Lesson 6: Map Symbols and Visual Variables

## INTRODUCTION

In this lesson the materials provide context on map symbols and visual variables. You will learn about map symbols, visual variables, and color as they relate to cartography. The lesson also provides information on two color theories, components of color and color models. You will learn how to consider your audience and about subjective reactions to color to help in the map creation process.

## LESSON OBJECTIVES

By the end of this lesson, you will be able to:

1. Identify characteristics of the following map elements: map symbols, visual variables, and color.
2. Apply appropriate symbology to create maps that accurately and effectively communicate the desired information for different map types and output formats.
3. Apply appropriate colors and patterns to create effective communication of data for different map types and output formats.

**LEARNING SEQUENCE**

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| Required Reading | Read the following:  Map Symbols and Visual Variables   * Map Symbols * Visual Variables * Color and Cartography * Two Color Theories * Components of Color * Color Models * Subjective Reactions to Color * Color in Cartographic Design |
| Assignments | Complete the following assignments:   * Quiz: Map Symbols and Visual Variables * Lab: Using Color on a Map Effectively |

## INSTRUCTION

## Map Symbols

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Map symbols are graphic marks used to encode thematic information on the map. Map symbols provide a graphic, simplified representation of the environment and come in many different forms.



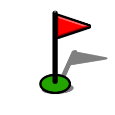
#### Geometric symbols

Geometric symbols are commonly used map symbols. Geometric symbols do not visually resemble the phenomenon being mapped as they are considered abstract representations. Geometric symbols are typically point symbols and require a legend to understand since they do not resemble the phenomena. Geometric symbols are circles, triangles, squares, crosses, and symbols with crosshairs, dots, or other symbols embedded within.

#### Pictographic Symbols

Pictographic symbols visually resemble the phenomenon being mapped. The pictographic symbols typically represent point data sets. A major benefit of pictographic symbols is that they may be understandable without a legend and since many pictographic symbols are so widely used they may be immediately interpretable by the map reader. The use of pictographic symbols will add to the theme or memorability of your map.

http://upload.wikimedia.org/wikipedia/commons/1/10/NPS_map_symbol_restrooms.png http://upload.wikimedia.org/wikipedia/commons/e/e3/NPS_map_symbol_airport.png http://upload.wikimedia.org/wikipedia/commons/8/85/NPS_map_symbol_information.png http://upload.wikimedia.org/wikipedia/commons/5/5b/NPS_map_symbol_recycling.png http://upload.wikimedia.org/wikipedia/commons/3/38/NPS_map_symbol_lodging.png

### Spatial Arrangement

Arrangement of spatial phenomena influences how they are symbolized on a map. There are four spatial arrangements: continuity, dimensionality, scale, and level of measurement.

#### Continuity

Continuity refers to whether an item is discrete in nature having well-defined boundaries and locations or continuous in nature where the measurements exist along a surface or continual. Discrete phenomenon is symbolized with points, lines, and polygons. Continuous spatial phenomenon is symbolized with surfaces, shading, and hatching to name a few.

**Discrete Continuous**



#### Dimensionality

Dimensionality refers the different dimensions that are symbolized in different ways with respect to spatial data. A point is considered to have zero dimensions. A line is considered to have one dimension. An area or polygon is considered to have two dimensions and a surface is considered to have 2.5 dimensions. A volume has three dimensions. A data set representing both space and time is considered to have four dimensions.

0-Dimension Points 1-Dimensional Lines 2-Dimensions

Area/Polygon

2.5 Dimensions 3-Dimensions 4-Dimension

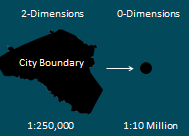
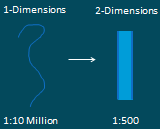
Surface Volume Space & Time



#### Scale

Scale is defined as the ratio at which the earth has been reduced in order to be placed on the map. Scale can determine the dimensionality of the spatial phenomenon. For instance, at a scale of 1 to 250,000, the boundary of the city can be shown with two dimensions because of that scale there is sufficient detail to warrant the use of a more complex symbol.

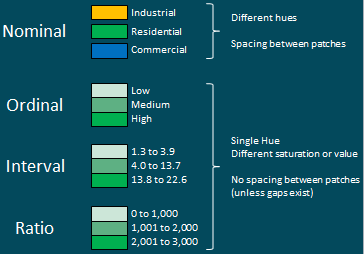
If we zoom out to a scale of 1 to 10,000,000 we can switch the dimensionality of the city boundary to 0 dimensions and therefore can be represented using a point. As another example, at a scale of 1 to 10,000,000, a river will be represented as a one-dimensional object and would be best visualized using a line symbol. However if we zoom in significantly to a scale of 1 to 500 we can see the banks of the river along with the body of the river. Therefore we can represent the river using two-dimensional symbols such as a polygon.

### Level of Measurement

The level of measurement refers to which category the data values fall within: nominal, ordinal, interval, or ratio. If the data is of nominal type, which means that its goal is to uniquely identify items and show them as different from other items, then we should use a different hue for each type of item in the data set. On the legend, there should be spaces between the representative patches to show that there is no continuity between the different types of items in that they are unique.

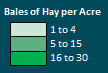
If the data is an ordinal, interval, or ratio type you should use a single hue to represent the items as they are of a single type, but you should vary the saturation or value to represent their change in order or magnitude. In the legend there should be no spaces between the representative patches to represent that the data exists along a continuum. The exception is if the data has naturally occurring gaps, then you would want to include gaps between the patches in the legend.



### There are three types of data and ways to symbolize that data: there is unipolar data, bipolar data, and balanced data.

#### Unipolar Data

Unipolar data is data has no natural dividing point. If we wanted to represent the number of bales of hay per acre there are no meaningful divisions and a continuum of the number of bales of hay. Simply start to 0 bales of hay and increase. For this you will choose a single hue and vary the saturation or value depending on the change of magnitude or order of the data.



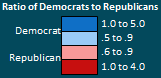
#### Bipolar Data

Bipolar data has a natural and meaningful dividing point. For example if we look at population change between the years 2000 and 2012 we can probably classify each state where it is gained population, had no change in population, or lost population. For bipolar data we should use a divergent color ramp. For the natural or dividing point, it is recommended to choose a gray color, or a color with equal parts saturation of the other two hues on the color.



#### Balanced Data

Balanced data has complimentary phenomena. We can show the ratio of Democrats to Republicans in a voting district. For balance data we should use a divergent color ramp.



## Visual Variables

### What are Visual Variables?

Visual variables are distinctions that we can use to create and differentiate symbols on a map. There are 10 visual distinctions available for symbolization: location, size, shape, orientation, focus, arrangement, texture, saturation, hue, and value. This section will cover each one of these nine distinctions. Nine of the ten visual variables will be discussed in the context of whether it is most useful for qualitative or quantitative mapping.

#### Visual Variable - Location

The location visual variable is the position of the object and the environment. Location can be determined in absolute, relative, or cognitive terms. In any case location determines where in our environment the object exists. No matter whether the data is qualitative or quantitative in nature in order for to be map it must have a location.

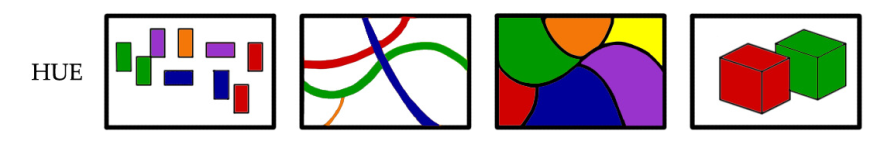
### Qualitative Visual Variables

Qualitative visual variables are used for nominal data. The goal of qualitative visual variables is to show how entities differ from each other. Qualitative visual variables show grouping of similar entities.

#### Hue

Hue, more commonly known as color, represents a wavelength on the visible portion of electromagnetic spectrum. Hue is great for identifying items as unique, or of a type of item. Hue creates a perception of groups, or likeness. The example images show how hue can be applied to data with 0 to 3 dimensions.

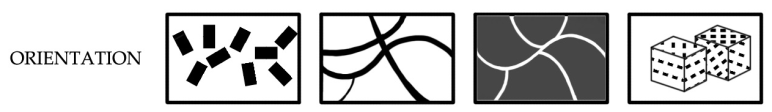




#### Visual Variable - Orientation

The orientation visual variable changes the orientation of the object and creates a perception of group or likeness.





#### Visual Variable - Shape

The shape visual variable identifies an item as unique or of a type. The shape visual variable refers to a point symbol although it can be arranged to resemble a line and placed inside an area or three-dimensional shape. The shape does not have to be a geometric form; it can also be a pictorial form.

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#### Visual Variable – Arrangement

The arrangement visual variable refers to the placement of elements composing a pattern or a texture. Arranging patterns or textures differently can create a perception of a single unique item or a group of items.



#### Visual Variable – Texture

Texture refers to the symbols covering an area. Textures identify items as unique or of a type.

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#### Visual Variable - Focus

Focus represents uncertainty by making the symbols look fuzzy or out of focus. The more uncertain a value is the fuzzier or out of focus it should look.

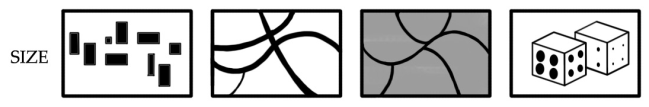
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### Quantitative Visual Variables

Now consider quantitative visual variables. Quantitative visual variables are used to display ordinal, interval, or ratio data. The goal of the quantitative visual variable is to show relative magnitude or order between entities.

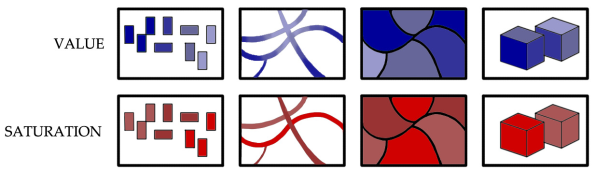
#### Visual Variable – Size

The size visual variable changes the size of the symbol to imply relative levels of importance. Line thickness implies relative flow levels in the case of road traffic, or water flow through a river.



#### Visual Variable – Value, Saturation

The visual variables value and saturation represent different magnitudes or order in a data value. It is important that you only very the saturation or value but not both for a given hue. This represents a single variable, which is represented by a single hue, with different quantitative values, which are represented by a difference in saturation or value.



#### Visual Variable – Focus

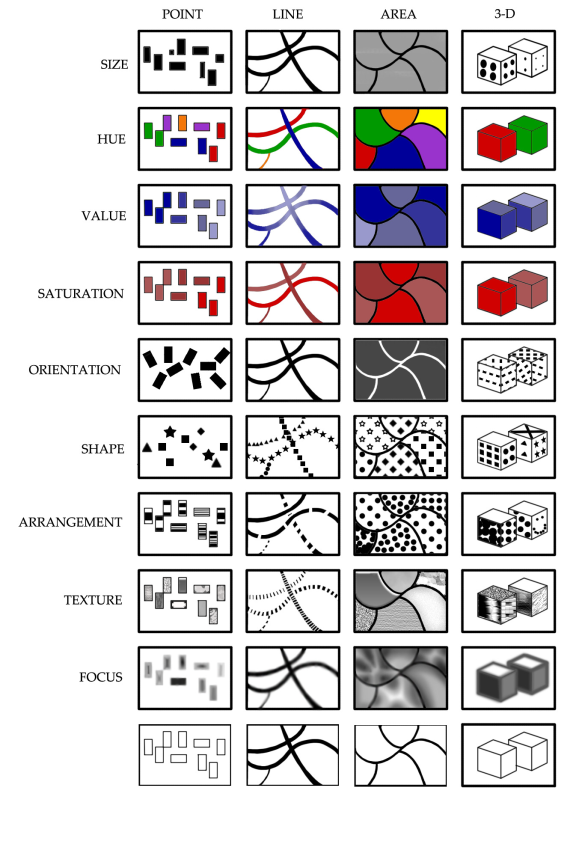
Again, the focus visual variable represents uncertainty in quantitative values.





### Nine Visual Variables

Here are the nine visual variables in a single graphic for you to compare and contrast.



### Matrix

This is a matrix that matches visual variables with attribute types that you can use for reference. The white value represents a poor matching of visual variable and attribute type and therefore, the use of visual variable for that attribute should be avoided. The light grey value represents a marginal matching of the visual variable at the attribute type it should be used with careful consideration. The dark gray value represents a good matching of the visual variable with the attribute type that should be the most common paring.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Interval** | **Ordinal** | **Nominal** |
| **Location** |  |  |  |
| **Size** |  |  |  |
| **Focus** |  |  |  |
| **Value** |  |  |  |
| **Saturation** |  |  |  |
| **Hue** |  |  |  |
| **Texture** |  |  |  |
| **Orientation** |  |  |  |
| **Arrangement** |  |  |  |
| **Shape** |  |  |  |

Good

Marginal

Poor

## Color and Cartography

### Color Principles

Color is an extremely valuable tool to cartographers. Color grabs the attention of your map reader and engages them with your map. Color also provides more design options than black and white printing and allows you to be more expressive and creative with your map creations. To maximize the effectiveness of our maps we must employ color in a proper fashion and beware of the following pitfalls: color complicates the map and makes reproduction more difficult.

Printing in color is quite a bit more expensive the printing and black and white. Additionally if colors are used incorrectly it may only confuse your users or have users perceive the map as being unattractive. People may perceive colors differently depending on their own biases or their culture. So while colors can really increase the effectiveness of our map they must use be with care and careful consideration.

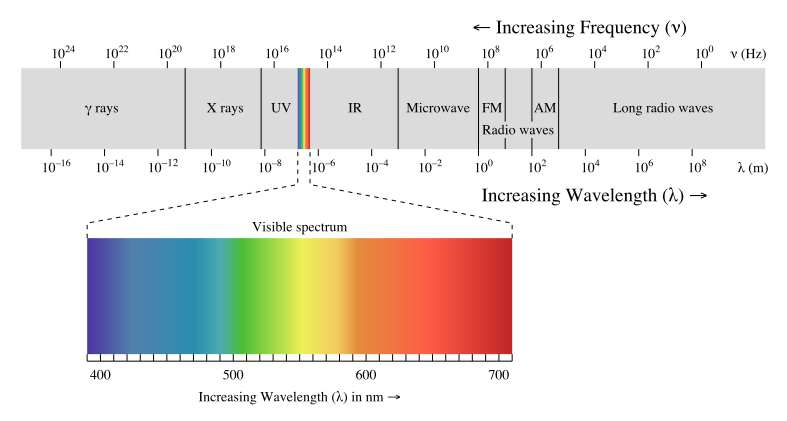
### What is Color?

We will begin our discussion of color with a short video that gives us a tour of the visual portion of the electromagnetic spectrum.

Watch "Tour of the EMS 05 - Visible Light Waves" (4:50)

### Electromagnetic Spectrum

To review, the visible portion of the electromagnetic spectrum is where we perceive colors as they differ in wavelength. The visible spectrum has longer wavelengths than ultraviolet, x-rays, and gamma rays, and has shorter wavelengths than infrared, microwave, radio waves, and long radio waves. Within this visible spectrum, we can compose any color we want to be used on a map.



### Two Color Modes

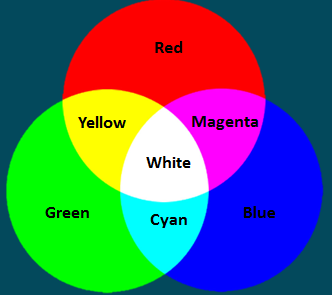
There are two modes of color: the illuminant, and reflective. Illuminant color requires a light source and an eye brain system. Examples of illuminant color are a computer monitor that illuminates light and color, and the human eye that senses those colors. The reflective motive color requires a light source, an object, and an eye brain system. An example of the reflective system is a sun that provides the light, a tree which is the object, and the eye that will sense the sun’s light source that reflects off of the tree.

## Two Color Theories

### Additive Color

Additive color is light made up of red, green, and blue which is commonly shortened to RGB. The idea is that we combine the red green and blue values to make all of the other colors. In the additive color theory red, green, and blue are considered the primary colors as they cannot be made by combining any other colors. RGB is used by monitors, TVs, movie films, your telephone screen, and other similar devices.

This is a Venn diagram showing how red, green, and blue work together to create other colors. If the maximum values of red, green, and blue are used white is produced. If no red, green or blue light is produced then the color black occurs. If you only combine red and green, then the color yellow is created. If you combine red and blue, the color magenta is created. And if you only combine green and blue, the color cyan is created.

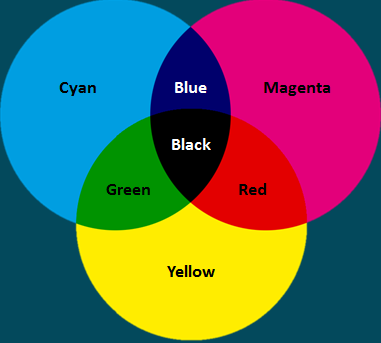


### Subtractive Color

Subtractive color is where light reflectance is reduced by ink. Magenta, cyan, and yellow which is often shortened to CMY, are the primary colors in the subtractive color theory. You combine CMY values to create other colors by reducing which light waves are reflected. Magenta, cyan, and yellow are used in print.

This is a Venn diagram showing how cyan, magenta, and yellow, the primary colors of subtractive color theory, work together to create other colors. If the maximum values of yellow, cyan, and magenta are used, then no light is reflected off the, and black is the resulting color. If you do not use any yellow, cyan, or magenta, then the resulting color is whatever color the medium is.

For instance, if you are using a green sheet of paper and you do not add any cyan, yellow, or magenta ink the result will be green, which is the color of the paper. If you combine cyan and yellow only, you get the color green. If you combine the color cyan, and magenta only, you get the color blue. If you combine the color magenta, and yellow, you get the color red. Notice that the combination of the three primary colors in the subtractive color theory which are the three primary colors in the additive color theory and vice versa.



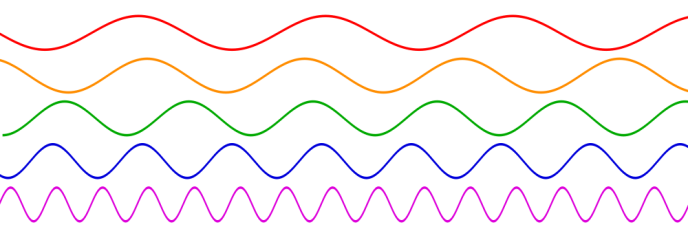
## Components of Color

This section will cover the various components of color: hue, saturation, and value.

### What are Components of Color?

#### Hue

Hue is the name that we give to colors. Some common color names are red, orange, green, blue, and violet, among others. In the electromagnetic spectrum each hue has its own wavelength. The wavelengths generally run from the color red which is the longest wavelength to violet which has the shortest wavelength.



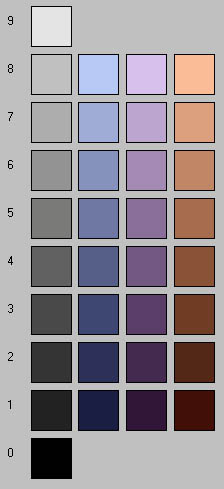
#### Saturation

The second component of color is saturation. Saturation is also known as chroma, intensity, or purity. Chroma represents how intense the color is for a particular hue. Saturation is specified in percentages where 0% represents a neutral gray, and 100% represents maximum color. Sometimes it is useful to think about saturation as determining how much great use in a color.

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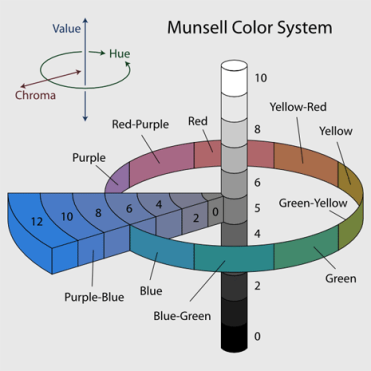
#### Value

The value component of color represents the quality of lightness or darkness in a hue. Value is often considered to represent the shades of a hue. Value is specified in percentages were 0% represents a light neutral gray, and 100% represents the color black.

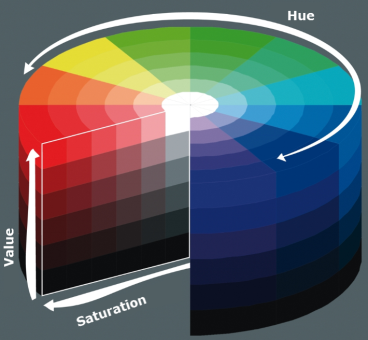
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#### Munsell Color System

To help you understand how hue, value, and saturation, commonly referred to as chroma, work together learn about the Munsell color system. The column in the center represents the value and it ranges from a pure light color only down to a dark color to black. As you move away from the value outwards you increase the chroma which increases the intensity of a color away from the neutral gray. As you rotate around the value you change the hue.

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This image is another visualization of the three components of color in the format of the color wheel.

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## Color Models

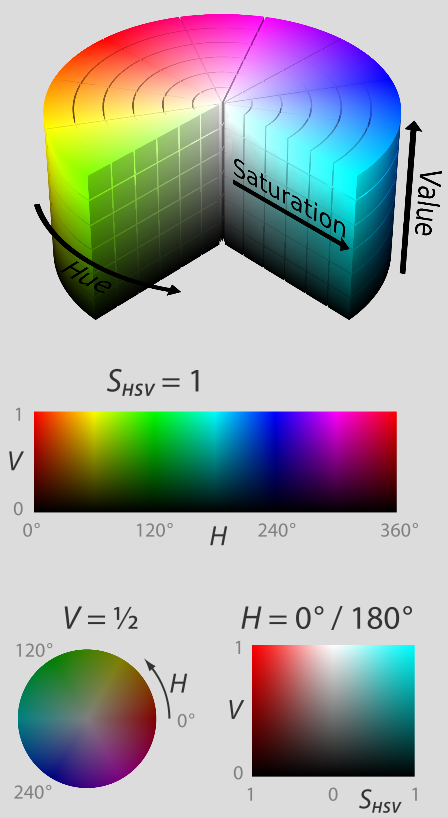
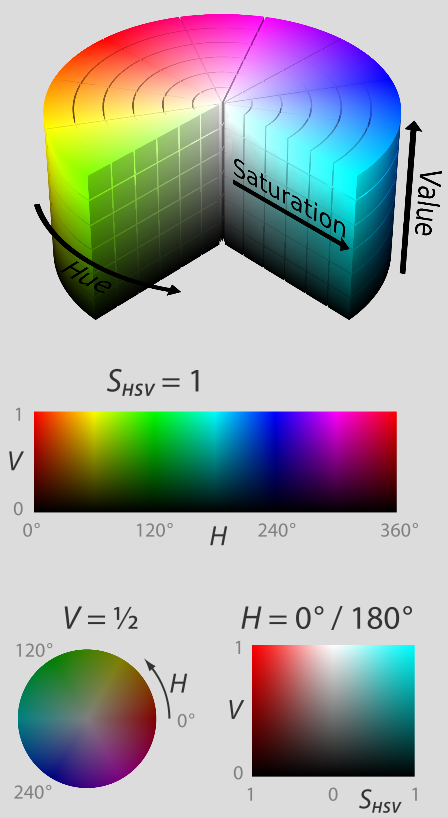
### What is a Color Model?

A color model is an abstract mathematical model describing the ways colors can be represented by numbers. There are six common color models used today: HSV, HSB, HSL, RGB, CMYK, CIE Lab, and Grayscale. Many GIS and mapping software packages support the majority of these color models.

### HSV

The HSV color model refers to the components of color which are hue, saturation, and value. In the HSV color model hue is measured between the numbers 0 and 360. Saturation is measured from 0% to 100%. Value is measured from 0% to 100%.

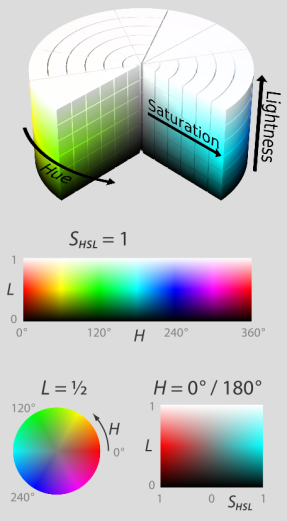
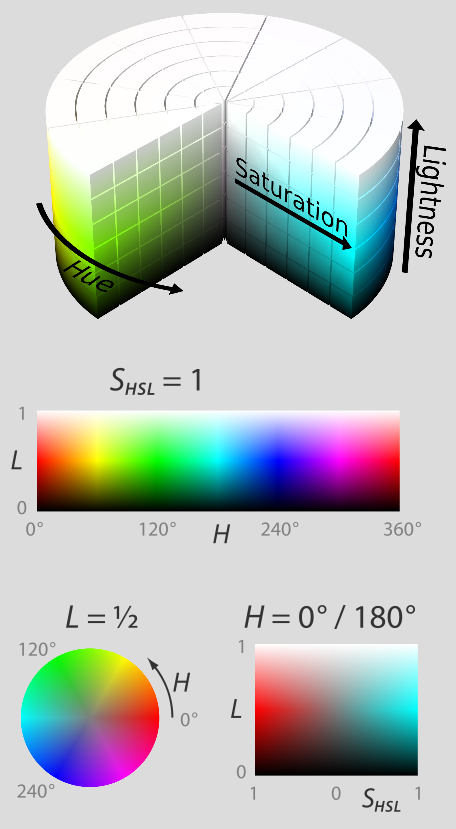
Perhaps HSV is best visualized as a color wheel. As you move around the color wheel you change the hue between the values of 0 and 360. As you move outwards from the center of the color wheel you increase the saturation between 0% and 100%. And as you move for the bottom of the color wheel to the top of the color wheel you increase the value between 0% and 100%. A few other common visual representations of the HSV color model are included here for you to review.

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### HSB/HSL

The HSB and HSL color models are similar to the HSV color model. The difference is that the B in HSB refers to brightness and references black to indicate how much light is received. The L in HSL refers to lightness and references white to indicate how much light is reflected.

Here are the visual representations of the HSL color model. The main difference between the HSL color wheel and the HSV color wheel is that instead of value increasing from the bottom of the color will to the top the lightness increases from the bottom of the color wheel to the top. The HSB color model visualization is the same as the HSL color model visualization except that lightness is replaced with brightness.

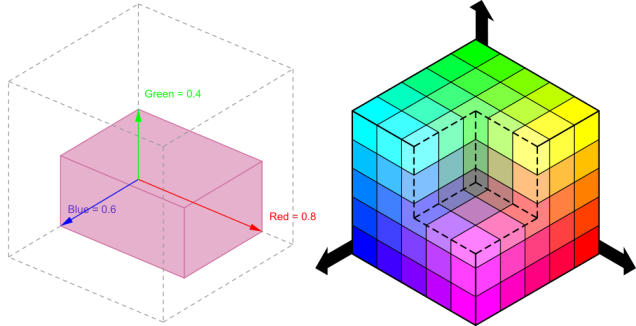
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### RGB

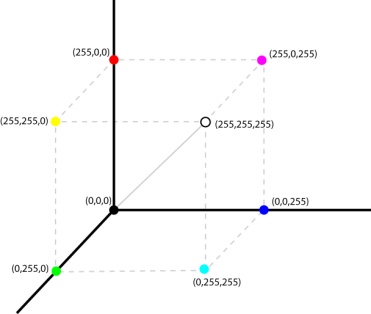
The RGB color model refers to the primary colors in the additive color theory which are red, green, and blue. The RGB color model uses 256 distinct numbers ranging between the values of 0 and 255 to determine how much red, green, and blue will be used to define the color. When there is a value of 0 it means that none of that color is included. When there is a value of 255 it means that the maximum amount of that color is included. The RGB color model can produce over 16 million colors. The RGB color model should be used when the output of a map is on a computer screen, TV, or film, as these devices natively use the red, green, and blue color model to display colors.

### RGB Cube

This is a visualization of the RGB color model as a cube. Each axis represents one of the three primary colors in the additive color theory and RGB color model. As you increase the values along these three axes either independently or together you can create any of the other 16 million possible colors available in this color model.



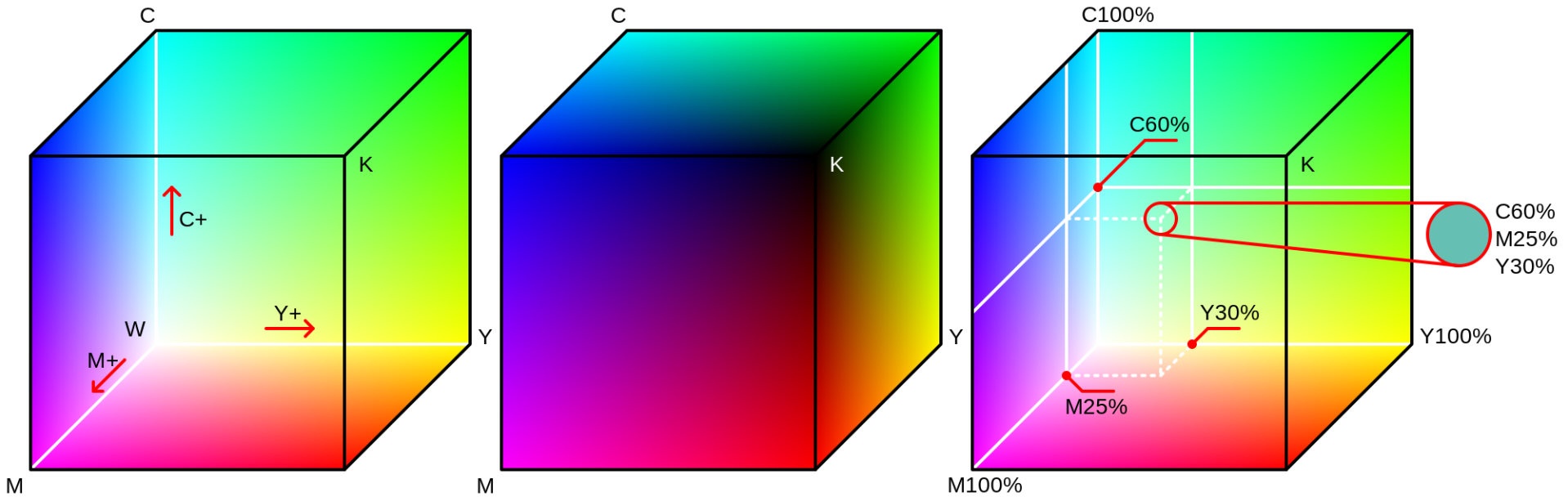
Remember that in the RGB color model colors are represented by three numbers ranging between 0 and 255. In this visualization the first number represents red, the second number represents green, and the third number represents blue. The RGB value of 0, 0, 0 represents the color black. The RGB value of 255, 255, 255 represents the color white. Notice that when you combine the maximum amount of only two of the three colors you produced the primary colors of this additive color theory.

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### CMYK

The CMYK color model refers to the subtractive color theory CMY. The CMYK color model specifies each cyan, magenta, and yellow color in percentages from 0% to 100%. The K in CMYK refers to the color black and is specified because impurities in ink may not create a pure black; therefore, many printing devices include a separate ink canister for the color black. You should use the CMYK color model when you are printing a map on a tangible medium.

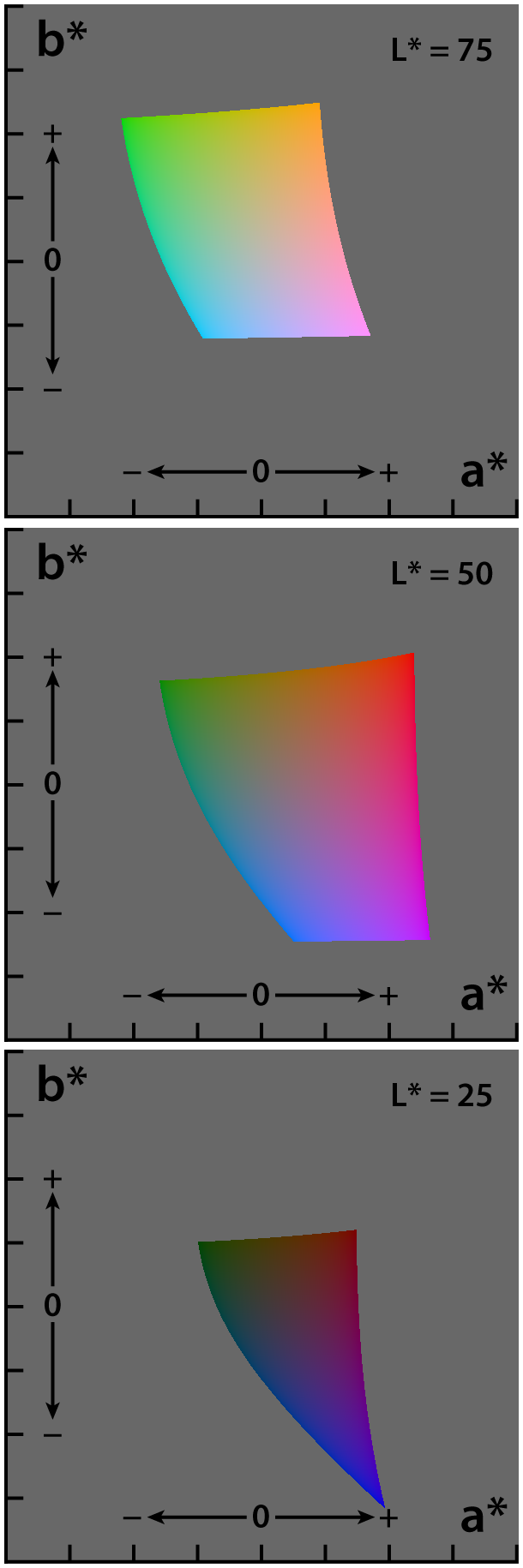
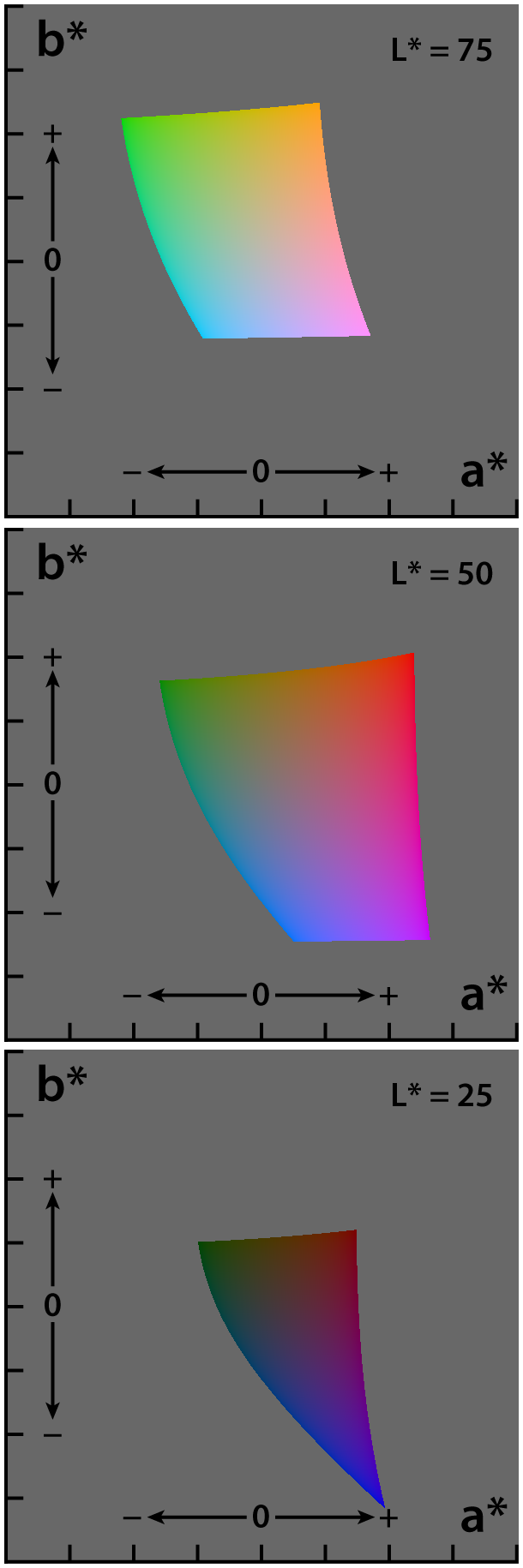
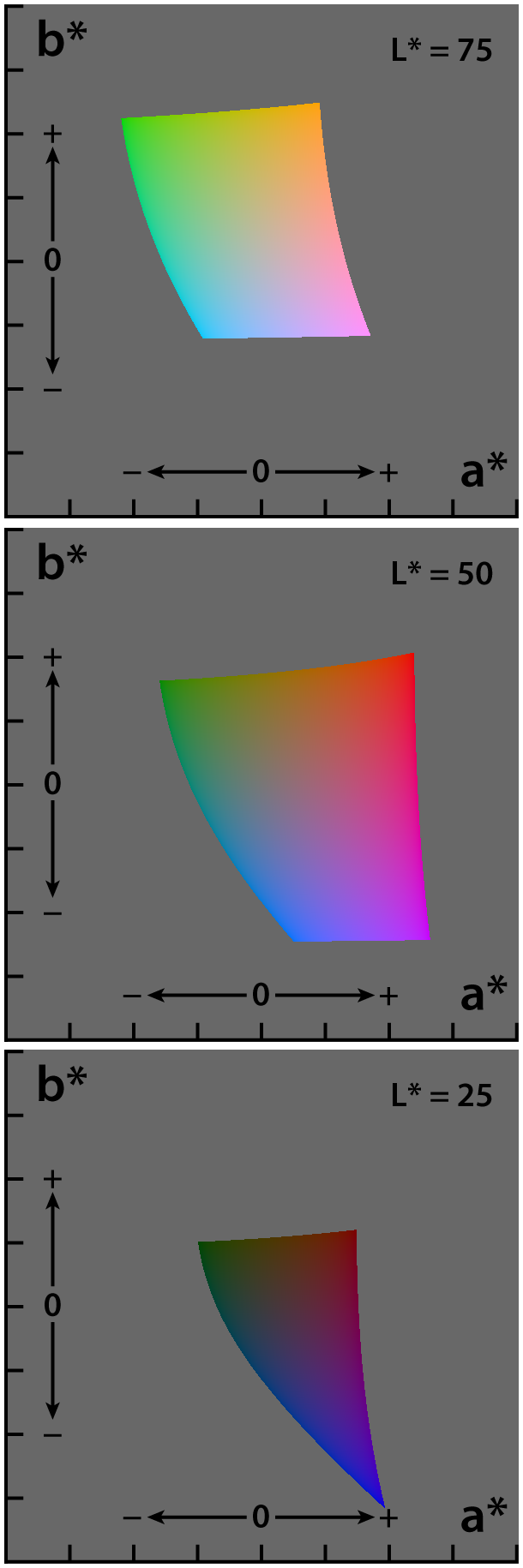
These images are a visualization of the CMYK color model represented as a color cube. Each axis represents one of the three primary colors in the subtractive color theory. A value of all 0% represents the color white, or the color of the tangible production medium. Values of all 100 represent the color black. As you increase the values along the 3 axes either independently or together you can create any of the other possible colors available in this color model.



### CIE L\*A\*B

The CIE lab color model describes colors as perceived by the human eye. This color model represents color using three values. The first value is for L which represents lightness of the color between black which is represented by the value of 0 and white which is represented by the value of 100. The second value is a which represents the relative position between magenta which has a value of positive 100 and green which is a value of negative 100. The third value in this color model is B which represents the relative position of the color between the yellow which is represented by the value of positive 100 and blue which is represented by the value of negative 100.

Here are three example visualizations showing how the values for L, A, and B work together to create color. On the left, the L value is at 75 which mean that it is closer to the color white. As a values for A and B change, unique colors are created. On the middle image the L value is 50 which mean that it is halfway between white and black. Again, as the values for A and B change, unique colors are created. And finally, on the right image the value for L is 25 which means that it is closer to black. As the A and B values change or unique colors are created.

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### Grayscale

The grayscale color model presents different shades of black. If the map is going to be presented in an achromatic fashion then you should using the grayscale color model as it will not introduce any color into the print, only intensities of light between black and white. If you choose to use the grayscale color model it is recommended that you limit the number of grayscale levels to six or seven at a maximum. The reason to limit the number of grayscale levels is at humans have a hard time differentiating levels of gray if there are more than six or seven on the map.

This is a visualization of the grayscale color model. The amount of black or white available to grayscale model can be specified multiple ways. There are two common ways of specifying the shade of gray: between the value of 0 which represents black and the value of 100 which represents white, where the value of 0% which represents white and the value of 100% which represents black.

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### Color Translation

Ideally you will choose which color model to work with when you begin your map design process. However, should you need to convert between different color models, you need to be aware that not all colors translate well between the color models. For instance, if you choose to create a map that will ultimately be printed on a piece of paper it is recommended that you initially choose the CMYK color model to create a map. Had you initially chosen the RGB color model in the later converted the colors to the CMYK color model, you may find that the colors did not translate as well as you had hoped and the printed product is different than the designed product.

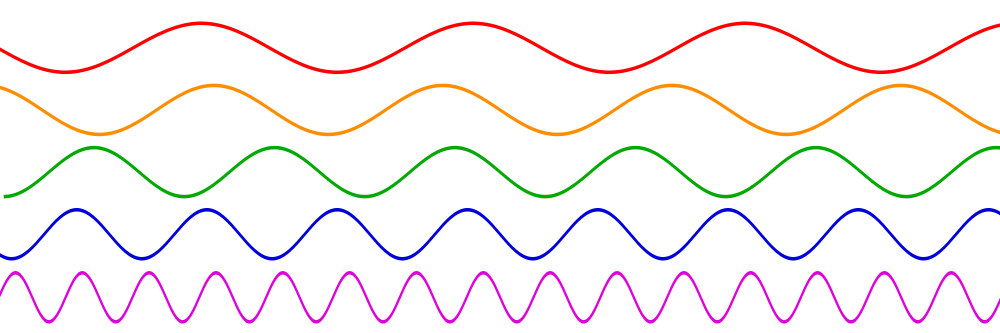
## Subjective Reactions to Color

### Color Preferences

There are various methods to determine color preferences depending on your audience and type of map you are working to create. This section will provide some information you should consider before determining your color strategy.

#### Warm and Cool Colors

Colors can probably be classified into warm colors and cool colors. Warm colors tend to have longer wavelengths and cool colors tend to have shorter wavelengths.



#### Advancing and Retreating Colors

Colors can also be classified as advancing colors or retreating colors. Advancing colors appear to be closer to you. Advancing colors have longer wavelengths high values and high saturations. Retreating colors appear further away from you and they have a longer wavelength low values and low saturations.

#### Young Children

When you are making a map for young children you should keep these color preferences in mind. Young children tend to prefer warm colors. Red is the most popular color followed by blue and green. Young children tend to prefer high saturation colors until about the 6th grade when saturation can be toned down.

Young children are only aware of a small range in a hue; therefore, you should not use two hues that are similar in color if you wish the hues to be perceived as distinct. Young children dislike attractive colors. They also tend to reject achromatic color schemes, where achromatic refers to a grayscale color scheme. Young children also prefer expected colors which means that they expect water to be blue, parks to be green, and roads to be black, for instance.

#### Adults

Adults favor colors with shorter wavelengths. Greenish yellow is the adult’s least favorite hue. Women prefer the color red over blue, and the color yellow over orange. Men prefer blue over red, and orange over yellow. Adults prefer saturated colors. Adults most to least favorite colors in order are blue, red, green, violet, orange, and the least favorite yellow.

### Color Conventions

While it is nice to design your map in line with the color preferences of your audience, general color conventions should overrule the broader color preferences. This means that, you should not buck common trends such as making water any other color the blue, or a cool color to represent danger when warm colors and especially red conventionally represent danger.

### Colors in Combination

You must careful when you use colors in combination. Colors have an interesting way of affecting each other when they are placed in proximity and can create a disjointed, confusing, and ugly map. Background colors should be light or dark and not intermediate colors. Consistently pleasing object colors are hues and the green to blue range and others use with very little gray, which means they will have higher saturation values.

Consistently unpleasant colors are hues in the yellow to yellow-green range and other hues with a large amount of gray, which means low saturation. The color of the focus objects must stand out from the color of the background. This is referred to as having a good figure to ground relationship. Vivid colors combined with great colors are judged to be a pleasant combination.

### Connotative Meanings of Color

There are many connotative meanings of color and they can vary greatly across different cultures. In the United State, these are commonly agreed-upon connotative meanings of color.

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| --- | --- |
| **Color** | **Connotations** |
| Yellow | Cheerful, dishonest, youth, light, coward, joyous, spring, warning |
| Red | Blood, fire, danger, power, loyalty, bravery, anger, strong, action |
| Blue | Silence, depression, truth, purity, formality, cold, depth |
| Orange | Fire, attention, action, fall, harvest, abundance |
| Green | Money, spring, nature, envy, jealousy, peace, youth |
| Purple | Dignity, royalty, despair, richness, elegant, painful |
| White | Clean, strong, mourning, heaviness |
| Black | Mourning, heavy, strength, mystery, death, deep, dark |
| Grays | Controlled, quiet, reserved, neutral |

## Color in Cartographic Design

### Cartographic Color Conventions

In cartography there are some commonly considered color conventions that you should generally follow. The first is that water is commonly blue. Unless the map is highly stylized, water should almost always be blue on a map. Forests, parks, or representations of any other green space are commonly green on a map. Red should represent hot temperatures, and blue should represent cold temperatures. Yellows and tans should represent arid regions. Browns and greens and other related earth tones typically represent land surfaces.

### Functions of Color in Design

We use color in map design to provide structure, readability, and psychological reactions to maps. If color is used well, it can greatly increase the attractiveness and usefulness of our map. Conversely, if colors used poorly, are maps will seem unattractive and untrustworthy to our users.

### Figure to Ground Relationship

The use of color cartographic design can allow us to produce strong figure to ground relationships. Color provides contrast between the background, which we consider a ground, and the focus of the map, which we consider the figures. Our wish is to have the figures be immediately visible and interesting to the user while the ground is useful for surrounding and contextual information. Similar hues, brightness, and saturation values are perceived to be grouped items. Warm colors represent figures better than cool colors.

Stronger colors should be selected for smaller areas to compensate for the smaller areas of the cover. If a large area of the map is covered by a high value, high saturation warm color, it may detract from the smaller areas and overpower the map. We can also use whitespace, or lack of color, to help establish a figure ground relationship an organization by allowing the user to focus on individual components of a map that are separated by the whitespace.

#### Poor Figure to Ground Examples

In these two examples there are poor figure to ground relationships. While there is a significant contrast between the figure and the ground they both compete for the height equally and it is difficult to determine where the land features are and where the water features are. For your reference, both these maps are of the Gulf of Mexico.

**Poor** 

**Poor** 

#### Figure to Ground Examples

The example on the left represents good figure ground relationship. South America is represented with a high saturation high value color in the ground is a cool devalued blue. The example on the right is an example of poor figure to ground relationship since both South America and the water have similar values even though the user is different. Colors of a similar value tend to be grouped together and it makes it hard for the eye to differentiate between the two.

**Good Poor**

#### Good Black and White and Color Examples

These last two examples show good figure to ground relationships using either black and white printing or color printing. On the left the color white is chosen for South America because it is visually more demanding than the color black. Therefore the water, which is black in this case, is considered to be a good ground. On the right, just as we saw in the previous slide the color chosen for South America is a strong hue with a high saturation and value which is significantly different than the white blue.

**Good – Black and White Good - Color**

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## SUMMARY

In this lesson the materials provided a context on map symbols and visual variables. You learned about map symbols, visual variables, and color as they relate to cartography. The lesson also provided information on two color theories, components of color and color models. You learned why you need to consider your audience and subjective reactions to color as it will help in the map creation process.

## ASSIGNMENTS

1. Quiz: Map Symbols and Visual Variables
2. Lab: Using Color on a Map Effectively