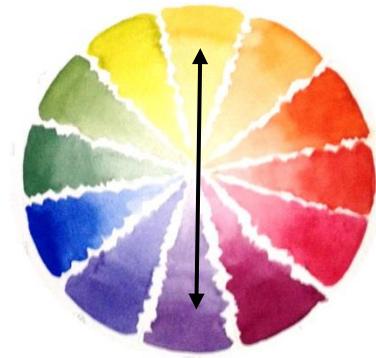
Finally

- 3a. 2 parts blue : 1 part yellow
- 3b. equal parts blue and yellow
- 3c. 1 part blue :2 parts yellow



## Complementary Colours

Each of the colours in the wheel has an opposite, known as the complementary colour. **Each colour's complement is found directly opposite on the wheel** e.g. the opposite of blue is orange and the opposite of yellow is violet (as shown). Complementary colours can be used as shade colours. It is said that mixing two complementary colours a perfect 'neutral' is achieved, unfortunately it's not quite so simple in reality.



## Warm and Cool Colours



Looking at the colour wheel, we can divide it broadly into warm (e.g. red and orange) and cool (e.g. blue and green) colours. On a basic level red is the warmest colour and blue the coolest BUT remember **temperature is relative**, so although all blues will always be cooler than all reds or yellows, there are warm and cool versions within a colour, for example Cadmium Red is warmer than Permanent Alizarin Crimson. **Activity: Look at the colour wheel to identify the warmer or cooler colours and look at your paint box to determine which colours are warm and which are cool.**

Colour temperature has an important relationship with light. The way the light falls on a subject affects the colour temperature. So although you know that a flower is essentially pink, the light will have an effect on the basic hue making it a warmer or cooler

pink. Try to look at flowers to identify those warmer and cooler hues. If you look at the peony here, you will see the variations in the basic pink hue. Can you see the different colour temperatures in the pinks? Are some warmer (more red) or cooler (more blue)

## Harmonious Colours

Colours that sit next to each other on the wheel are called harmonious colours. They can be used to make a more ambient painting.

## Special Case Colours White, Black and Neutral Tint

### White

Two colours that are not present on the colour wheel are black and white. Unlike light, with paint we cannot mix white. In watercolour **we use the white of the paper and transparent washes of paint for our white. We can on occasion use white paint for certain jobs such as fine hairs and bloom**, which is found on subject such as plums and grapes. Titanium white is the most opaque of the whites and best suited for these jobs.

### Black

We can mix forms of **Black, these comprise mixes of the three primaries**. For example by **mixing French Ultramarine with Permanent Alizarin crimson in equal ratios and then adding a small amount of Cadmium Yellow we can mix a rich black**. You can try alternative mixes of different blues, reds and yellows to find variations of black. **This mix can be used as a Neutral Tint.**

### Neutral Tint as an alternative to Complementary Colours

Neutral tint is a useful colour mix because it can be used to make a shade colour and is an alternative to using complementary colours to make a shade. If added to a colour in small amount it neutralises or darkens a colour without altering it. This approach can be preferable to using a complementary colour because they can corrupt colours making and make them 'muddy'

### ACTIVITY:

1. Try mixing colours from your colour wheel with the Neutral Tint mix described above to make a shade colour.
2. Mix the same colours from your colour wheel with their complementary colour to see what results you obtain.
3. Compare the differences.

*There is no better test of your colour tones being good, than your having made the white in your picture precious, and the black conspicuous....*

*Ruskin*