The Public

AN INTRODUCTION TO:

COLOUR

The Public is an activist design studio specializing in changing the world.

This zine, a part of our *Creative Resistance How-to Series*, is designed to make our skill sets accessible to the communities with whom we work. We encourage you to copy, share, and adapt it to fit your needs as you change the world for the better, and to share your work with us along the way.

Special thanks to Amanda (Ande) Benedict from OCADU's Design Program in Toronto, for developing this zine on behalf of The Public.

For more information, please visit thepublicstudio.ca.

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Introduction to colour theories

Colour is an expressive and important asset for anyone. In Western design education, colour is taught as a form of theory, discovered and continuously developed by various artists, scientists and theorists, then passed down to us. As with any other principle of design, there is often an emphasis on Western philosophies and histories. However evolved, it's important to remember that colour theory, is just that: a theory. There are perhaps as many colour theories as there are answers to the question, **What is your favourite colour?**

A general theory as to how colour behaves can be useful to anyone interested in creative expression, because it works together with other elements of design to create an engaging piece and communicate an abstract or specific idea. However, colour selection and use can also be very subjective, and is as linked to emotion and personal experience as it is to science and history.

This zine contains information and activities that can be useful in order to explore and better understand colour and colour relationships. These activities can be completed by purchasing a simple set of acrylic paints and a brush from your local dollar store. Use a sheet of coated paper, such as from a magazine as a palette, as coated paper is less likely to absorb paint.

What are Acrylics?

Acrylic paints were introduced intially as an alternative to oil paints. Unlike oil paint, acrylics are fast drying and more economically accessible depending on how they are produced. There is a wide selection of acrylics available from expensively formulated paints marketed towards professionals, and the more affordable paints marketed towards students.

If for some reason affordable acrylic paints are difficult to attain (as they were as recently as the late 1990s) a good altenative is tempera paint, also known as poster paint. Tempera paint is often certified non-toxic and is therefore popular amongst elementary school teachers. Tempera is generally thinner than acrylic, but still does the job!

WHAT IS COLOUR?

Colour is usually described in two ways, by its physical properties and also by its perception by humans. In the past, people have tended to research one set of descriptors more than the other, but in design, it's useful to consider both. Production with colour can be very technical, and knowledge of colour inks is useful, but it's also important to consider the emotional effects of colour. Understanding your audience and your content will help you pick engaging colours, so make sure to do your research!*

Different systems and authorities on colour exist and not all methods of viewing colour, even on your computer screen, are created equally. For example, besides the default screen calibration of your computer, many other calibrations exist, and different calibrations are useful for different reasons. In film, there are professionals called colourists whose job it is to adjust calibrations and many other variables in order to enhance the colour of the film itself.

In art and design education, colour is often taught as a "scientific" principle, related to the physics of light before making a segue into the application of colour creatively. This sometimes results in the construction of an art vs. science binary, but it's important to remember that the fields of art and science overlap and inform one another constantly and this is especially true when we look at the Western history of colour theories. Additionally there is no one clear definition as to what the fields of "art" and "science" are, and the definitions commonly accepted and spread by educational institutions are not free from bias.

Calibration? Calibrations?

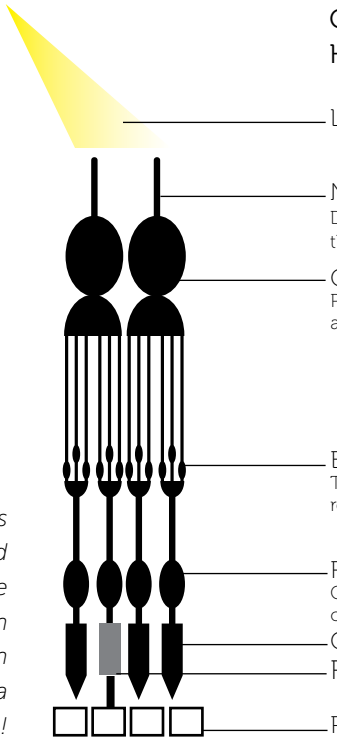
In computer hardware, calibration is how your monitor's settings are adjusted to show colour in a particular way. For example, you can calibrate your monitor to CIE RGB (explained in detail on p.15), and see what that does. You can experiment with all the different calibrations on your screen just by typing "Screen Calibration Mac" or "Screen Calibration PC" into a search engine. Usually the panel for adjusting your monitor can be is in the Settings or Properties section of your computer's operating system.

* IMPORTANCE OF RESEARCH: See The Public's zine on **Design Research** for help on figuring out how to communicate your message!

Colour as a science

Colour vision differs from one species to another. In humans, what we perceive as 'colour' is the result of a combination of the physical characteristics of light interacting with the retina whose activity is then processed by the brain. The light that is visible to us is part of the same electromagnetic spectrum that also includes radio waves, microwaves, infrared light, x-ray, gamma ray and ultraviolet light.

In the eye, the retina has two types of cells which are sensitive to different types of light. Rod cells are located on the outer parts of the retina for peripheral vision and are mostly responsible for night-vision and other low-light settings. Cone cells are more active in colour vision, being sensitive to red, green and blue spectra. Current scientific research indicates that the human eye is capable of seeing 10 million colours, all of which are perceived by the brain as being a combination of red, green and blue. Below is a diagram of the retina, illustrating this.



After light is understood through the retina, it is then sent to the brain for processing via optic nerves!

ADDITIVE VS. SUBTRACTIVE MODES

Colours produced by light-based sources, such as a projector or a computer screen are part of the **additive** system, when the primary colours of this system (red, green and blue) are combined in equal parts, they produce white.

Colours produced by material based sources such as dyes and paints are part of the **subtractive** system, and its primaries (red, blue, yellow), when combined in equal parts, will produce black. This is explained in more detail on p. 14.

'Colour Vision' is not a universal term!

Nowadays, the 'green' you see in traffic lights is actually more of a greenish-blue, so as to be accessible to persons with red-green blindness. But older traffic lights have stark green bulbs, presenting a potential hazard for drivers. Many colour blind people avert this by learning when to stop and go based on which light is lit, the top means stop, the bottom means go. Ideally when we design systems for public use that depend on colour, we want everyone to be able to use them safely!

COLOUR BLINDNESS

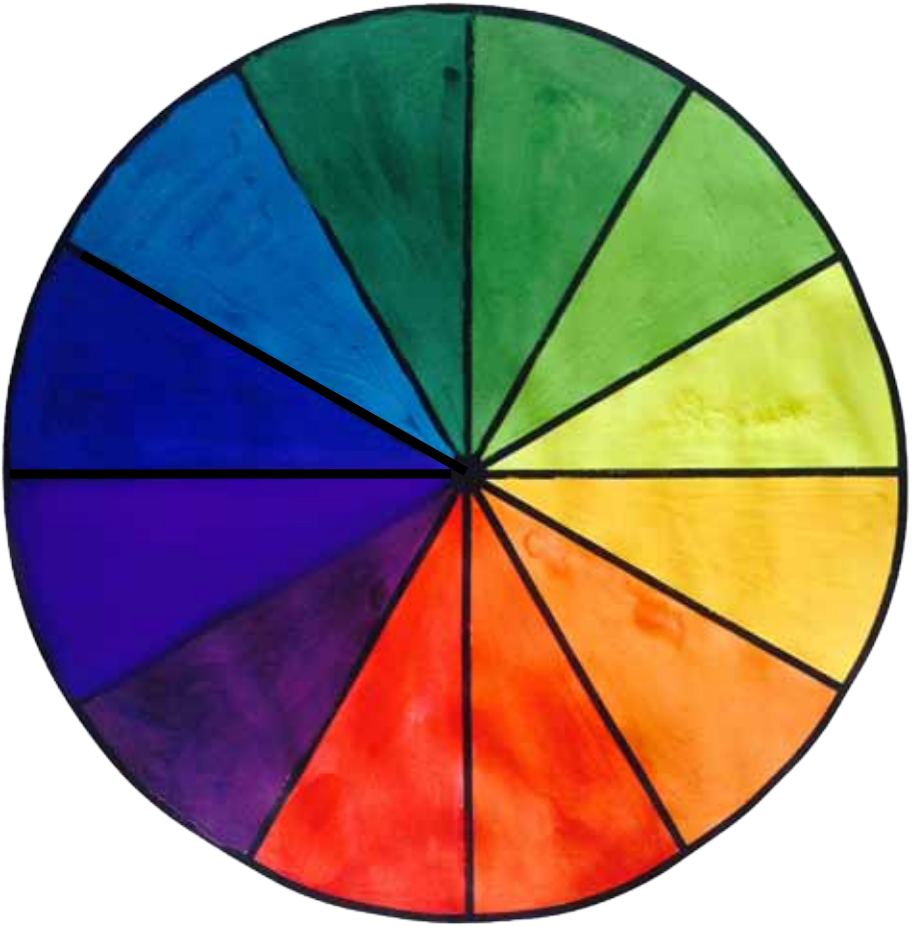
Some people perceive colours differently than others. The term 'colour blindness' is somewhat of a misnomer, because affected persons simply see colours in a different way than the majority of other people.

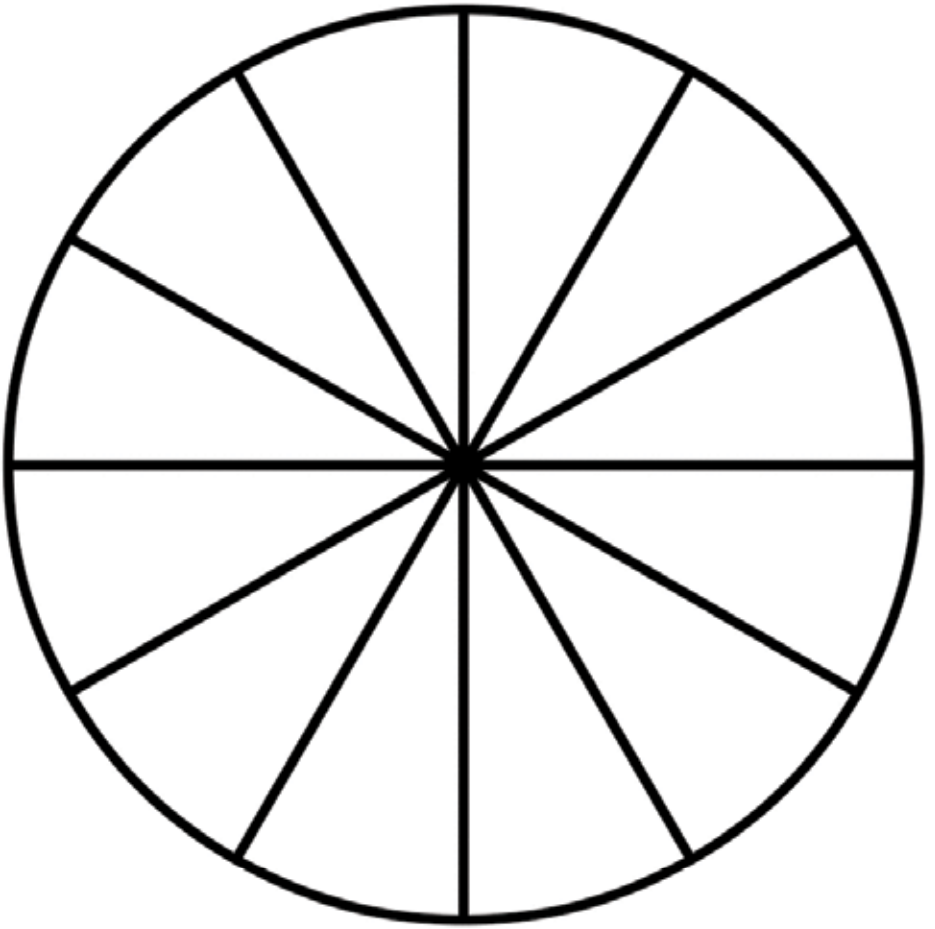
Colour blindness occurs more often in people with a Y chromosome (about 5–8%) than people without one (roughly 1%). There is also a spectrum of colour blindness, the most common form being the inability to perceive what most people see as red and green and the rarest form being where the only colours perceived are on the greyscale.

There are currently no existing medical methods of conforming colour blind vision to what is perceived as 'normal colour vision'. But an early diagnosis of colour blindness can allow those affected to learn about the possible dangers of a world designed largely by people who are not colour blind, if they choose to.

COLOUR WHEELS

In Western design practice, colour wheels are commonly used to explain relationships between colours. It's not a perfect system, there is much dispute over it and there is certainly no one true colour wheel, but when you look at the wheel below, do the colours seem placed in the correct position? What changes would you make? Observe the wheel below, then try to re-create it for yourself using paint. Take note of what colours are easy to mix, and which ones are more difficult.





Colour histories

The following is a typical chronological timeline of Western colour theorists. It also shows a trend in who was allowed to research and produce art, and whose ideas were influential. Sir Isaac Newton's research was conducted during the Scientific Revolution, which saw a shift away from theocracy in England. .

384–322 BCE

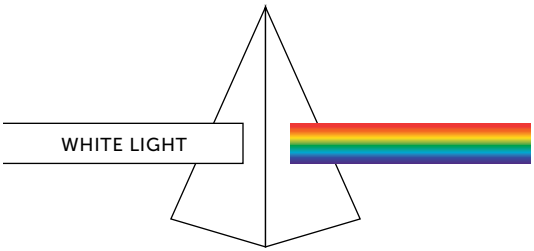
ARISTOTLE OR THEOPHRASTIS

- Connected colour to the mixing or absence of light
- Colours were linked to the time of day, red and yellow representing the day and darker colours representing the night
- These notions were highly influential and prevailed throughout the European middle ages

1672

SIR ISAAC NEWTON

- Passed a beam of sunlight through a prism, producing the visible spectrum (see below)
- Determined that all colours are actually light



1810

JOHANN WOLFGANG VON GOETHE

- Proposed a study of colour based on perception rather than as a physical property of light
- Assigned colours to categories such as "radiant" and "gentle"

1831

MICHEL EUGÈNE CHEVREUL

- Recorded behavior of colours when placed side by side
- Art movements such as orphic cubism and neo-impressionism were influenced by Chevreul's work

1878

EWALD HERING

- Theorized a system of colour opponency where six primary colours are coupled together, red-green, yellow-blue and white-black
- This theory provided the foundation for the Natural Colour System (NCS)

1910

WILHELM OSTWALD

- Introduced the notion of adding white as tinting and adding black as shading
- Observed that some colours are more harmonious with one another than others

1934

FABER BIRREN

- Theorized that warmer colours are more dynamic and therefore of more use to the designer (compare the swatches below and see if you agree with him)

WARM

COOL

1961

JOHANNES ITTEN

- Taught design at the Bauhaus School
- Published *The Art of Colour*, based on a highly influential 12-section colour wheel

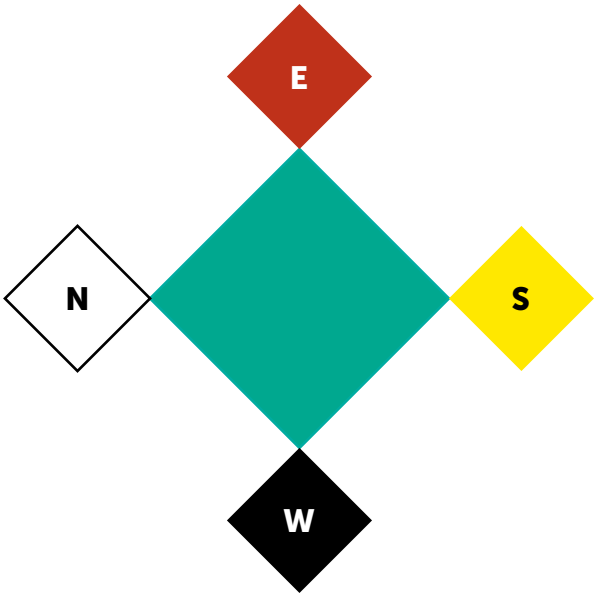
1963

JOSEF ALBERS

- One of Itten's students
- Developed the illusionary effects of colour

Colour theories have been around for centuries before Sir Isaac Newton aimed light through a prism. Indigenous cultures in Meso-America and Mesopotamia have been documenting their use of colour for thousands of years. The Mayans in particular assigned their own primary colours to directions on maps of their making. They then assigned objects, events and resources such as God, water, corn, plague, to these hues.

MAYAN COLOUR COMPASS



This diamond compass and its colours appear frequently in Mayan art, clothing and architecture. In some cases, certain colours were used symbolically, especially in construction. Religious spaces were painted green-blue because It symbolized divinity, houses were painted yellow because ityellow represented the harvest and the hearth. This is not to say that say that 'Mayan culture' is some great monolithic entity– different villages retained different colour customs. Furthermore, Mayan cultures are alive and are constantly evolving like any other culture. Despite brutal genocidal tactics of European colonizers, today over seven million Mayans inhabit their ancestral lands, over thirty distinct Mayan dialects exist, many of them relatively untouched by Spanish.

On that note, most academic sources about Mayan cultures both historical and current are examples of unethical, Western, anthropological traditions. Though more often then not ignored in Western design education, when they are included in curriculum indigenous cultures are 'othered'. Moreover, what we know about their customs has often been obtained with a severe lack of respect. Frequently the words 'exotic' and 'ancient' will appear in academic texts and such attitudes towards Indigenous peoples are what aids in the continuance of discrimination and violence towards these communities.

Physical properties of colour

Hue: generic name for any of several colours typically determined by a dominant corresponding wavelength (e.g. red, blue, green)

THESE HUES ARE PRODUCED BY CMYK IF YOU PRINTED THIS ZINE, OR RGB IF YOU'RE VIEWING THIS ZINE ON YOUR COMPUTER

Saturation: refers to how pronounced or "faded" a particular hue is within a certain colour

DESATURATED SATURATED

Value: (sometimes called key): refers to the lightness or darkness of a particular hue, altered by the addition or subtraction of black or white

HIGH VALUE LOW VALUE

Primary Hues: "Pure" hues, or hues which cannot be created using any other hues in a chosen colour system. Primary hues are mixed to produce all other hues.

Secondary Hues: Produced when two primary hues are mixed together in equal parts.

Achromatic Hues: refers to white, black and greyscale, which are important to our understanding of light and dark.

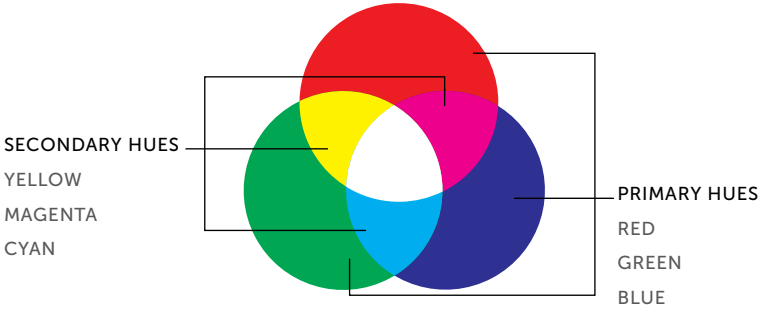
Analogous Hues: refers to white, black and greyscale, which are important to our understanding of light and dark.

Complementary Hues: Colours located across from one another on the colour wheel are often deemed complementary. When used together, complementary colours typically enhance one another.

COLOUR MODES

Additive

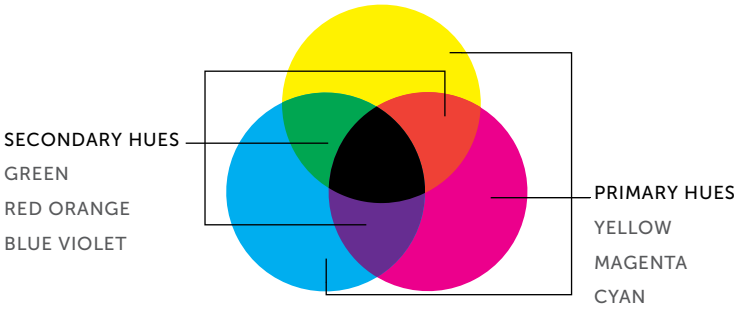
Light-generated colours, such as those generated by a computer screen, television or photography. The primary colours of the additive system are red, green and blue (RGB).



When you're designing a computer based graphic such as a website design, blog template, online brochure, online presentation, or working with film or animation, it's best to work with the additive system or work in RGB.

Subtractive

Hues produced through the mixing of pigment, such as in paint and ink are part of the subtractive colour system. There are two sets of primaries in this system depending on medium. The traditional paint system is based on red, blue and yellow (RBY) and the printer system based on cyan, magenta, yellow and black (CMYK).



When you go to print:

If you work on a monitor and then go to print, you'll be going from one mode of colour to another (RGB to CMYK) so what you see isn't always what you get! As a general rule of thumb, colours when printed are darker than they are on your screen, and while it's rare that you'll get a completely different hue than what you want, it does happen. If doing a colour test with your printer isn't an option, work in CMYK because the colours that print are more likely to be closer to what you saw when you were working on a screen.

CONTEMPORARY COLOUR SYSTEMS

CIE

Throughout the 20th century, several attempts have been made to develop a standardize colour systems, and a few successes have emerged. In the 1940s, the Commission Internationale de l'Eclairage developed the CIE system. The CIE system eliminates the 'problem' of human interpretation of colour, allowing designers to match colours that to the human eye seem very similar and are easily confused. The CIE system is the standard in the light industry.

Munsell

Colour theorist Albert Munsell first developed his system in the early 1900s. Munsell extended the title of 'primary' to red, yellow, blue, green and purple and used these to create 100 secondary colours, which he then arranged according to hue, value and saturation. In 1941 it was adopted by the United States Bureau of Standards, which still employs it today

NCS

Based on Hering's work, the Natural Colour System (NCS) emerged from Sweden and focuses on the perception of colour by the human brain. In the NCS, colour is defined according to darkness, saturation and hue.

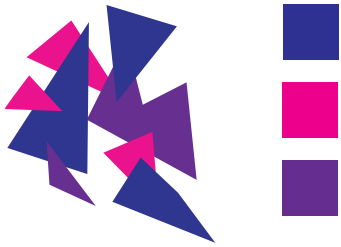
Pantone

In 1962 the Pantone Color Matching System was created in the United States. Though it has become the standard for graphic designers and printers, it differs from other colour systems in that it doesn't contribute a colour theory , but rather it exists entirely for profit. Pantone numbers colours in order to identify them.

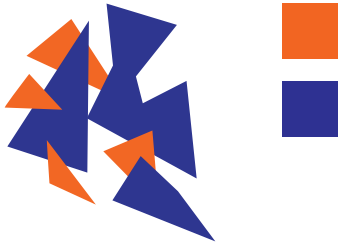
Colour harmonies

Broadly speaking, 'colour harmonies' are colour combinations that are aesthetically pleasing. They are useful to a designer because humans typically like to see balance and a harmony of colour is one of many ways to achieve this balance. Additionally, harmony of colour can help make a design feel unified and may encourage a viewer to engage with the piece. The rules of colour harmonies are by no means set in stone. There are exceptions to every rule and 'unity' is not necessarily always sought after. Ultimately, it's up to an individual designer or group of designers working together on the same project to decide what colours are appropriate to solve a particular problem.

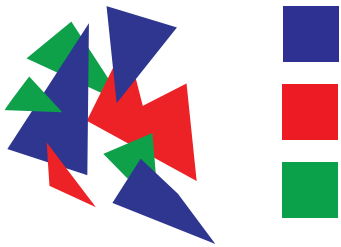
Analogous harmony is created when colours that are next to one another on the colour wheel are used in a composition. This is particularly useful when a designer is trying to use only cool colours or only warm colours.



Complementary or dyadic harmony is when colours that are opposite of each other on the colour wheel are used. Common complementary harmonies are blue-orange, purple-yellow, green-magenta.



Triadic harmony relies on the use of three colours that are equally spaced on the colour wheel. Triadic harmonies in particular allow designers to create dynamic compositions with a wide variety of colour.



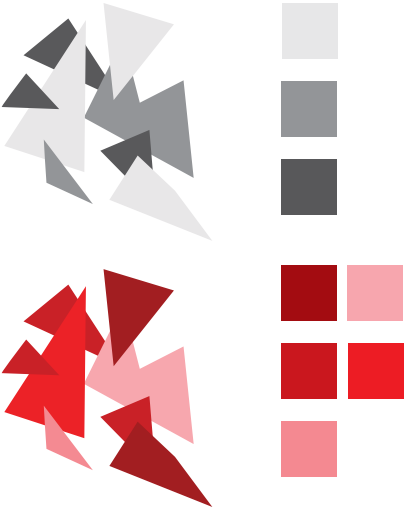
Achromatic harmony lacks all hue, and so are composed of black, white and greyscale. Achromatic harmony is commonly used in minimalism and low-budget production.

Monochromatic harmony, sometimes mistaken for being achromatic harmony, refers to a composition with only one colour, with various tints, tones and shades of that colour being used. Similar to achromatic schemes, playing with value can help generate contrast.

These harmonies can provide a good starting point for creating unified compositions, but remember that you can create any number of effective colour combinations.

TRY THIS!

To start your experiments in colour, try using paint or coloured pencils to start colouring in some of the images on the next page as certain colour harmonies. Refer to the colour wheel on p.8 if you need help remembering where colours are on the colour wheel.

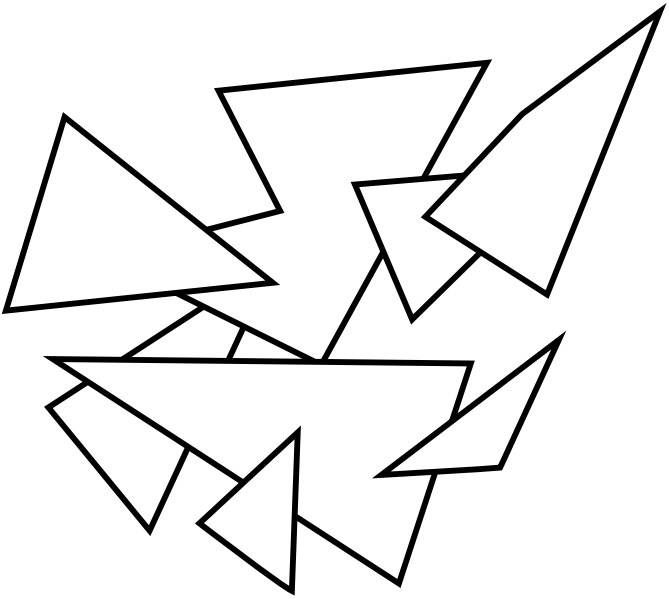


Using Greyscale

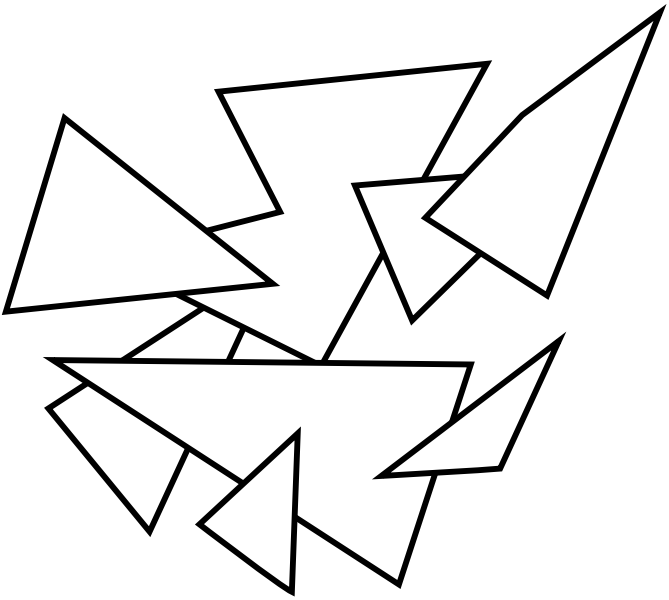
Colour printing is universally expensive! If your budget doesn't include room for CMYK/colour printing, have no fear. You can use value to create movement and focal interest. Try experimenting with gradients and remember that greyscale is a spectrum unto itself. The Beehive Collective (illustration below) works extensively with greyscale.*

* **BEEHIVE COLLECTIVE** IS AN ANONYMOUS, ALL-VOLUNTEER GROUP OF COLLABORATIVE CREATORS WHO WORK TOGETHER TO PRODUCE STUNNING NARRATIVE GRAPHIC CAMPAIGNS. SEE MORE AT BEEHIVECOLLECTIVE.ORG

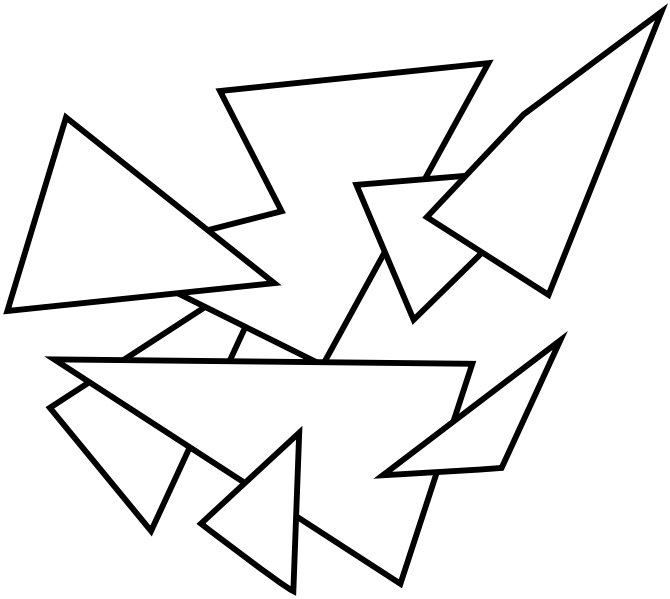
COMPLEMENTARY HARMONY



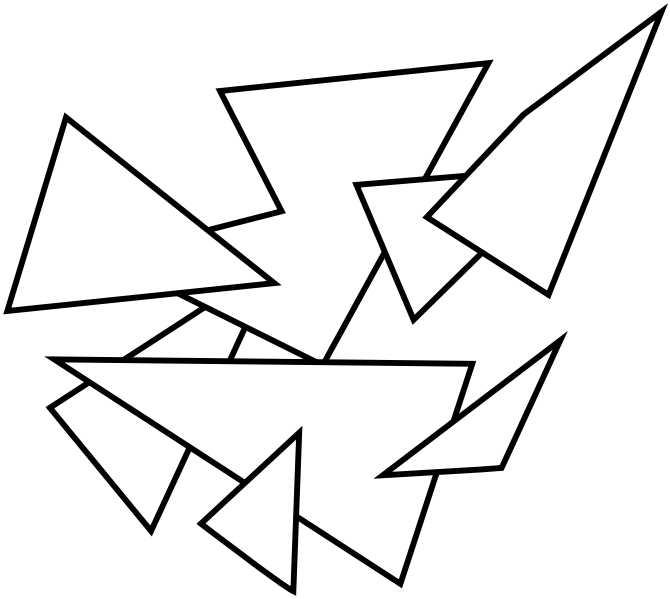
ANALOGOUS HARMONY



MONOCHROMATIC HARMONY



ACHROMATIC HARMONY



Colour and Us

COLOUR AND ACCESSIBILITY

The freedom to design with many colours is great, but certain colours work better in certain situations. Additionally, some colours have specific connotations that it's good to be aware of.

For example, one of the first rules of typography is that your type should be legible.* Colour can have a huge effect on whether or not type is legible.

*See The Public's zine on **Typography** for tips on how to make your type accessible!

WHICH OF THE TWO IMAGES BELOW SEEMS EASIER TO READ?

LEFT: ONE WAY OF MAKING SURE YOUR TYPE IS LEGIBLE IN ALMOST ANY SITUATION, THE BLACK STROKE AROUND THE WHITE LETTERS PUSHES THE TYPE FORWARD, SO THAT IT APPEARS TO BE SITTING ATOP THE IMAGE.

There have been attempts by some institutions to create accessibility standards within graphic design. Some of the standards might seem obvious, for example, a book printed in a very small font size would likely be difficult for anyone to read. But we should try to think outside our personal limitations or what we might consider as 'the norm' of physical limitations when we're trying to create accessible design. What may seem perfectly fine for one person, may create an obstacle or danger for another.

Though we should be wary of attempts to 'standardize' design, because we rely so much on individuality to create our designs, it's best to have as many informed (either by education, experience, or both) opinions as possible if we are to create the most accessible design we can.

In Canada, The Association of Graphic Designers of Ontario with support from their provincial government produces *Access Ability: A Practical Handbook on Accessible Graphic Design*. The handbook is available free of charge on the RGD website and outlines steps for graphic designers to take in order for their designs to be accessible. Its section on the colour outlines the following tips for creating accessible design:

- Aim for a 70% difference in the value of the colour of the type and the colour of the background

- Try testing your completed designs by printing them in greyscale, if you have difficulty reading your type, or if objects on the page seem to meld together, you need more contrast, which refers to how brightness makes two or more objects in the same field of view, appear separate from each other.
- Using complimentary colours is normally a good way to achieve strong contrast of hues, but if the saturation and value of the colours are too similar, *simultaneous contrast* (shown below) will occur, causing an optical illusion that makes the colours appear to vibrate and put a strain on the eye.

Most municipalities have specific guidelines for designers creating objects for public space. There are usually very specific rules about how much space an object can occupy, what kinds of objects can be installed within a designated area and yes, what colours and textures are appropriate. Since public space is typically used by a vast amount of people, all with different abilities and experiences, it's good to observe what types of public design are effective.

Try taking a walk down your street or around your community, jot down some answers to the following questions:

What colour are the street signs?

What colours do you see most often in signage?

What colours are the hardest to read?

Do you like these colours? What alternatives would you use? Why?

COLOUR AND CAPITALISM

In some ways, standardization is a good thing. Standard systems allow people with different experiences and abilities to use the same products in the same way. Often times, this lowers cost. For example, purchasing a Pantone book means that you can know exactly how your colours will turn out after you print them, and you can save money on colour tests in the long run. While this is useful, Pantone also charges a lot of money for their colour swatches has a number of corporate partnerships with other companies. This begs the question, why does Pantone have the right to own colours? We should also be critical of standardization, or globalization of design, because of its ties to Western capitalism. When Pantone "standardized" colour, they established themselves as an authority, as a ruling power. Anyone who wants access to the system has to purchase their books, curated by their staff. For whose benefit is this? The designer? The artist? Or the select few who can afford annual Pantone books. The question has become urgent as more and more design firms and client require the use of Pantone's system.

We have to ask ourselves who is doing the standardizing, and furthermore, what is the standard? Who is considered "standard". Inevitably, there are people who fall outside of the "standard". For example the "standard" test that people write if they want to become a pilot discriminates against people with colour blindness. Of course there are concerns surrounding a person's ability to pilot an aircraft, but can we really call something "standard" if it's exclusive only to a certain group of people (like Pantone's customers?), even if that group happens to be the majority?

COLOUR NARRATIVES

From a very early age we receive messages from the world around us about what certain colours mean. Depending on where you live of course, colours mean different things. With some exceptions, street lights almost everywhere in the world use green for go and red for stop. Environmental organizations are drawn to green because green in nature is a symbol of birth, new life and health.

Think of the dials for temperature control in an automobile. How strange and disorienting would it be if red was used as the symbol for

cold by accident? It's not written anywhere in stone that blue is for cold and red is for hot, and yet we accept this as 'normal' convention. We use colour to label and understand our world.

It's also important to remember that colour isn't always a neutral force, it can and is highly politicized in certain contexts and as designers this is relevant to our work. Sometimes clients will ask that you avoid certain colours so as to avoid certain connotations, same as with when we avoid certain imagery because it's weighted and carries along its own meanings regardless of how you use it. For example, because of the coupling of Christianity and capitalism in Western society, even non-Christians will associate the colours red, green and white with Christmas.

Sometimes common associations can be useful. For example, if you are designing an ad campaign for Christmas retail, you can't really go wrong colour-wise if you use red, green, white and gold, and that's okay. And it would probably be ill-advised and possibly even unsafe if designing infographics to assign red to mean cold and blue to mean heat, so it's good to be aware of the connotations of certain colour narratives.

But colour narratives, specifically those spread about cultures outside of non-Western cultures are also dangerous and contradictory to what we're trying to achieve when we design for accessibility. Statements like "In Chinese culture, red is a symbol of luck," are hugely reductive, even if they do convey some granule of the truth. This is a common tactic of design firms who try to brand products with "cultural symbolism" and end up watering down entire cultures. We should ask, who is delivering the statement? Why do we talk about cultures as though they are artifacts? In fact, China's history spans several millennia and it's hard to imagine that we can make any one static observation about its culture. Additionally, being home to over a billion people and spawning a massive world-wide diasporic population, who's to say that there is one dominant culture that presides over all people who identify as ethnically Chinese or of Chinese descent? It's best to avoid

Politicized Colours

Colours are often used to symbolize political parties or ideologies (think of The Green Party, or the importance of red to communism) so be aware of this especially when doing community work!

making such huge generalizations about something as deeply personal as culture, especially when it's not one's own. Design choices that are grounded in reductive racial stereotypes, perpetuated by Western institutionalized education are harmful. We should strive instead to listen and learn from our experiences and the experiences of others. Unlike other species of animals, humans possess empathy–we can imagine ourselves into the situations of others. This doesn't mean that we should appropriate other peoples' experiences, but rather, be sensitive to experiences that differ from our own in order to make smart design choices that still reflect an ability to think outside of ourselves.

Another widely perpetuated colour narrative that spans most of our history as a human race is the light/dark dichotomy, where lightness or whiteness represents the forces of good, whereas darkness or blackness is evil or bad. You don't need to look farther than the history of graphic design and advertising in the United States and Britain to see this colour narrative racialized and circulated amongst the public. Disturbing images for example, in the deep southern United States of Ku Klux Klan members dressed in all white from head to toe toe burning crosses or images of 'dirt' and 'soot' being eliminated with the use of Pears Soap in the Victorian Era of England are complicit in the use of colour narratives to oppress people.

TRY THIS!

Get to know your own sense of colour narratives. Fill out the colour charts on the following pages with associations that you have to colour. Write whatever comes to mind, then reflect on why you've made the associations that you have. Try comparing your charts to someone else's, and see if you have any colour associations in common.

Colour Associations

RED

ORANGE

YELLOW

GREEN

BLUE

PURPLE

GREY

WHITE

Sources

BOOKS

Colour and Two-Dimensional Design, by Glenn McArthur, OCAD University Press, Toronto, 2011

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Here Comes Holi: The Festival of Colours by Meenal Atul Pandya. MeeRa Publications. 2003.

The Art of Color: The Subjective Experience and Objective Rationale, by Johannes Itten, John Wiley & Sons, New York, 1997

ONLINE

ColorCombos (for trying out colour schemes for web applications)
www.colorcombos.com/index.html

Genopal (recolours your graphics)
www.genopal.com

Registered Graphic Designers' Handbook on Accessible Graphic Design
www.rgd.ca/database/files/library/RGD_AccessAbility_Handbook.pdf

The Affirmations Colouring Book
A thoughtful, alternative colouring book for adults, containing quirky and thoughtful pages that encourage self-love.
Purchase at: www.etsy.com/ca/shop/SarahMangle