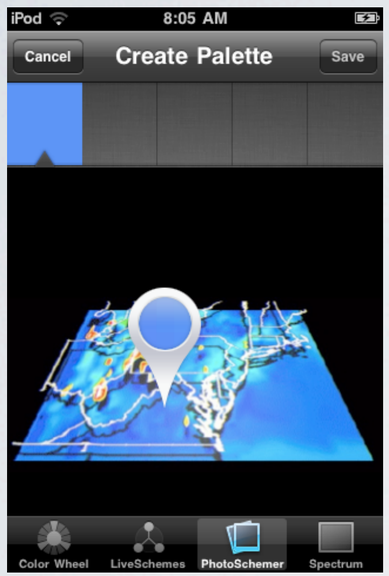
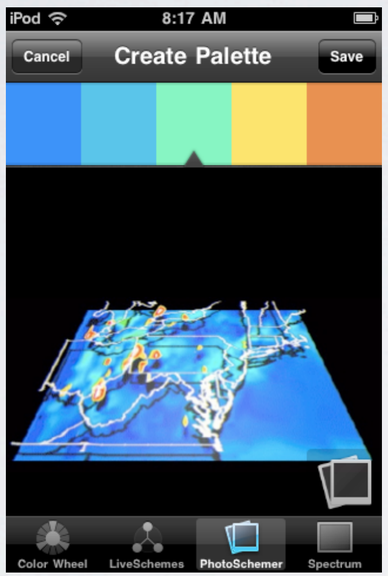
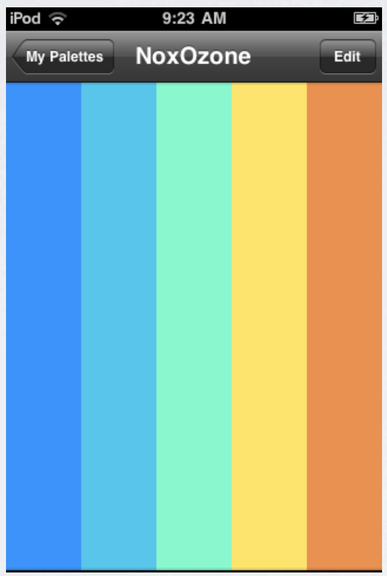
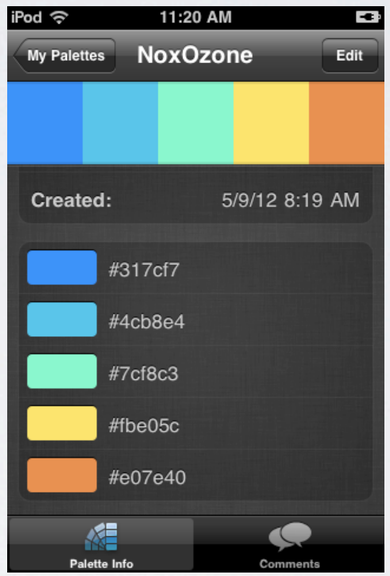
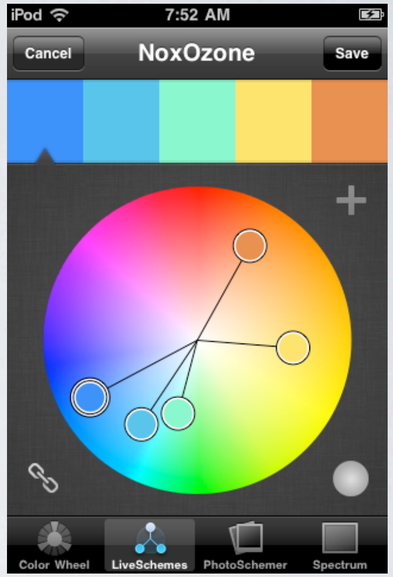
APPLYING COLOR THEORY TO DIGITAL MEDIA & VISUALIZATION











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IN THIS TUTORIAL, WE HIGHLIGHT 5 TOPICS:

- Additive and Subtractive Color Models.
- Defining Color Gamut, Spaces and Systems.
- Selected Artistic Movements related to Color Theory.
- Case Studies pertaining to Colorizing Visualizations.
- Hands on Workshop using Online & Mobile Color Tools.

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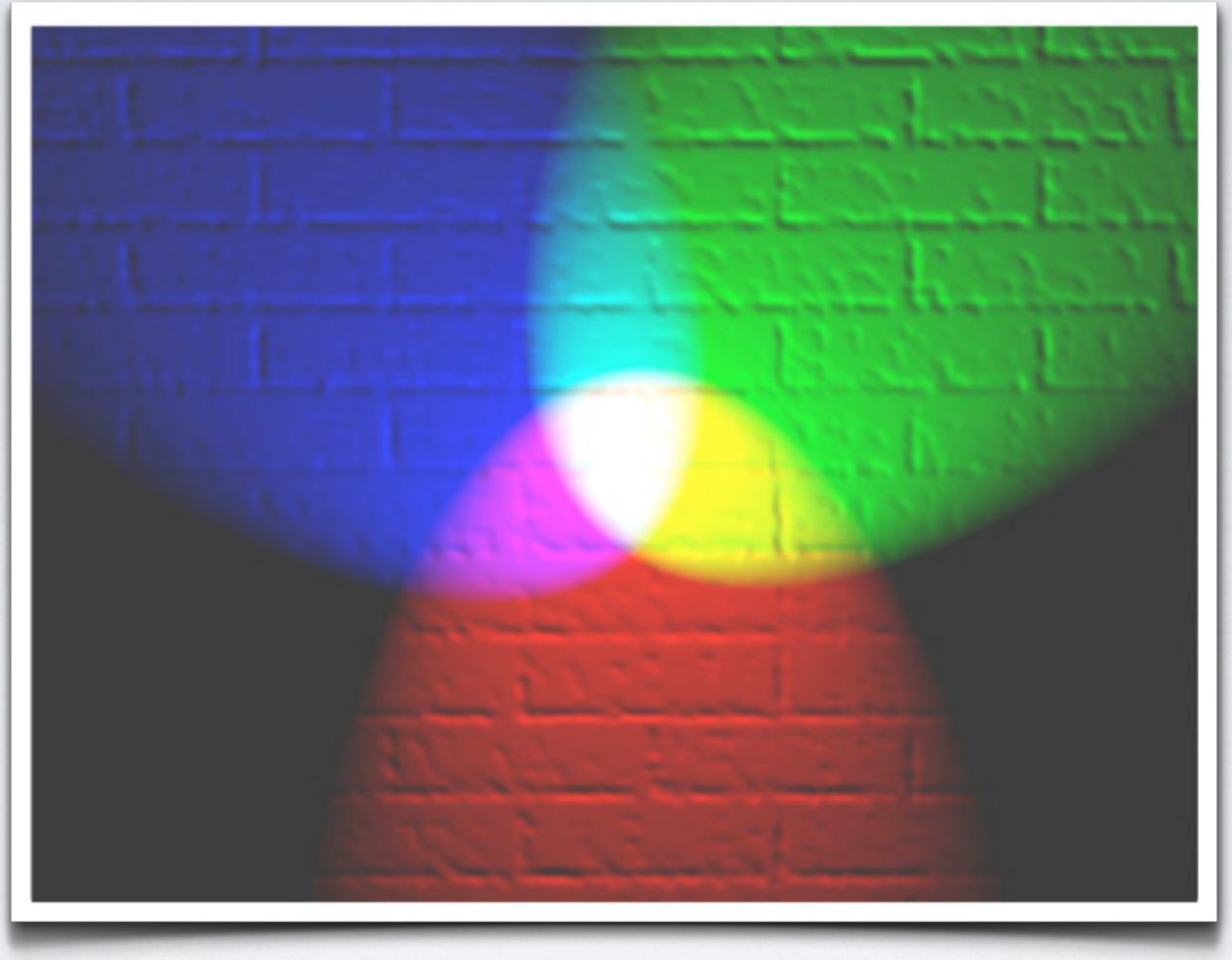
FIRST, LET'S START OUR TUTORIAL WITH A REVIEW OF ADDITIVE AND SUBTRACTIVE COLOR MODELS:

- Red, Green Blue (RGB) - adding colors with light as seen on our color display monitors and with digital cameras.

- Cyan, Magenta, Yellow and Key Black (CMYK) - subtracting colors with ink as seen from high resolution printouts and with our local printing devices.

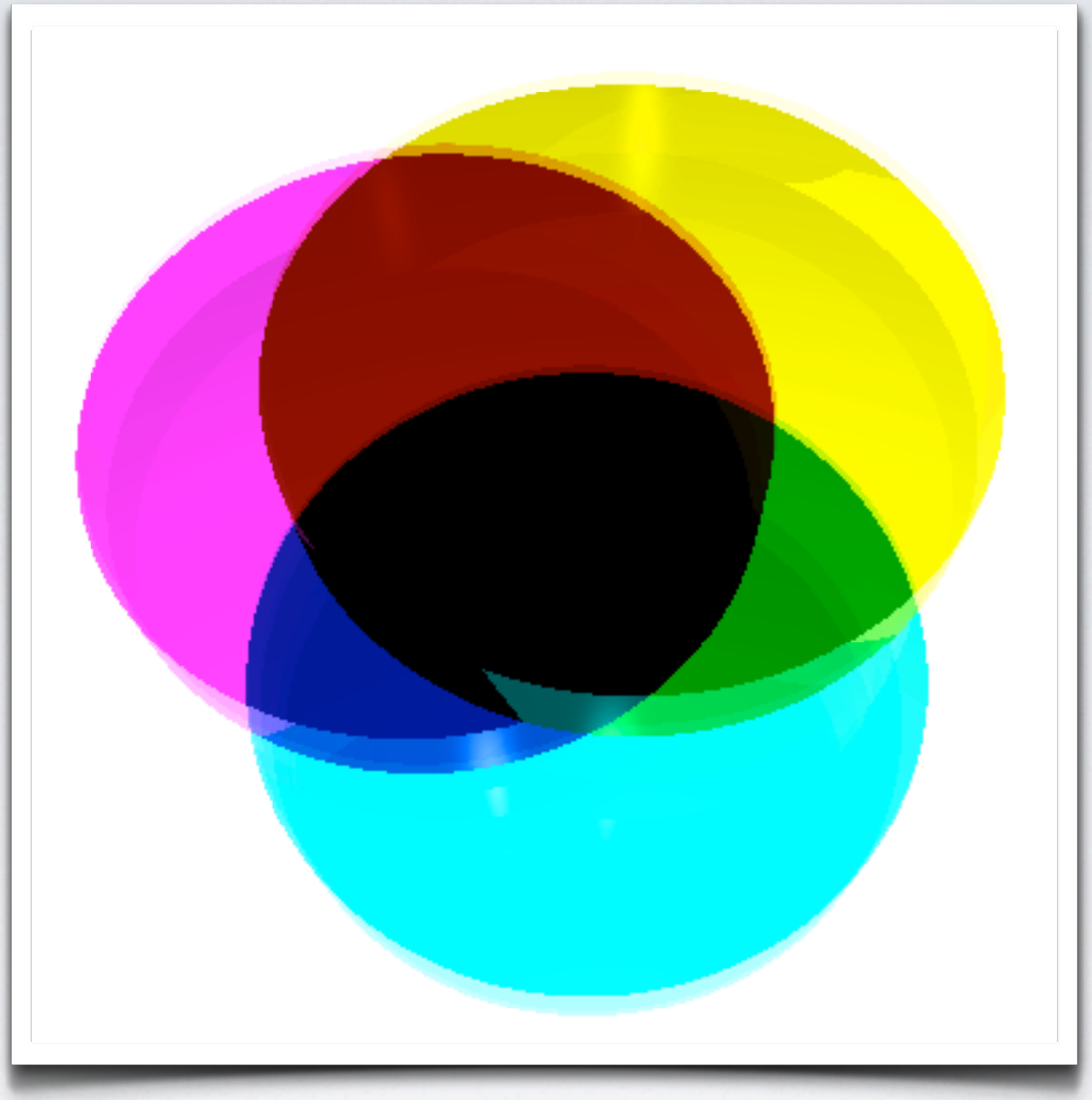
- Red, Yellow and Blue (RYB) - subtracting colors with paint when we use a real paintbrush, crayons or makers.

RED, GREEN AND BLUE (RGB) - THE ADDITIVE COLOR MODEL OF LIGHTS:



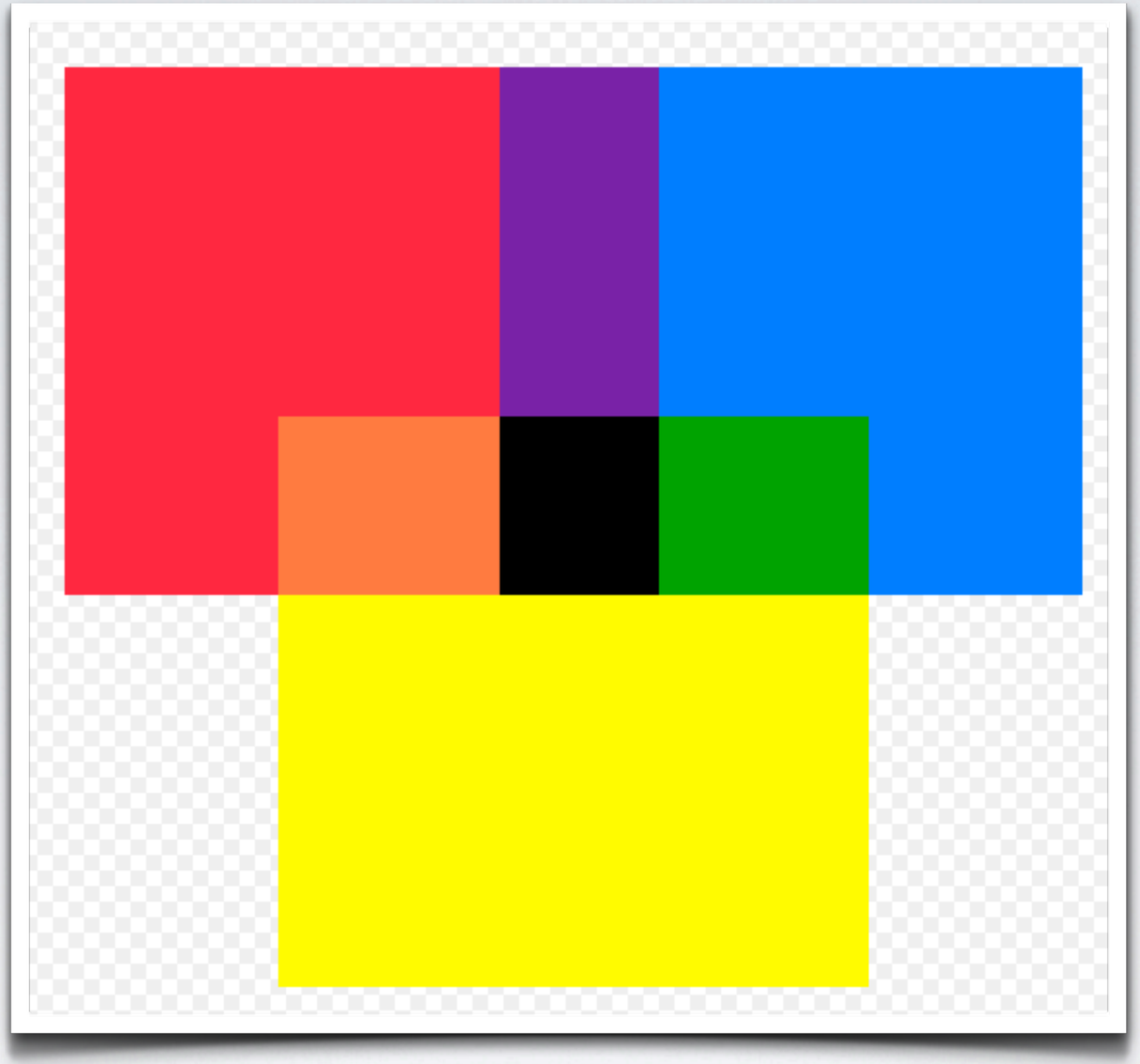
Red, Green and Blue lights showing secondary colors. Open Source Image available at WIkipedia and created by en:User: Bb3dxv, see: http://en.wikipedia.org/wiki/File:RGB_illumination.jpg.

CYAN, MAGENTA,YELLOW AND KEY BLACK (CMYK) - THE SUBTRACTIVE COLOR MODEL OF PRINTING:



Layers of simulated glass show how semi-transparent Cyan, Magenta and Yellow colors combine on paper. Open Source Image available at WIkipedia and created by Mirsad Todorovac, see: http://en.wikipedia.org/wiki/File:Color-subtractive-mixing-cropped.png.

RED, YELLOW, AND BLUE (RYB) - THE PAINTER'S SUBTRACTIVE COLOR MODEL:

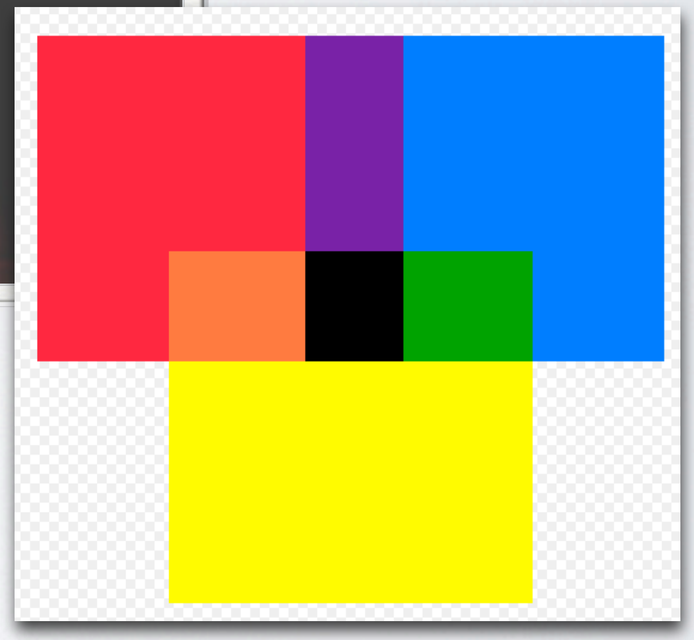


Mixture of Red, Yellow and Blue primary colors used in art and design education, particularly in painting. Public Domain image available at WIkipedia and created cflm, see: http://en.wikipedia.org/wiki/File:Color_mixture.svg.

VISUALLY SUMMARIZING COLOR MODELS:

RGB adds with lights.

CMYK subtracts for printing.



RYB subtracts to mix paints.

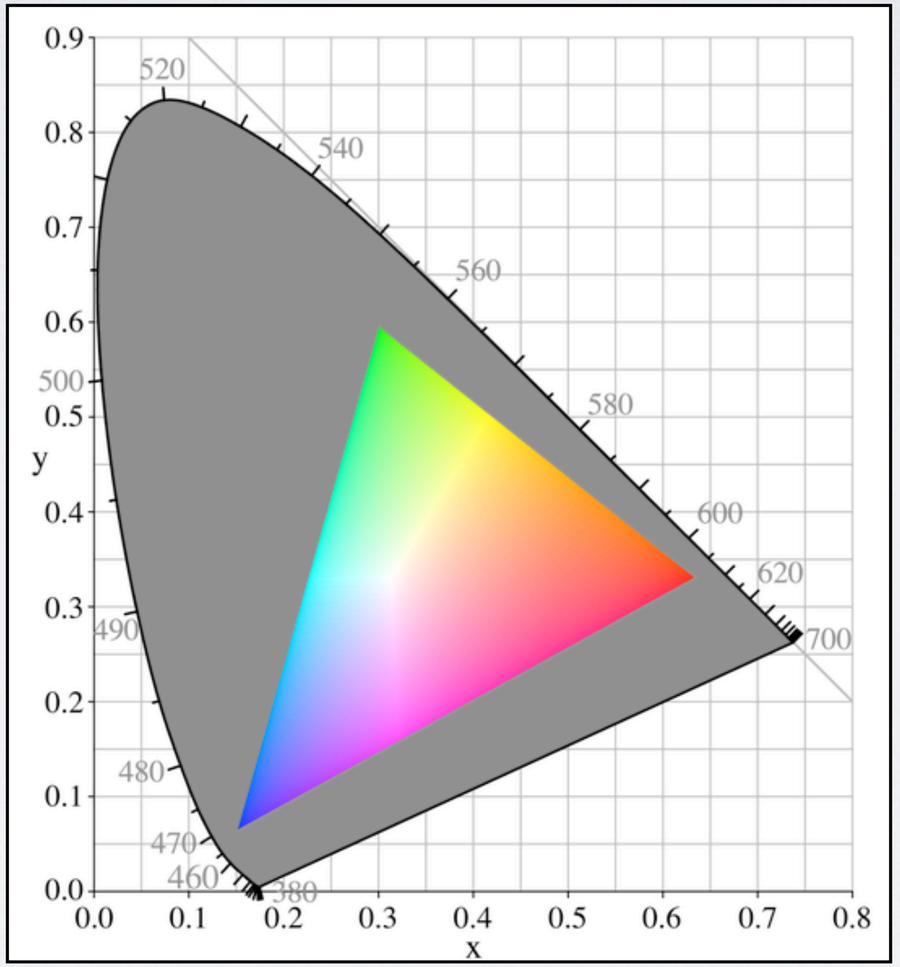
SOMETIMES OTHER COLOR MODELS ARE DEVELOPED TO SUPPORT SPECIFIC OUTPUT DEVICES:

- **Hexachrome (CMYKOG) - six color printing process once used: Cyan, Magenta, Yellow, Key Black, Orange and Green.**

NEXT, WE DEFINE SOME COLOR TERMINOLOGY:

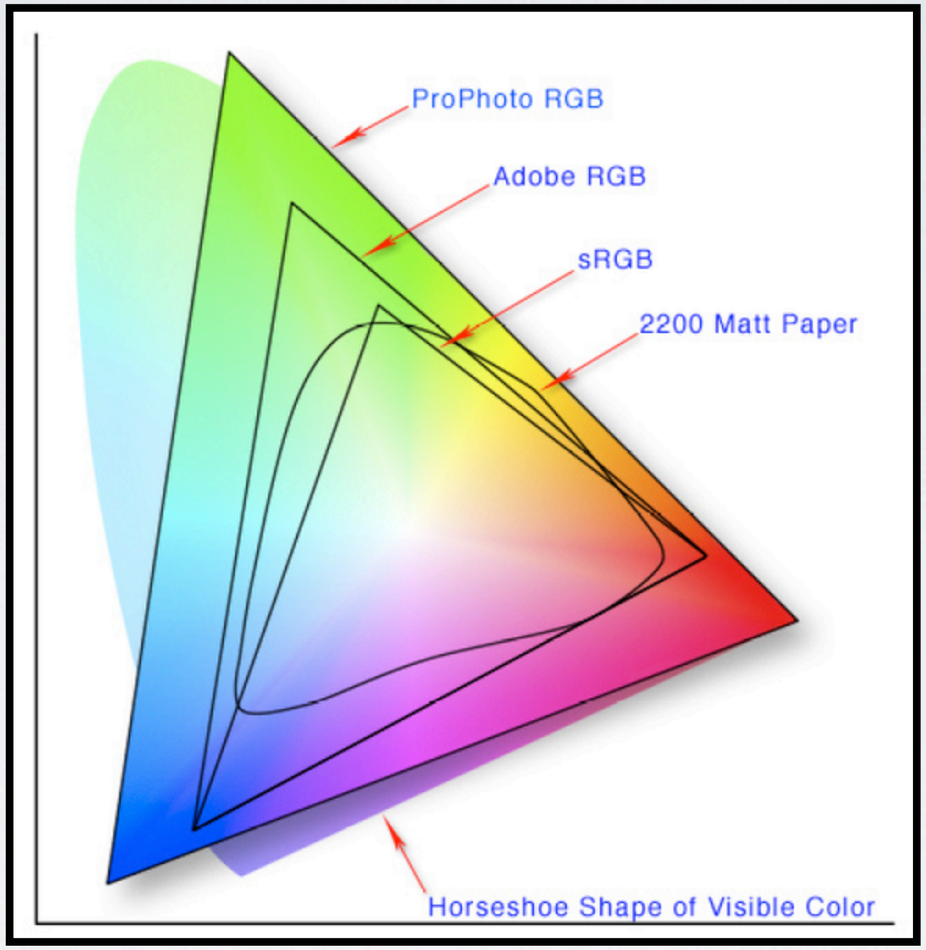
- Color Model + Color Gamut = Color Space.
- International Commission on Illumination Color Space (CIE XYZ).
- Munsell Color System.
- Pantone Color Matching
- Web Colors: Hex Triplets
- Hue, Saturation, Value (HSV)
- The Color Wheel and Color Schemes

COLOR GAMUT: THE SUBSET OF COLORS THAT CAN BE ACCURATELY REPRESENTED IN A GIVEN CIRCUMSTANCE.



The Color Gamut of a typical computer monitor. The grayed out portion represents the entire color range available. Open Source Image available at WIkipedia and created by Hankwang, see: http://en.wikipedia.org/wiki/File:CIExy1931_srgb_gamut.png.

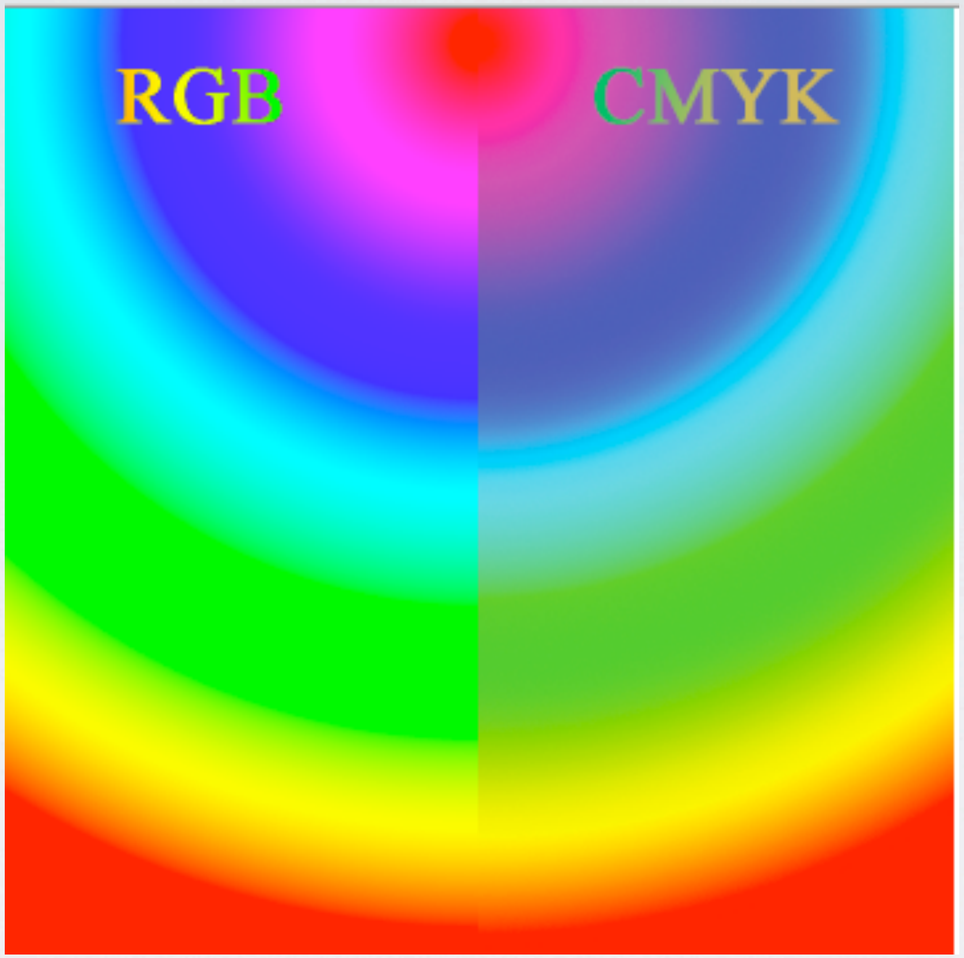
COLOR MODEL + COLOR GAMUT = COLOR SPACE.



RGB MODEL + COLOR GAMUT = COLOR SPACE

Comparison of the color spectrum (shown as the large oval in the back) with RGB color spaces. This image shows that an Epson 2200 printer can produce colors outside sRGB and Adobe RGB color spaces. Open Source Image available at WIkipedia and created by Jeff Schewe, see: http://en.wikipedia.org/wiki/File:Colorspace.png.

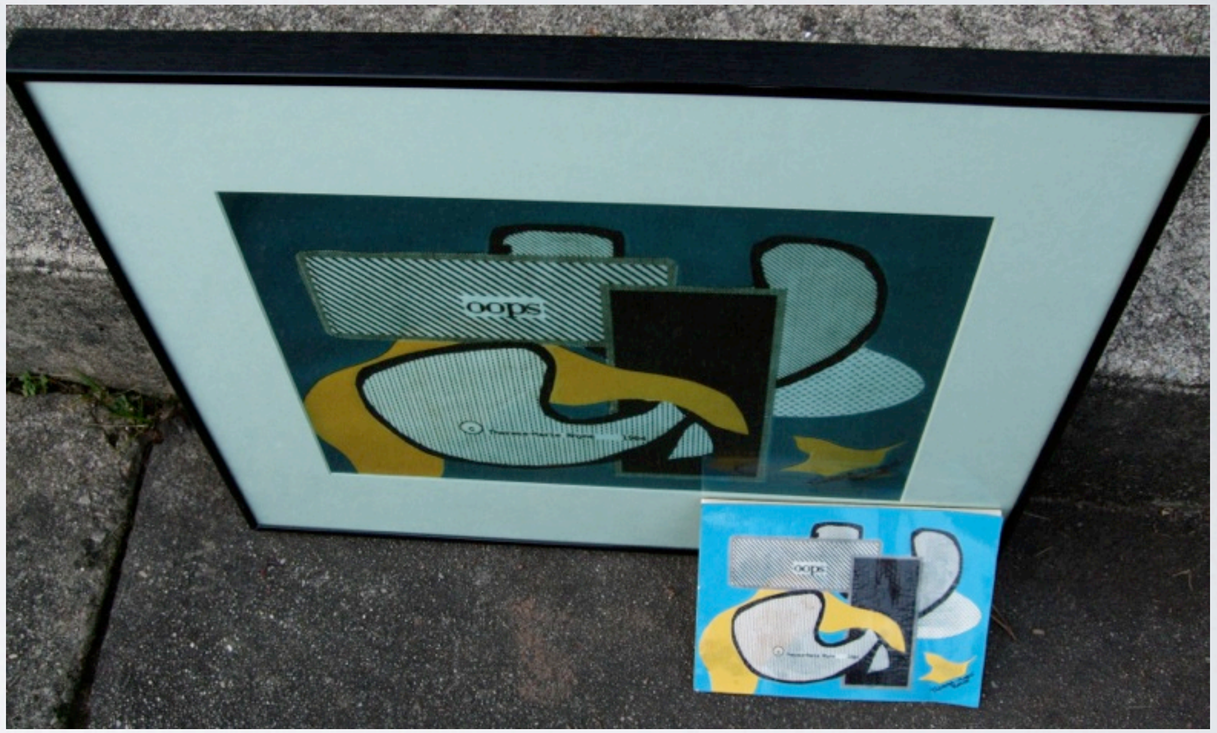
COMPARISON OF RGB & CMYK COLOR SPACES



Comparison of the RGB and CMYK colors models. This image depicts the differences between how colors appear on a color monitor (RGB) compared to how the colors reproduce in the CMYK print process.

Public Domain Image available at WIkipedia and created by Annette Shacklett, see: http://en.wikipedia.org/wiki/File:RGB_and_CMYK_comparison.png.

SOME REAL WORLD COMPARISONS OF COLOR SPACES.



CIBACHROME (ILFOCHROME) PHOTOGRAPH VERSUS PAPER COLLAGE

Comparison of imagery from two color collage studies. The original collages were made by cut and pasting colorful papers together. Later a 35mm slide was taken of the paper collage and a Cibachrome (Ilfochrome) color print was created from the slide image. Notice the differences between the final colors of the paper imagery and the photograph imagery. Imagery created by Theresa-Marie Rhyne.

SOME REAL WORLD COMPARISONS OF COLOR SPACES.

COMPARISON OF COLOR PRINTOUTS AND COLOR PHOTOGRAPHS

Here, we show two examples that compare an original color printout of a digital image with a photograph of a 35mm slide of the same digital image. Imagery created by Theresa-Marie Rhyne.

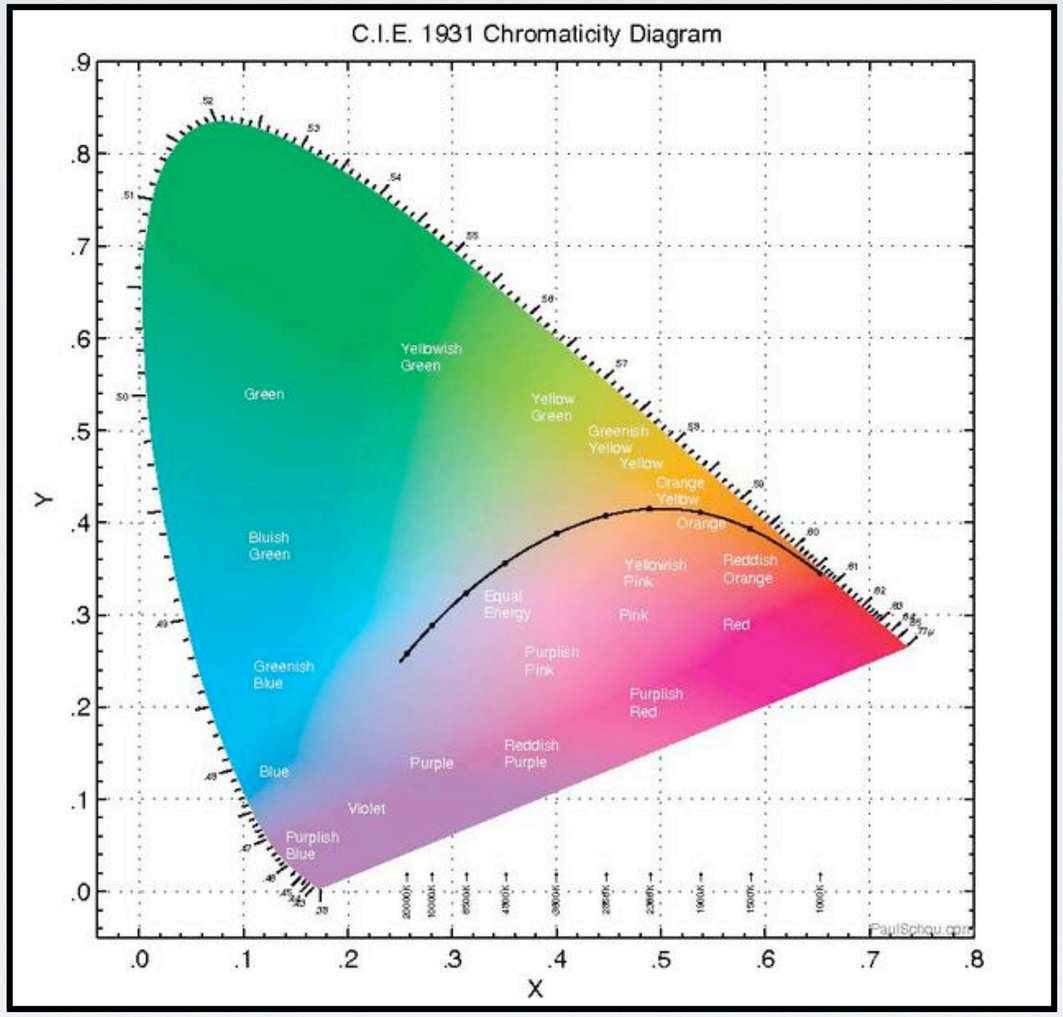
ADDITIONAL RESOURCES ON COLOR MANAGEMENT:

- "Real World Color Management, 2nd Edition" by Bruce Fraser, Chris Murphy and Fred Bunting (http://www.colorremedies.com/realworldcolor/).

- "Real World Image Sharpening with Adobe Photoshop, Camera Raw, and Lightroom, 2nd Edition" by Bruce Fraser and Jeff Schewe (http://www.adobepress.com/bookstore/product.asp?isbn=0321637550).

- Color Management Web Site: (http://www.colormanagement.com/).

CIE XYZ COLOR SPACE: FROM THE INTERNATIONAL COMMISSION ON ILLUMINATION



The CIE XYZ color space is a based on experimental perception studies conducted by W. David Wright and John Guild in the 1920s. The CIE 1931 XYZ color space,shown above, is designed for matching calibrated displays or printers.

Open Source Image available at WIkipedia and created by Paulschou, see: http://en.wikipedia.org/w/index.php?title=File:Chromaticity_diagram_full.pdf&page=1.

UPDATES TO CIE XYZ COLOR SPACE:

- CIE 1931 was limited in expressing lightness, purity and dominant wavelength between colors.

- In 1976, CIE evolved two systems to address uniform color spacing:
CIELUV and CIELAB.

- CIE LUV is designed as a simple to compute transformation of CIE XYZ 1931 to address perceptual uniformity, L, u & v are calculated from chromaticity coordinates.

CIE LUV is well suited for computer graphics, for more mathematics details see:
Computer Graphics: Principles and Practice in C (2nd Edition)
J. Foley, A. van Dam, S. Feiner, and J. Hughes.

- With CIE LAB (CIE Lab), L = lightness coordinate, a = red/green coordinate, and b = yellow/blue coordinate.

For more specifics on CIE LAB, see Gernot Hoffmann's discussion at:
http://www.fho-emden.de/~hoffmann/cielab03022003.pdf.

CIE LAB is closely related to the Munsell Color System.

MUNSELL COLOR SYSTEM:
A HUE, VALUE AND CHROMA COLOR SPACE

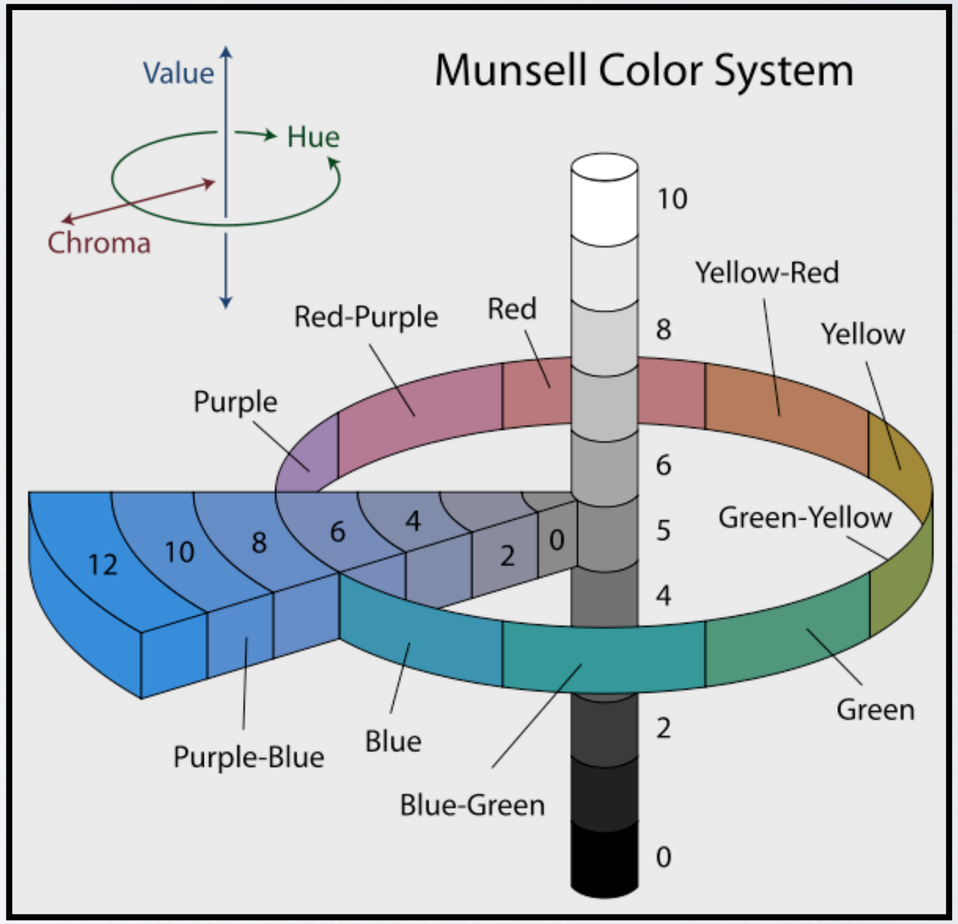
- **Hue: 5 principal hues of Red, Yellow, Green, Blue and Purple with 5 intermediate hues halfway between each principal.**

  Each of these 10 steps is divided into 10 sub-steps to yield 100 hues with integer values.

- **Value: black (value 0) at the bottom to white (value 10) at the top.**

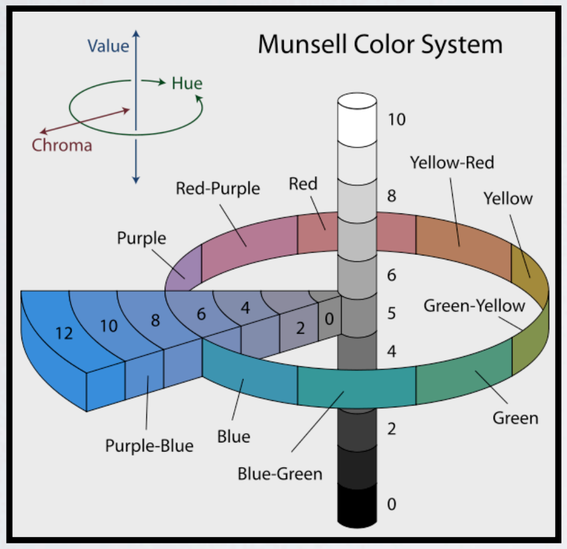
- **Chroma: measured radially from the center of each slice.**

  Lower chroma value is less pure, more washed out like a pastel.

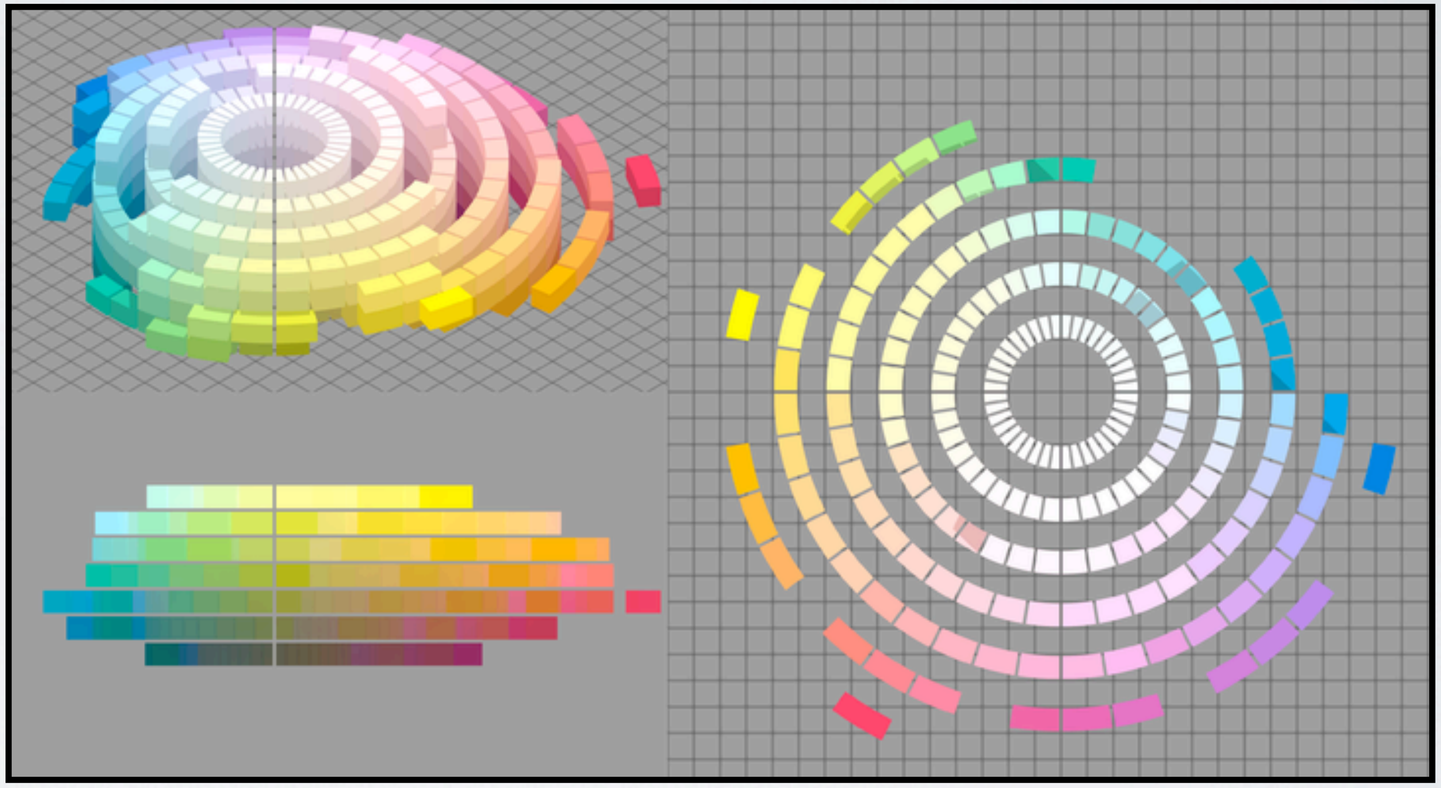


Open Source Image available at WIkipedia and created by Jacobolus, see: http://en.wikipedia.org/wiki/File:Munsell-system.svg

MUNSELL COLOR SYSTEM:
A HUE, VALUE AND CHROMA COLOR SPACE



Open Source Image available at WIkipedia and created by Jacobolus, see: http://en.wikipedia.org/wiki/File:Munsell-system.svg



Albert H. Munsell developed the Munsell Color System in the early 1900s. The 1929 Munsell Book of Color defined the fundamentals of the color space configuration shown above.

Open Source Image available at WIkipedia and created by SharkD, see: http://commons.wikimedia.org/wiki/File:Munsell_1929_color_solid.png.

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PANTONE COLOR MATCHING SYSTEM:
USED FOR STANDARDIZING COLORS

- 1,114 colors specified by their allocated number such as “PMS 130”.

  Colors based on 15 pigments (13 base color pigments along with black & white) that are mixed in specified amounts.

- Aids in standardizing colors in the CMYK color printing process.

  CMYK printing effectively reproduces a special subset of Pantone colors.

- Pantone online: www.pantone.com

- my PANTONE app : http://www.pantone.com/pages/pantone/pantone.aspx?pg=20696

Open Source Image available at WIkipedia and created by Parhamr, see: http://en.wikipedia.org/wiki/File:PantoneFormulaGuide-solidMatte-2005edition.png

WEB COLORS: HEX TRIPLETS

- A hex triplet: the 6 digit, 3-byte hexadecimal number used in HTML, CSS, SVG and other web focused applications to represent colors.

- A byte: a number in the range 00 to FF (hexadecimal notation) or 0 to 255 in decimal notation.

- The bytes represent red, green, and blue components of color.

  Byte 1: red value

  Byte 2: green value

  Byte 3: blue value

- If any one of the 3 color values is less than 10 hex (or 16 decimal), it must be represented with a 0 so that the triplet always has 6 digits.

Named	Numeric	Color name	Hex rgb	Decimal
		black	#000000	0,0,0
		silver	#C0C0C0	192,192,192
		gray	#808080	128,128,128
		white	#FFFFFF	255,255,255
		maroon	#800000	128,0,0
		red	#FF0000	255,0,0
		purple	#800080	128,0,128
		fuchsia	#FF00FF	255,0,255
		green	#008000	0,128,0
		lime	#00FF00	0,255,0
		olive	#808000	128,128,0
		yellow	#FFFF00	255,255,0
		navy	#000080	0,0,128
		blue	#0000FF	0,0,255
		teal	#008080	0,128,128
		aqua	#00FFFF	0,255,255

Image from the World Wide Web Consortium (W3C)'s CSS Color Module Level 3 Recommendation (standard) - 07 June 2011, (http://www.w3.org/TR/css3-color/#svg-color)

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HUE, SATURATION AND VALUE (HSV): IMPROVE RGB COLOR MODEL IN REGARD TO PERCEPTION

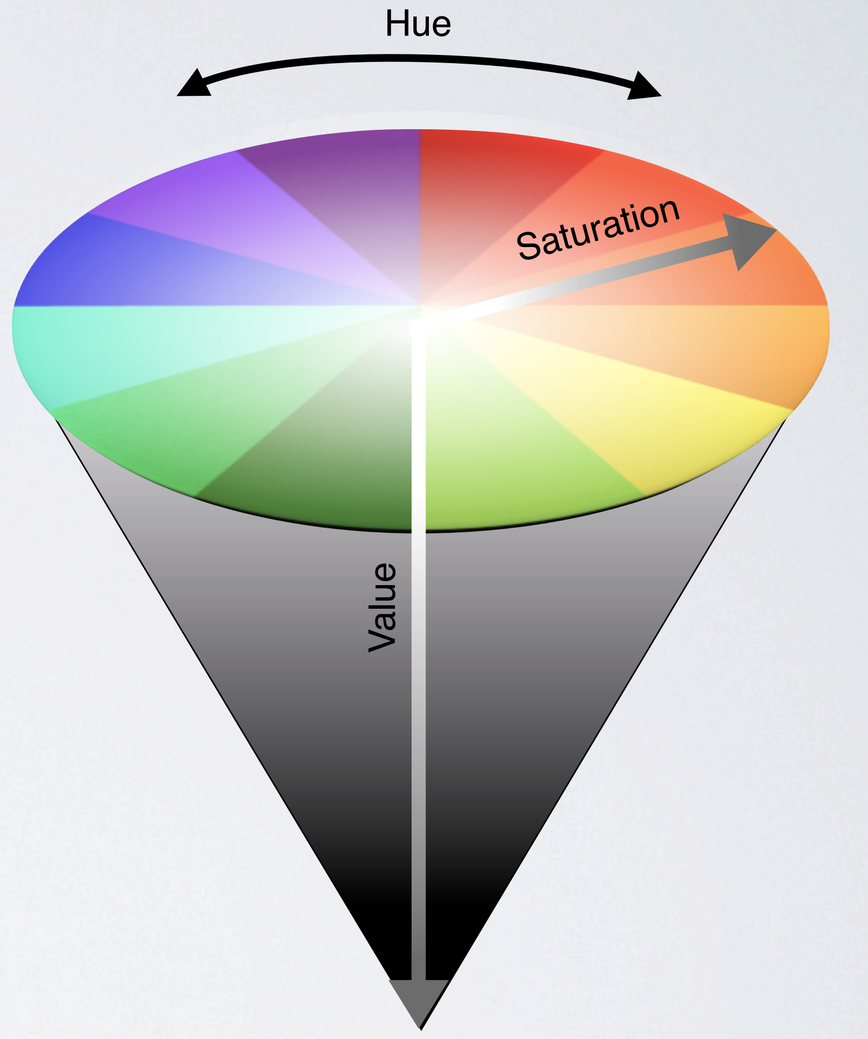
- HSV concepts presented by Alvy Ray Smith @ SIGGRAPH 1978: "Color Gamut Transform Pairs", (http://alvyray.com/Papers/CG/color78.pdf)

- Hue: defines a particular color selection in terms of wavelengths dimensions.

- Saturation: refers to the dominance of hue in a color, ranges from "pure" to "desaturated".

- Value: expressed in terms of lightness or darkness of a given color, overall intensity of the spectral light.

- HSV is expressed as a 3D cone where color hue values are strongest at the outer edge and become desaturated when moving toward the central linear axis.



Three dimensional cone representation of the Hue, Saturation and Value (HSV) color model for color display devices. Illustration by Theresa-Marie Rhyne, 2011.

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THE COLOR WHEEL:
ARRANGING COLORS HUES AROUND A CIRCLE

- Primary Colors: set of colors combined to make a useful range of colors.

  RGB, CMY, and RYB are the most popular sets of primary colors.

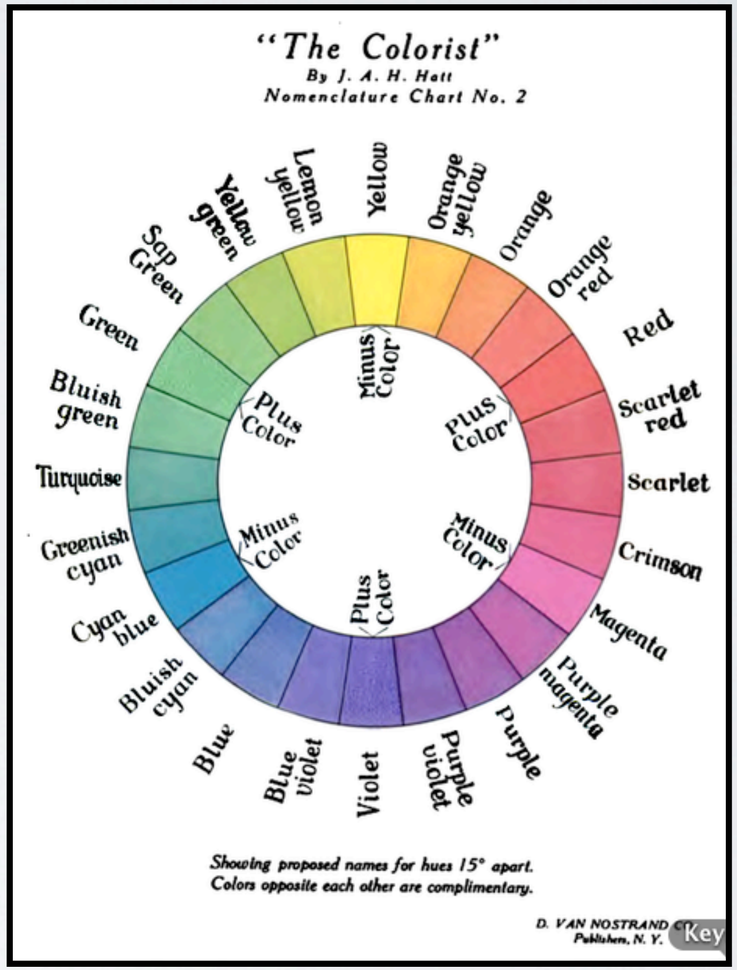
- Secondary Colors: produced by mixing primary colors.

  For RGB: Yellow, Cyan, Magenta

  For CMY: Blue, Green, Red

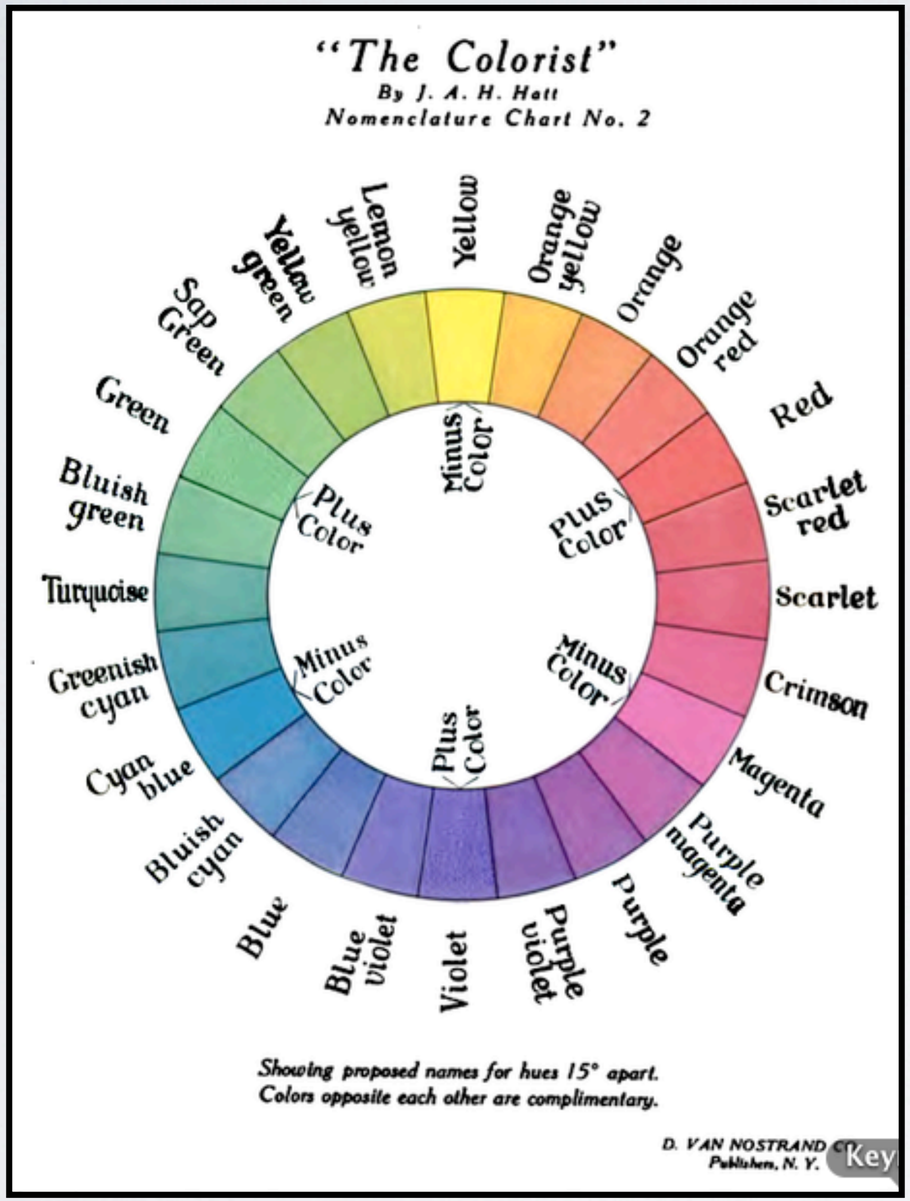
  For RYB: Orange, Green, Purple

- Complementary Colors: colors opposite each other on the color wheel.



Public Domain Image available at WIkipedia and created by J. Arthur H. Hatt for "The Colorist" in 1908. See: http://en.wikipedia.org/wiki/File:RGV_color_wheel_1908.png.

USING THE COLOR WHEEL TO BUILD COLOR SCHEMES



- Monochromatic: Different tints or shades of one color.
- Analogous: colors adjacent to each other on the Color Wheel.
- Split Analogous: a main color and two colors one space away from it on each side of the Color Wheel.
- Complementary: colors opposite each other on the Color Wheel.
- Split Complementary: a main color and two colors on each side of its complementary color.
- Triadic: 3 colors equally spaced on the Color Wheel.
- Tetradic: Any 4 colors with a logical relationship on the Color Wheel such as 2 complementary pairs.

Others to be discussed in our Hands on Session.

Public Domain Image available at WIkipedia and created by J. Arthur H. Hatt for "The Colorist" in 1908. See: http://en.wikipedia.org/wiki/File:RGV_color_wheel_1908.png.

NOW, LET'S EXAMINE SELECTED ARTISTIC MOVEMENTS PERTAINING TO COLOR THEORY:

- Pointillism (as well as Impressionism, Divisionism and Ben Day Dots).
- Fauvism.
- Color Field Painting.
- Bauhaus teachings of Color Theory.

POINTILLISM: BUILDING AN IMAGE FROM SEPARATE DOTS OF PAINT

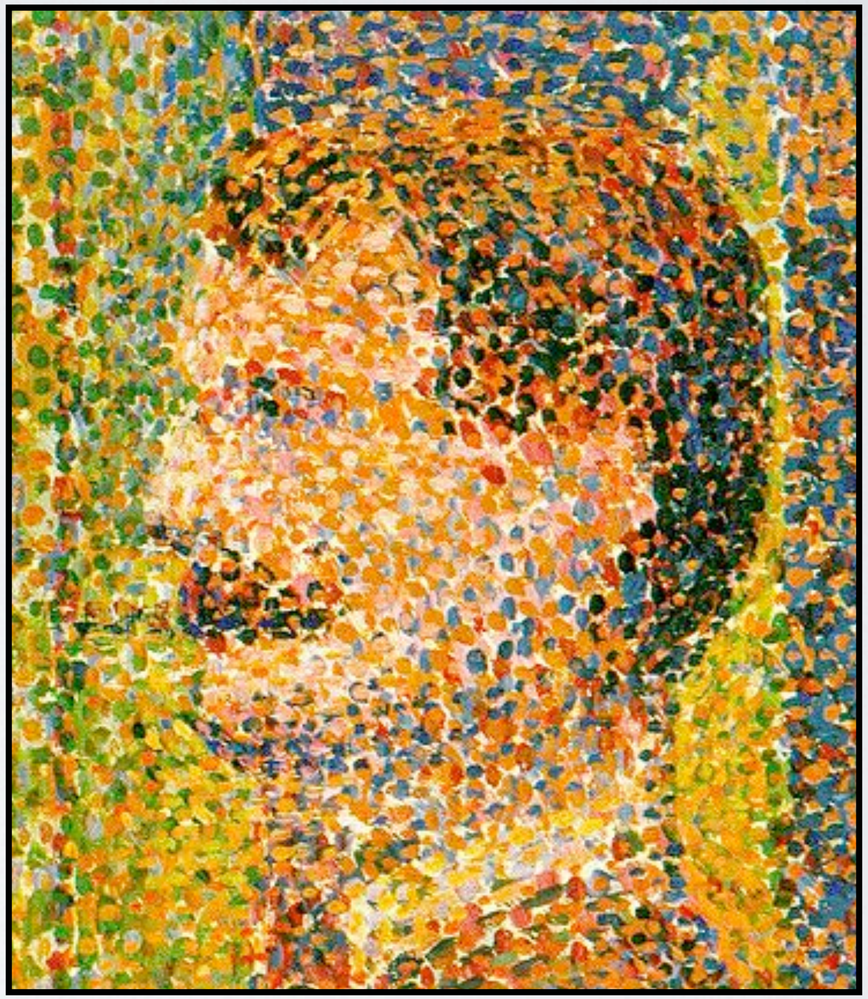
- Technique of painting developed by George Seurat in 1886. Image on right is from his "La Parade de Cirque" painting.

  Relies on the eye and mind of the viewer to compose the color dots into a broader range of tones.

- Pointillism is an outgrowth of the Impressionism art movement.

  Impressionism paintings noted for visible brush strokes & emphasis on light.

- Divisionism is a variant of Pointillism that focuses on color theory.



Public Domain Image available at WIkipedia (expired Copyright) , see: http://en.wikipedia.org/wiki/File:Seurat-La_Parade_detail.jpg

MANY OTHER METHODS ARE ANALOGOUS TO POINTILLISM

- The CMYK printing process used by color printers is dot based.
- Television and Computer Monitors use a pointillist method to represent image with the RGB color model.
- Ben-Day Dots printing process uses colored dots that are widely spaced, closely spaced or overlapping to create optical illusions.

The illustrator Benjamin Day developed the method that has been used in comic books. The artist, Roy Lichtenstein, enlarged and exaggerated the method.

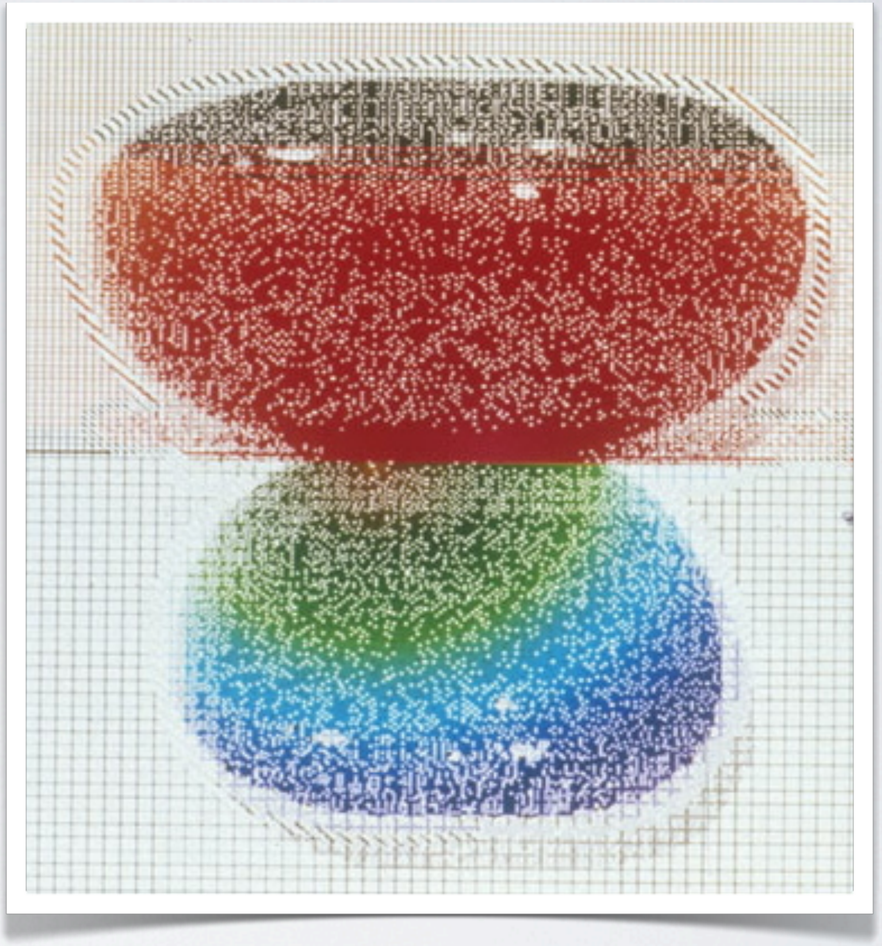


Image created by Theresa-Marie Rhyne to study Divisionism and Ben Day dots. See: http://theresamarierhyne.com/Theresa-Marie_Rhynes_Viewpoint/Blog/Entries/2009/12/3_Exploring_Divisionism_in_Computer_Graphics.html

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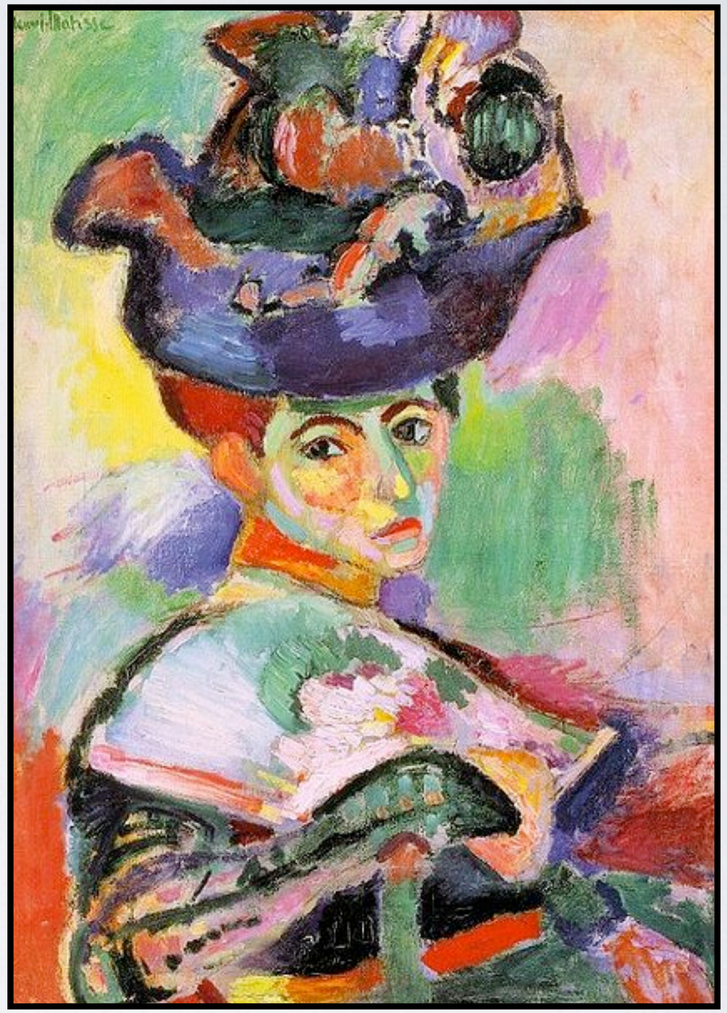
FAUVISM: STRONG COLOR EMPHASIZED OVER REPRESENTATIONAL OR REALISM

- Short lived art movement from 1905 to 1907.

  Leading artists were Henri Matisse and Andre Derain. Image on right is Matisse's "Woman with a Hat" oil painting created in 1905.

- The grouping of artists were called "Les Fauves" or " The Wild Beasts".

  Painterly qualities of wild brush work and saturated color. The subject matter was simplified and sometimes abstract.



Public Domain Image in the USA available at WIkipedia (image created before 1923) , see: http://en.wikipedia.org/wiki/File:Matisse-Woman-with-a-Hat.jpg.

COLOR FIELD PAINTING: LARGE AMOUNTS OF FLAT SOLID COLOR SPREAD ACROSS A CANVAS

- Abstract Expressionism art movement that emerged during the 1940s and continued into the 1950s and 1960s.

  Leading artists were / are Kenneth Noland, Gene Davis, Ellsworth Kelly, Helen Frankenthaler, Anne Truitt, Jack Bush, and Frank Stella.

  Image on right is Frank Stella's "Ragga II" painting created in 1970.

- Large canvas areas of pure color that created areas of unbroken surface and a flat picture plane.

  Still an active abstract painting style today.

Fair Use Image in the USA taken by Theresa-Marie Rhyne. "Ragga II"painting and Copyright by Frank Stella, 1970. Dimensions: 120 by 300 inches. In the collection of the North Carolina Museum of Art, see: http://collection.ncartmuseum.org/collection11/view/objects/asitem/People$0040185/0?t:state:flow=57b04465-42fb-4180-ab3b-b7063019d013.

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NEXT, WE HIGHLIGHT SELECTED BAUHAUS TEACHINGS OF COLOR THEORY:

- The Bauhaus: School in Germany with pioneering approaches to teaching design. School operated from 1919 to 1933. Many instructors continued developing their teachings after 1933.

- Paul Klee: “The Diaries of Paul Klee 1898 - 1918”.

- Wassily Kandinsky: “Concerning the Spiritual in Art”.

- Johannes Itten: “The Art of Color: the subjective experience and objective rationale of color”.

- Josef Albers: “The Interaction of Color”.

SPECIFIC FOCUS ON JOSEF ALBERS:

- German born American artist & educator.

  Taught at the Bauhaus, eventually immigrating to the USA to teach at Black Mountain College & Yale University.

- Created color studies entitled “Homage to the Square” for a 25 year period starting ~1950.

- In 1963, published “The Interaction of Color” detailing his color theories.

Fair Use Image in the USA taken by Theresa-Marie Rhyne. “Homage to the Square” color studies created by Josef Albers and on display at the North Carolina Museum of Art. Copyright by the Josef & Anni Albers estate & foundation. http://collection.ncartmuseum.org/collection11/view/objects/asitem/People$0040176/4;jsessionid=8A427C773907338158799E73A053A5C7?t:state:flow=276f0018-1877-46d0-9c16-6cb0ad65949d.

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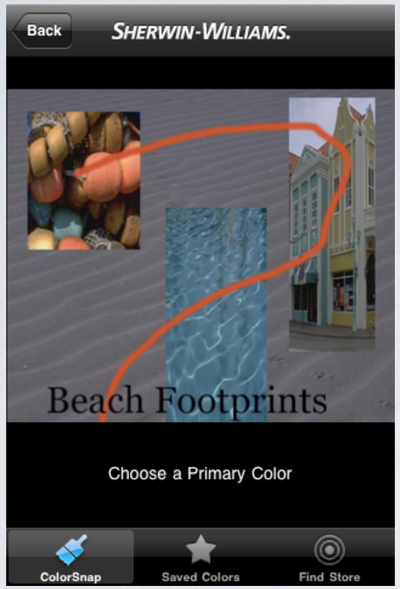
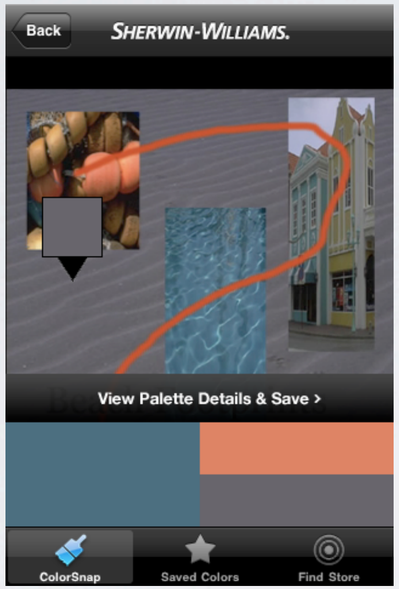
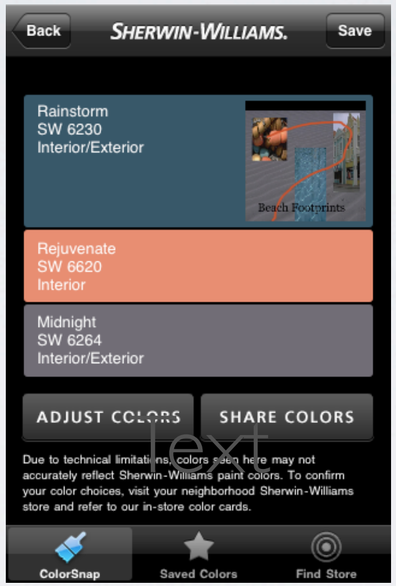
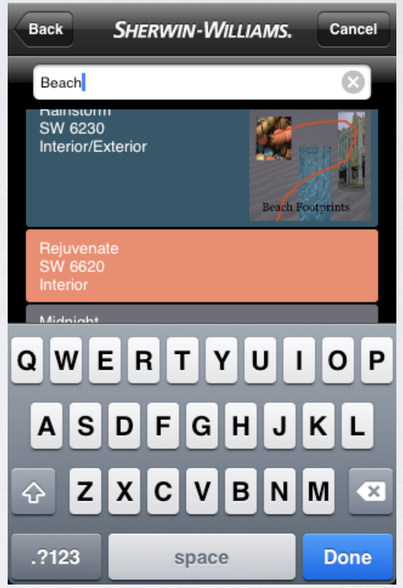
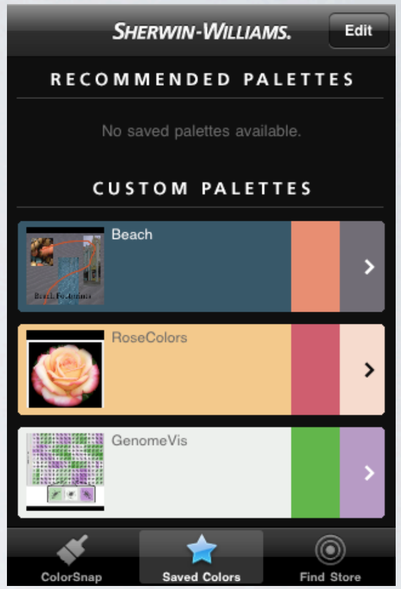
CASE STUDY #0: APPLYING OUR COLOR THEORY KNOWLEDGE TO PAINTING:







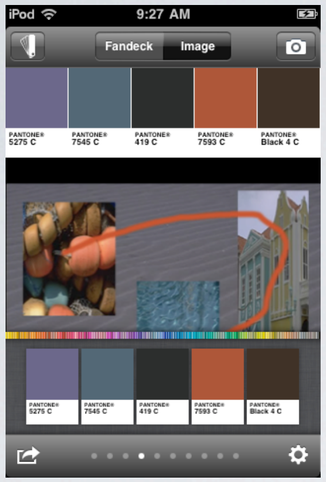


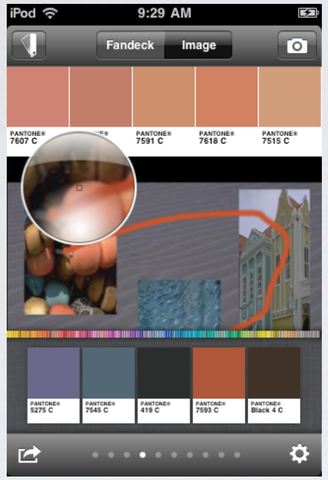


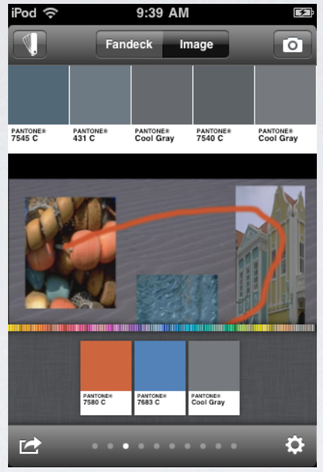
Use the Sherwin Williams ColorSnap Mobile App to import a digital image we like and then match color paints. We will discuss further details later in our Hands on Workshop.

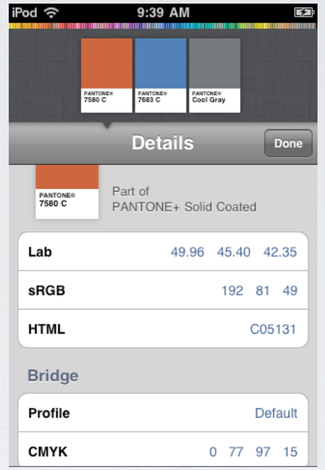
See: http://www.sherwin-williams.com/architects-specifiers-designers/color/color-tools/colorsnap-for-iphone-android-and-blackberry/

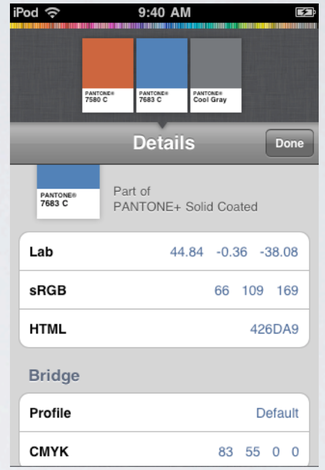
USING MY PANTONE APP: STUDY OF CONTRASTING COLORS

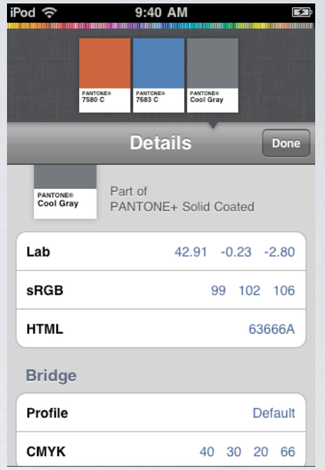


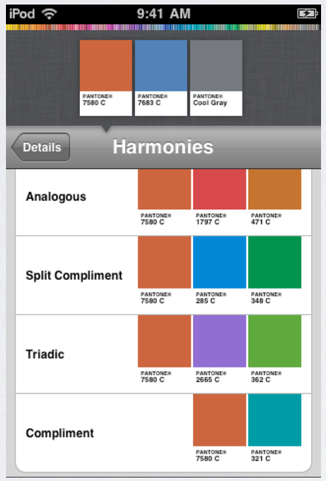


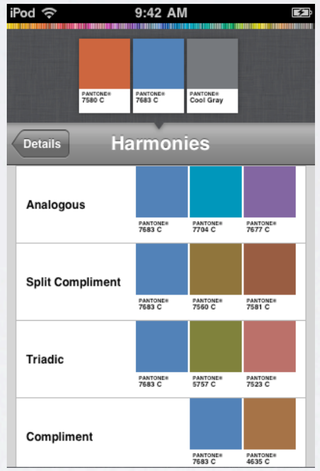


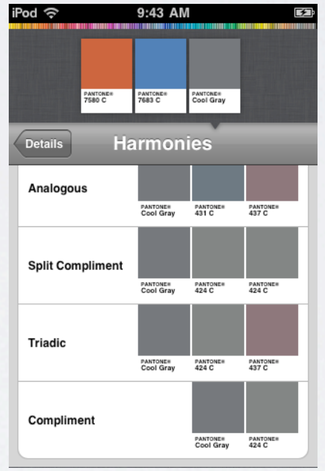








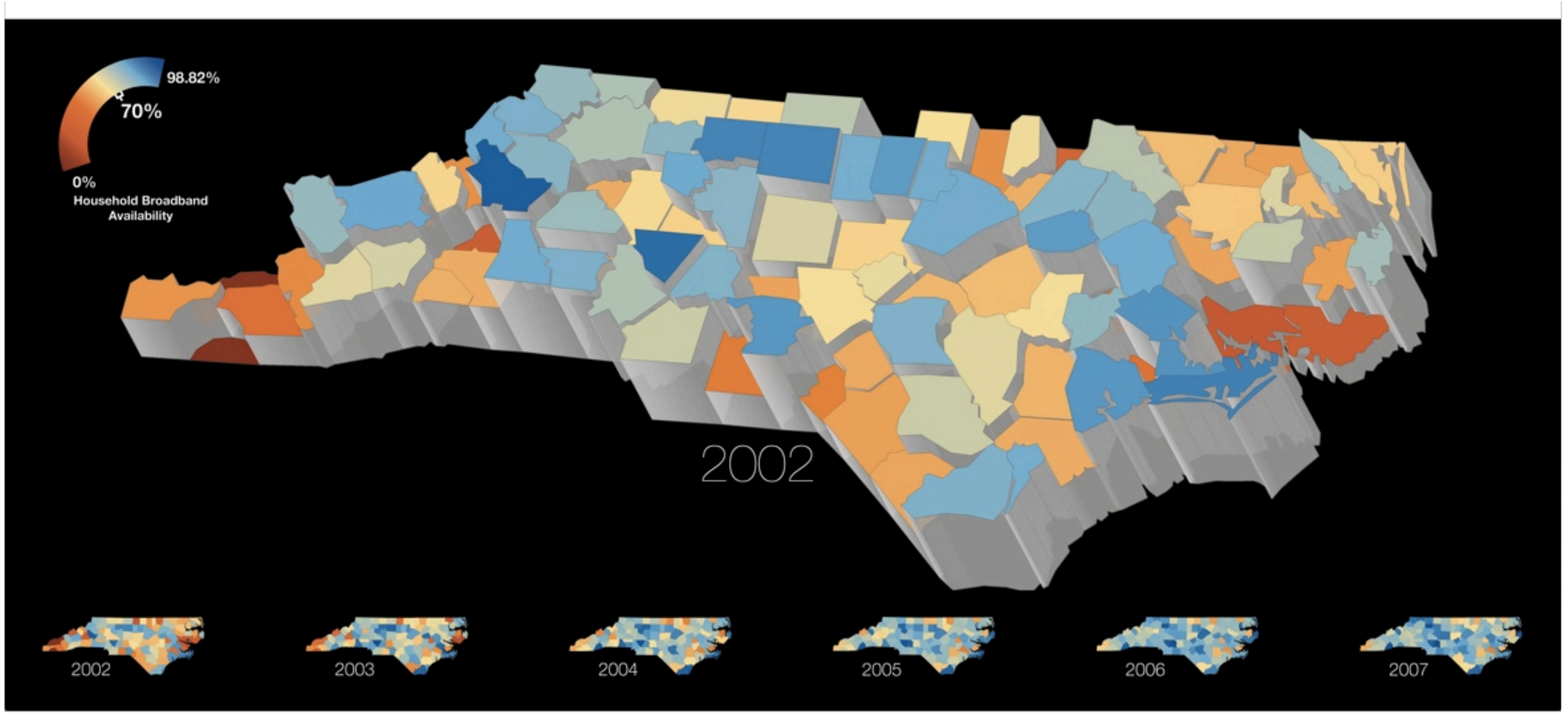




Use the myPantone Mobile App to examine color scheme of digital image for transfer to print media . We will discuss further details later in our Hands on Workshop.

See: http://www.pantone.com/pages/pantone/pantone.aspx?pg=20696

CASE STUDY #1: COLORIZING HOUSEHOLD BROADBAND AVAILABILITY



Visualization based on Household Broadband Availability data for the 100 Counties in the State of North Carolina from the years of 2002 through 2007. Information and data provided by the e-NC Authority.

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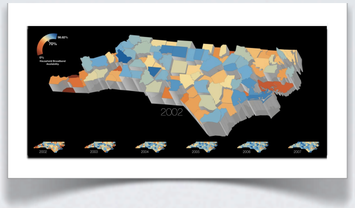
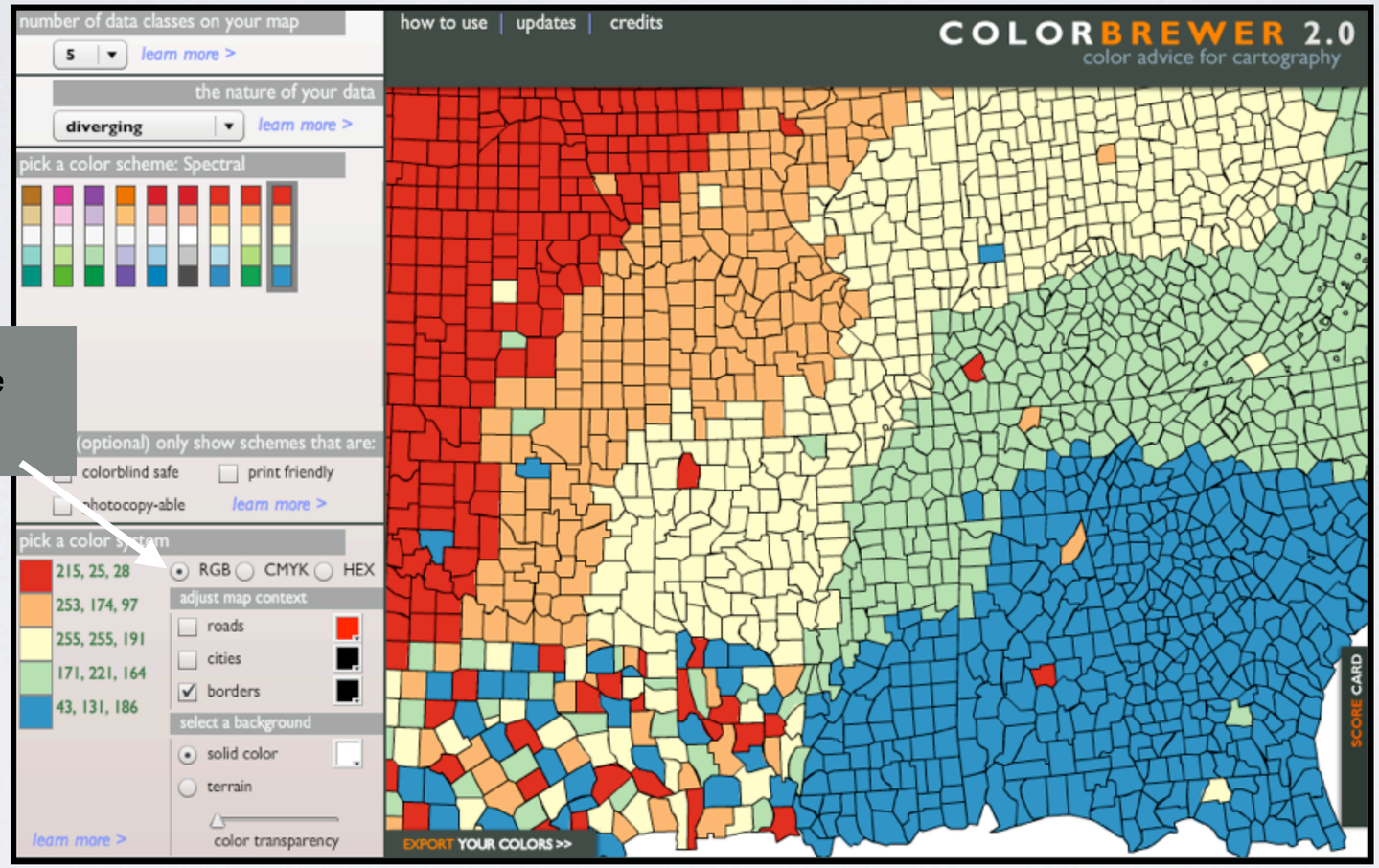
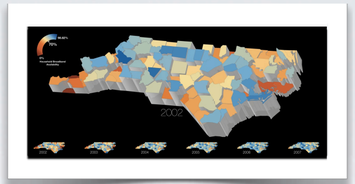


USING THE COLORBREWER 2.0 TOOL TO DEVELOP COLORMAPS:

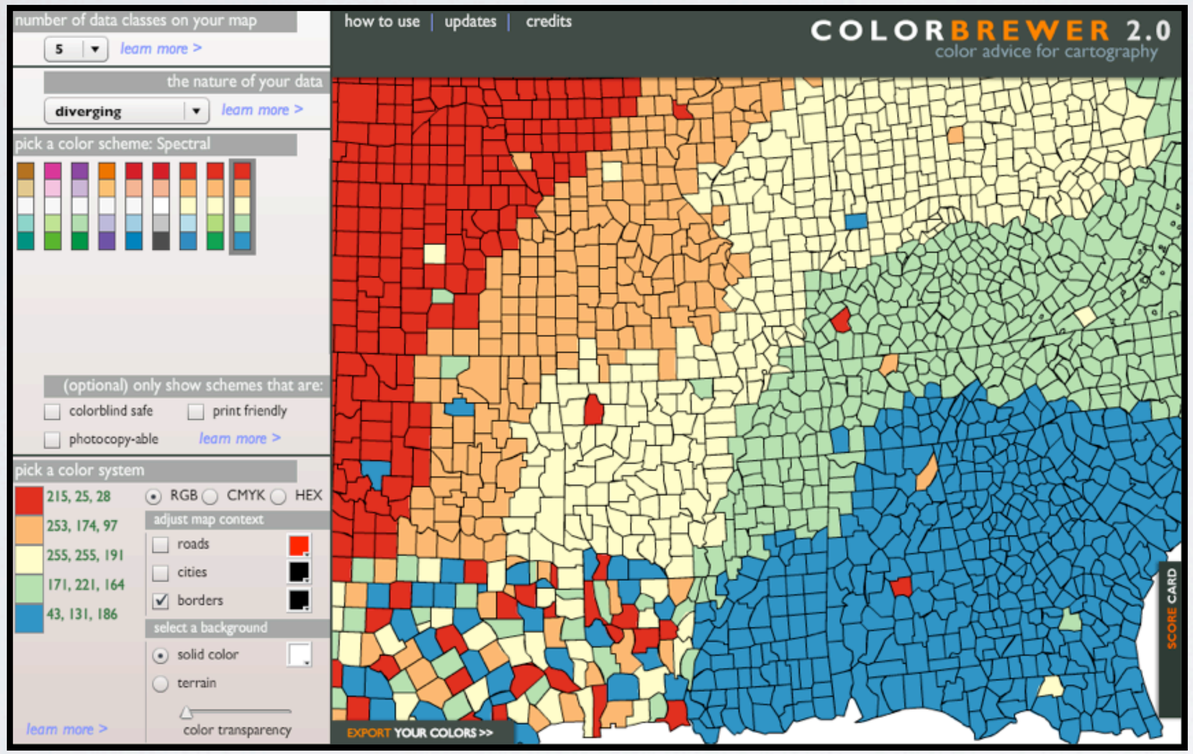


Note: Color Space Parameters

The ColorBrewer tool was conceptualized with color schemes by Cynthia A. Brewer with interface design and software development by Mark Harrower and others (both in the Department of Geography at Pennsylvania State University). See: (http://colorbrewer2.org/).



COLORBREWER'S COLOR SCHEME CONCEPTS:



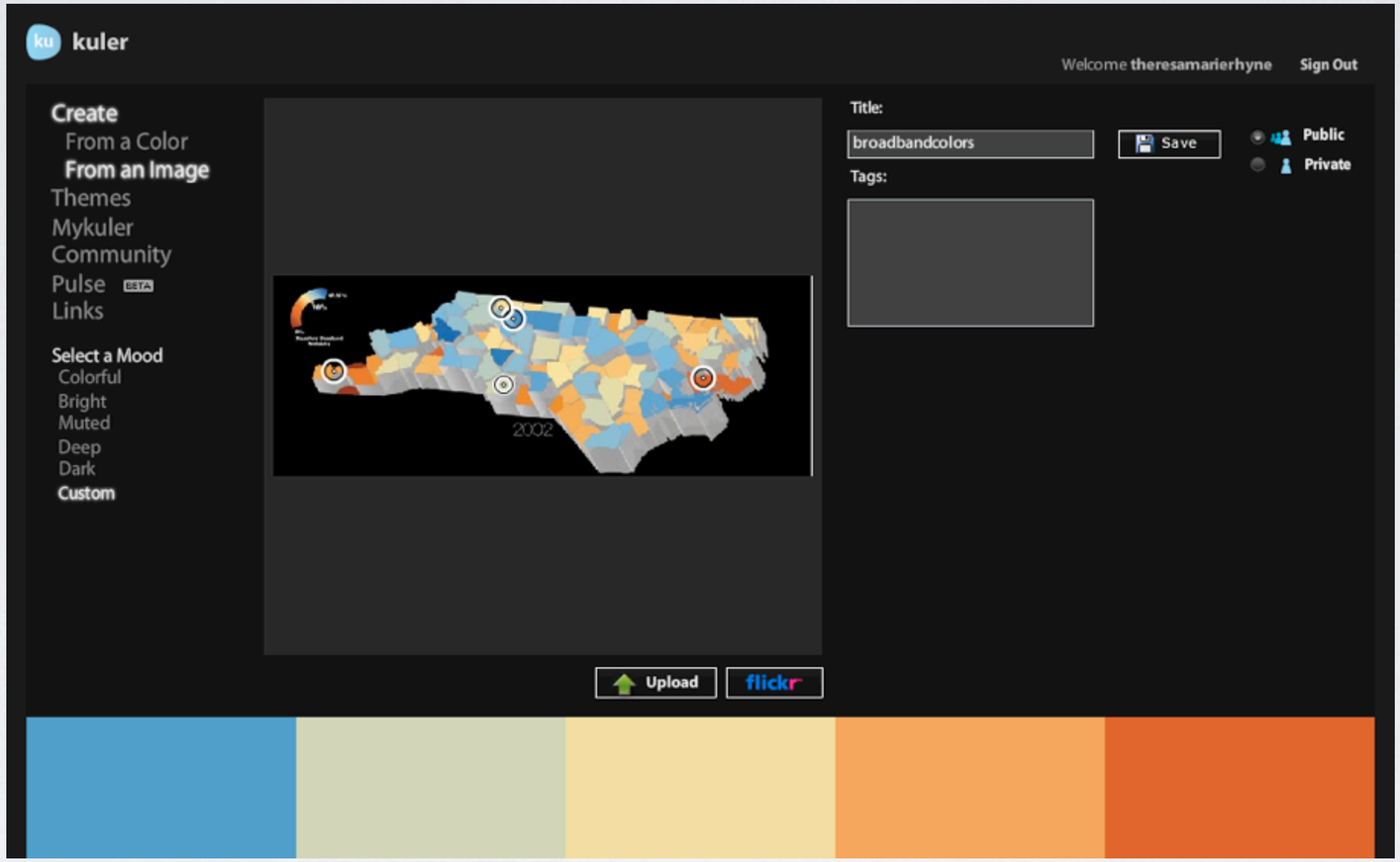
- Sequential Schemes: optimized for ordered data from low to high.

- Diverging Schemes: places equal emphasis on mid-range critical values as well as extreme values.

- Qualitative Schemes: does not imply magnitude differences and suited for representing nominal or categorial data.

The ColorBrewer tool was conceptualized with color schemes by Cynthia A. Brewer with interface design and software development by Mark Harrower and others (both in the Department of Geography at Pennsylvania State University). See: (http://colorbrewer2.org/).

NOW, LET'S USE ADOBE'S KULER TOOL TO ANALYZE THE COLORS IN OUR BROADBAND AVAILABILITY VISUALIZATION:



Adobe's Kuler tool allows us to analyze the colors in a JPEG image. We can save the resulting color palettes for future work. See: http://kuler.adobe.com/.

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WITH ADOBE'S KULER TOOL, WE OBTAIN COLOR VALUES AND POSSIBLE COLOR RELATIONSHIPS:

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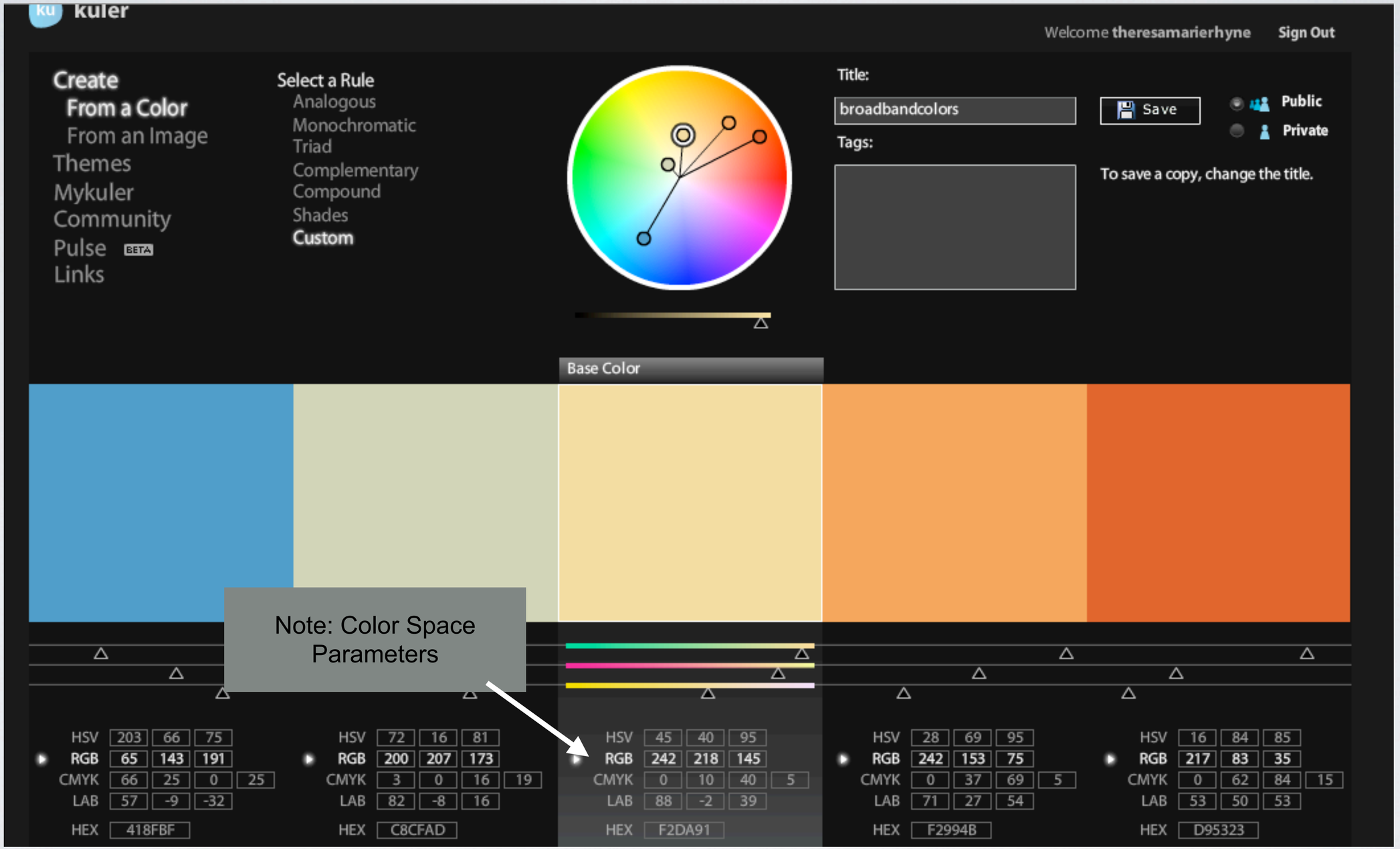
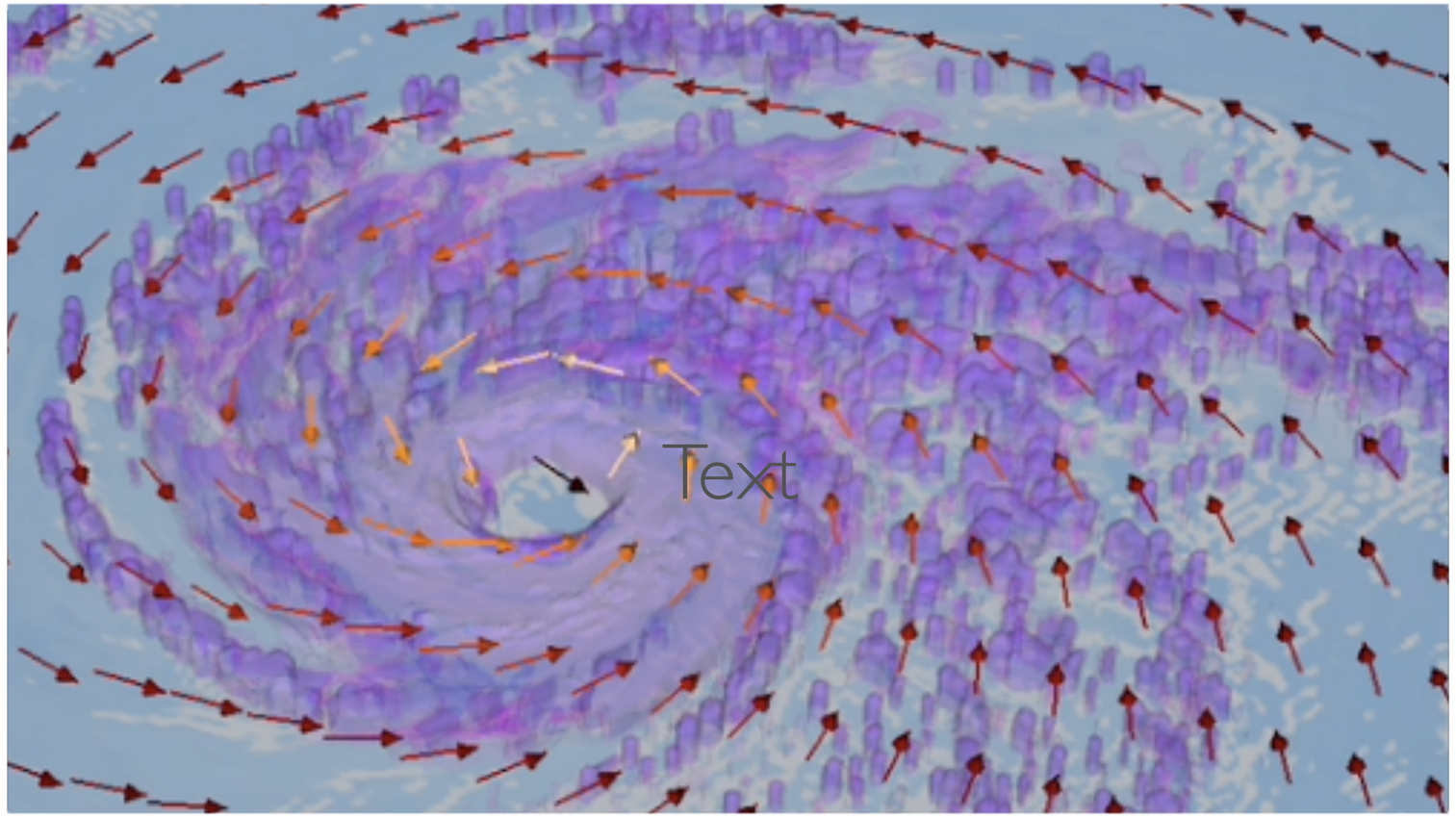
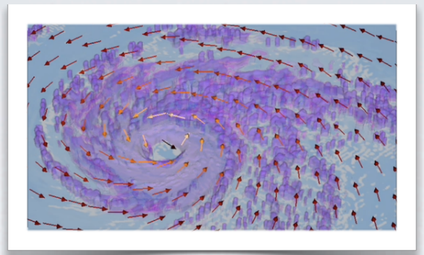


CASE STUDY #2: COLORIZING A HURRICANE



Visualization based on a Hurricane Katrina model run at 2 kilometer grid resolution using the Weather Research Forecast (WRF) model. The animation shows rain isosurfaces, with the purple areas being locations of heaviest rainfall. Dark blue areas are land masses.



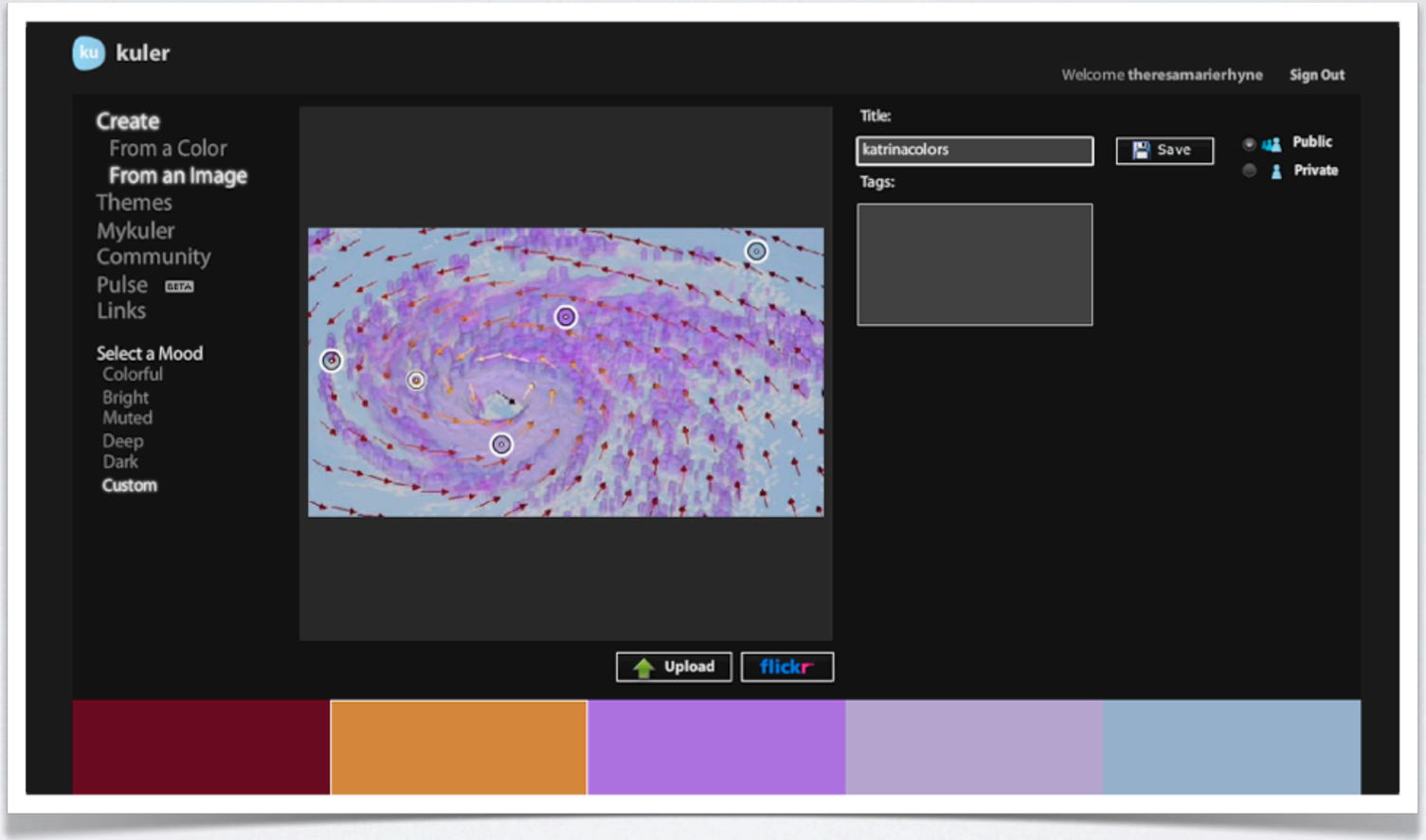
HERE, WE HIGHLIGHT 3 TOPICS:

- Applying Color Theory to a time series animation of Hurricane Katrina.

- Using Adobe's Kuler tool to analyze an existing Color Scheme.

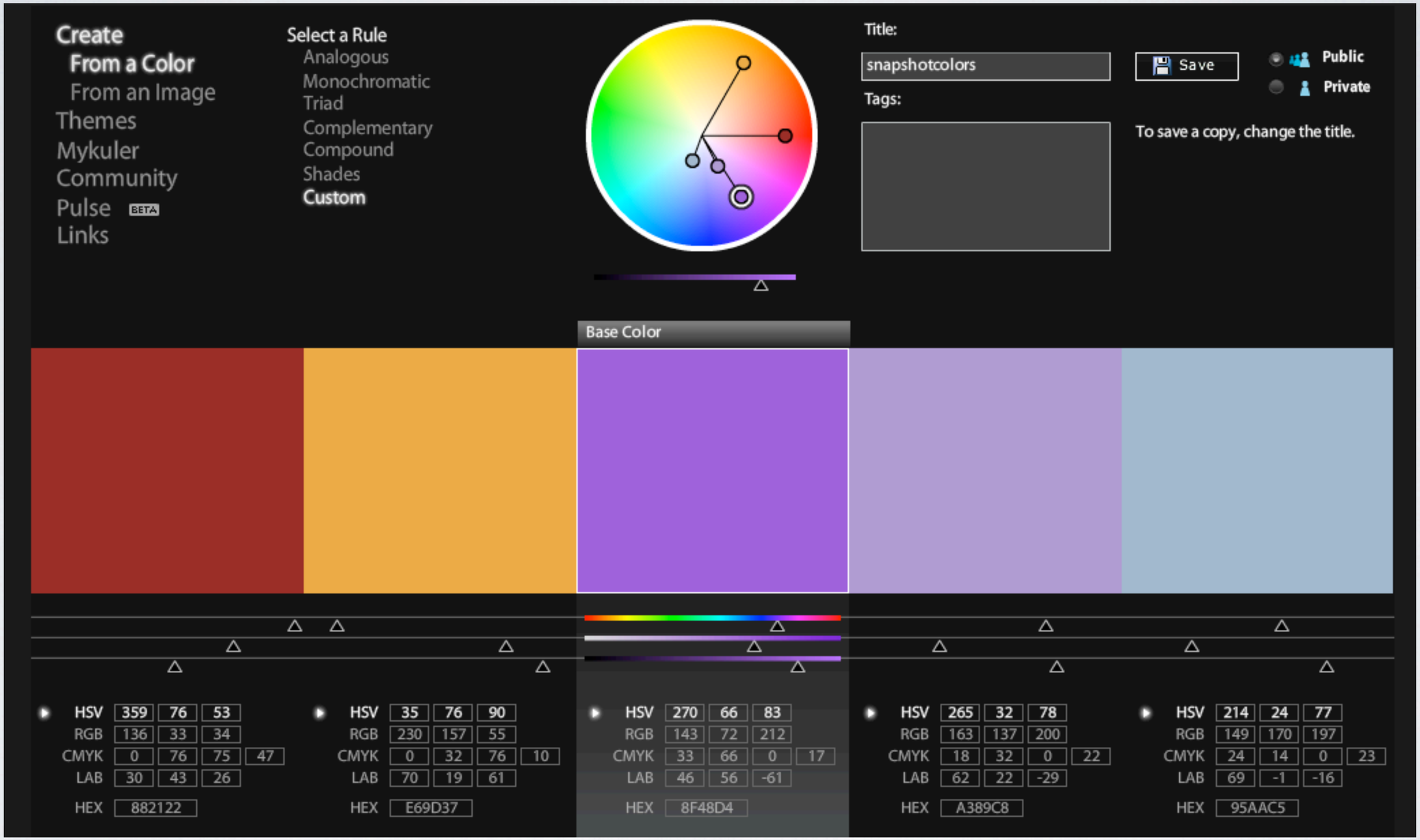
- Working with the Color Brewer tool to build the Tropical Storm Animation Color Scheme.

FIRST, LET'S USE ADOBE'S KULER TOOL TO ANALYZE THE COLORS IN OUR HURRICANE VISUALIZATION:



Adobe's Kuler tool allows us to analyze the colors in a JPEG image. We can save the resulting color palettes for future work. See: http://kuler.adobe.com/.

WITH ADOBE'S KULER TOOL, WE OBTAIN COLOR VALUES AND POSSIBLE COLOR RELATIONSHIPS:



theresamarierhyne@gmail.com

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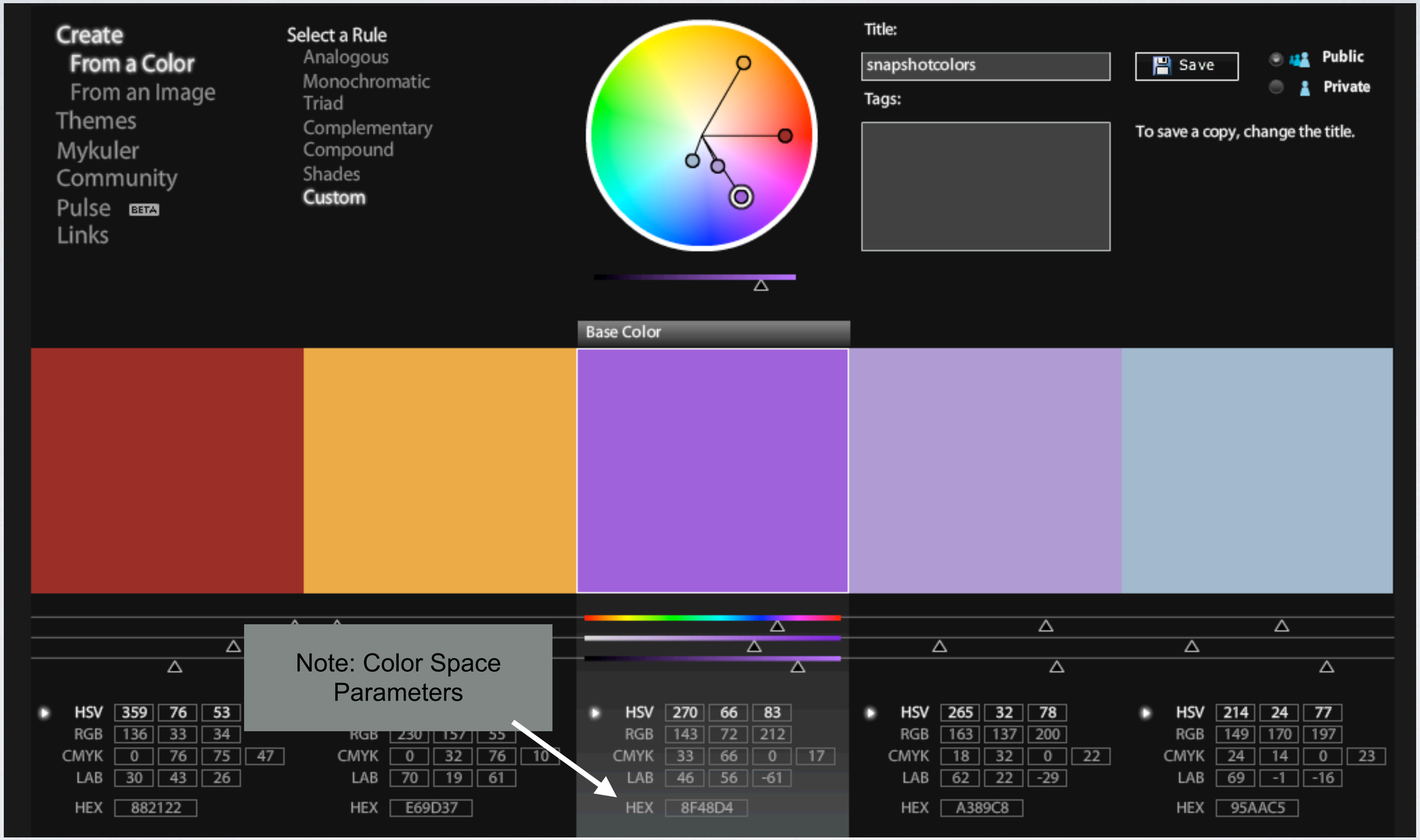
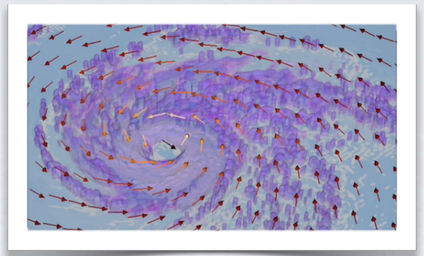


theresamarierhyne@gmail.com

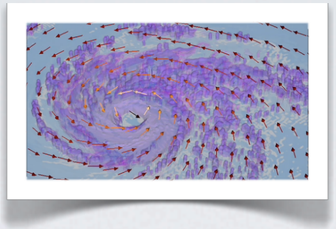


KEY ELEMENTS OF COLOR MAP DESIGN :

- Establish Color Maps based on flow of Animation Sequences rather than Static Image Displays.

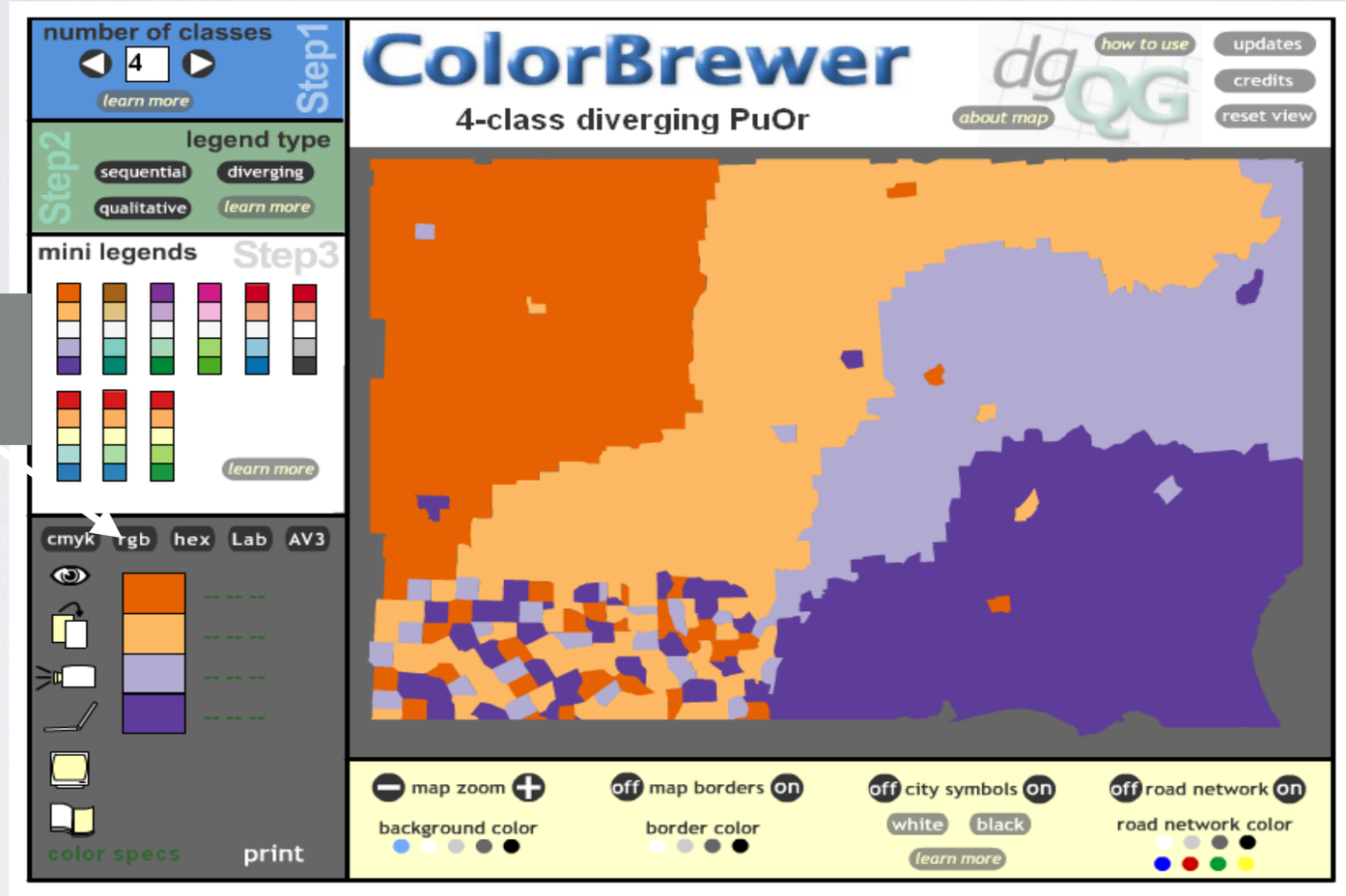
- ColorBrewer tool helps to Mock-Up Color Maps.

- From the Mock-Up develop the Final Color Maps with the visualization & animation tool (VisIt).



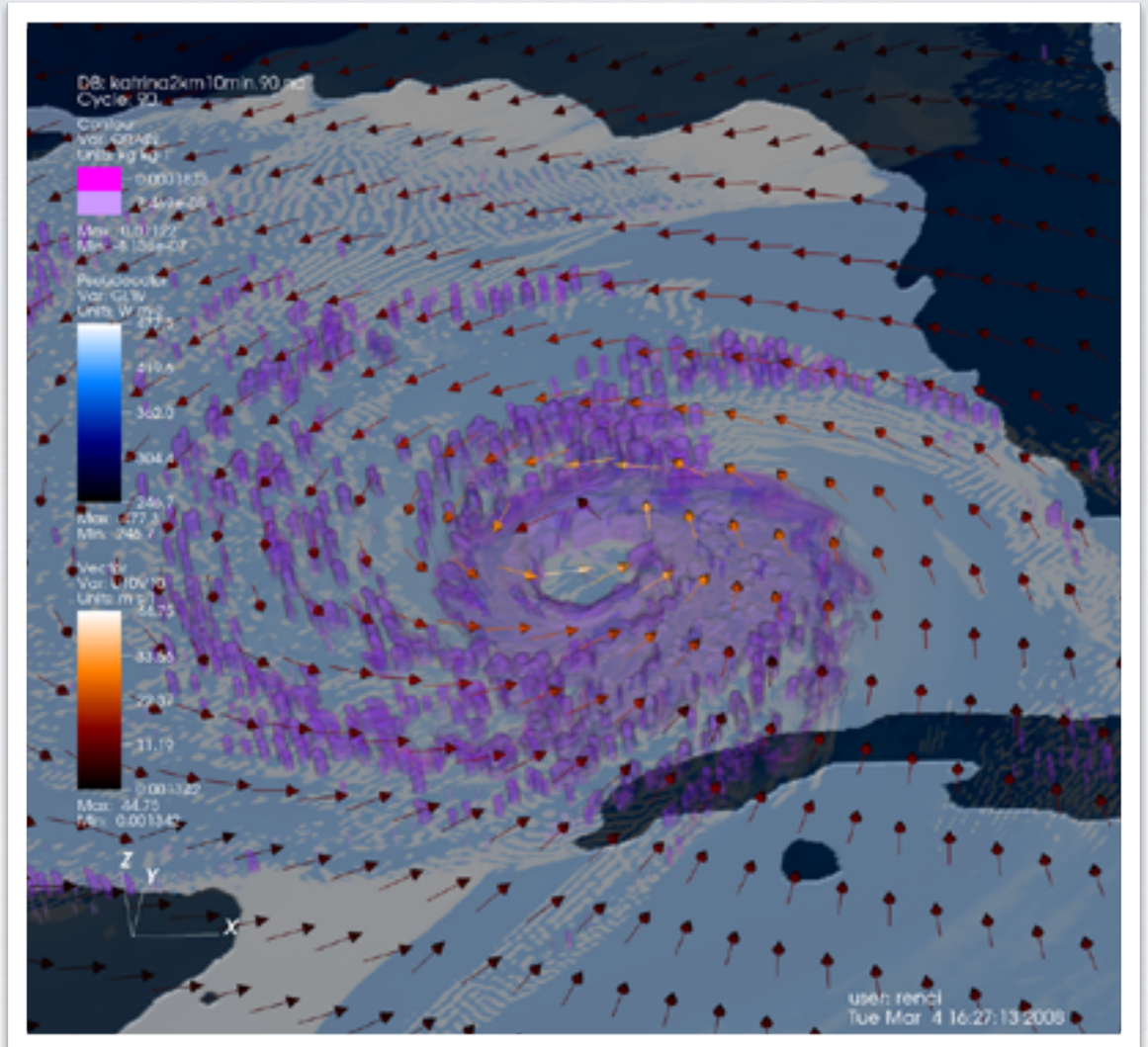
USING THE COLORBREWER TOOL TO DEVELOP COLORMAPS:

Note: Color Space Parameters



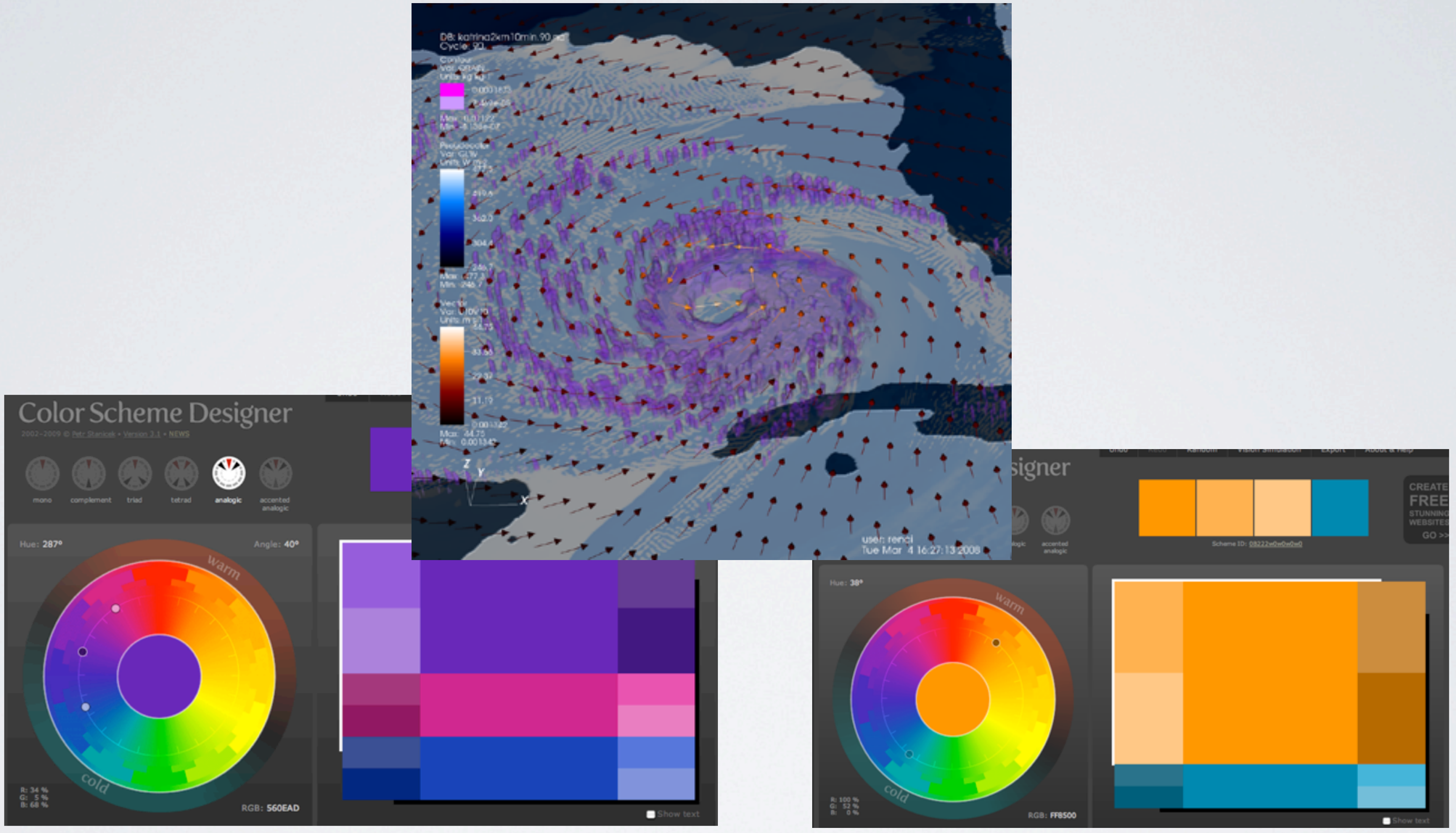
The ColorBrewer tool was conceptualized with color schemes by Cynthia A. Brewer with interface design and software development by Mark Harrower (both in the Department of Geography at Pennsylvania State University). See: (http://www.personal.psu.edu/cab38/ColorBrewer/ColorBrewer.html).

FRAME FROM ANIMATION SEQUENCE SHOWING COLOR MAPS:



Visualization programming by Steve Chall with Colorization executed by Theresa-Marie Rhyne at RENCI@NCSU. Created in the VisIt open source visualization tool from weather model data based on Hurricane Katrina, see: (http:www.llnl.gov/VisIt).

A COLOR SCHEME ANALYSIS OF OUR HURRICANE



Using Color Scheme Designer, we see that our hurricane colors form an analogous color scheme of Magenta, Purple and Blue. Our wind vectors, in Orange, from a complementary color scheme to our Blue ocean background.

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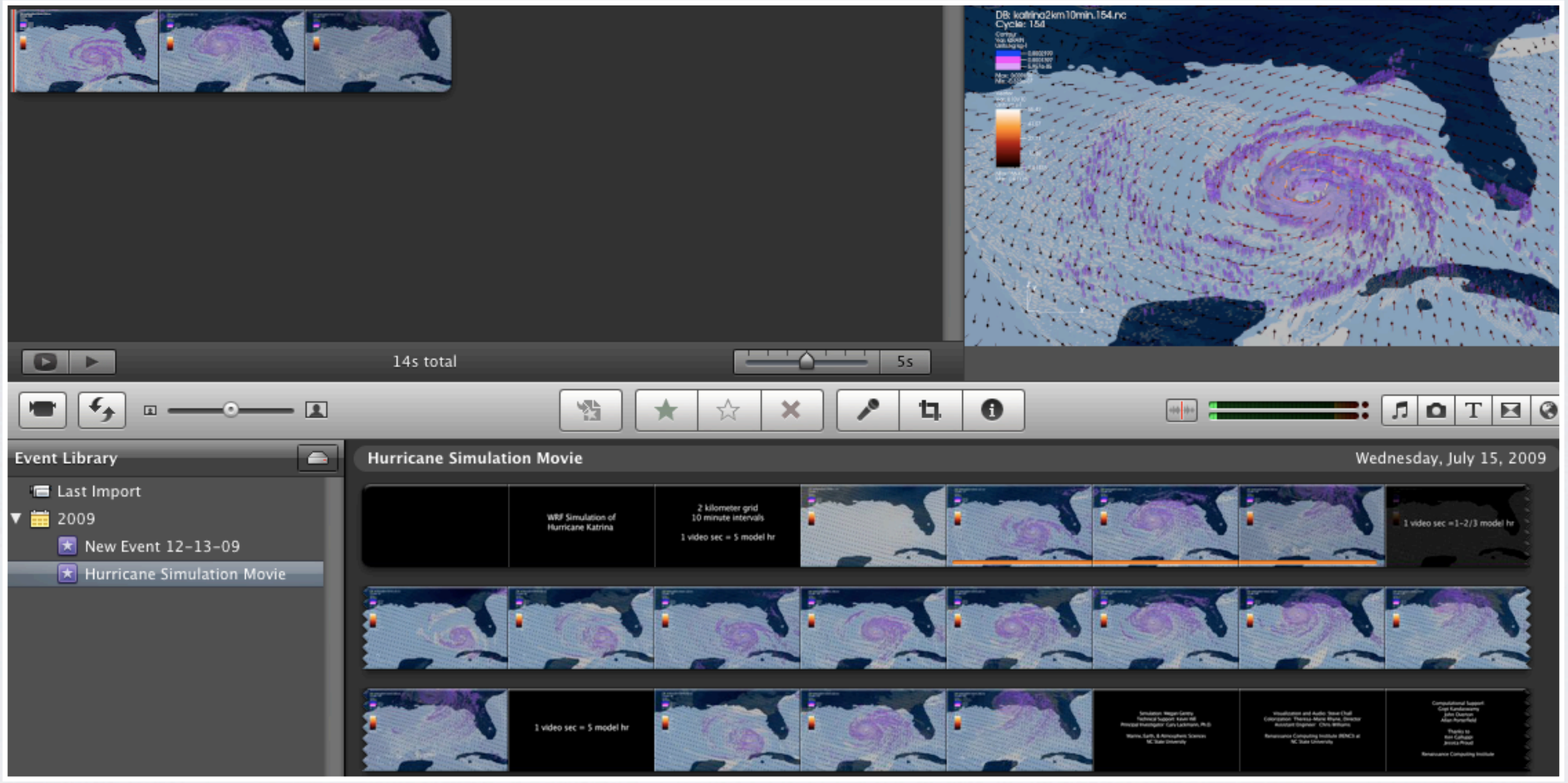
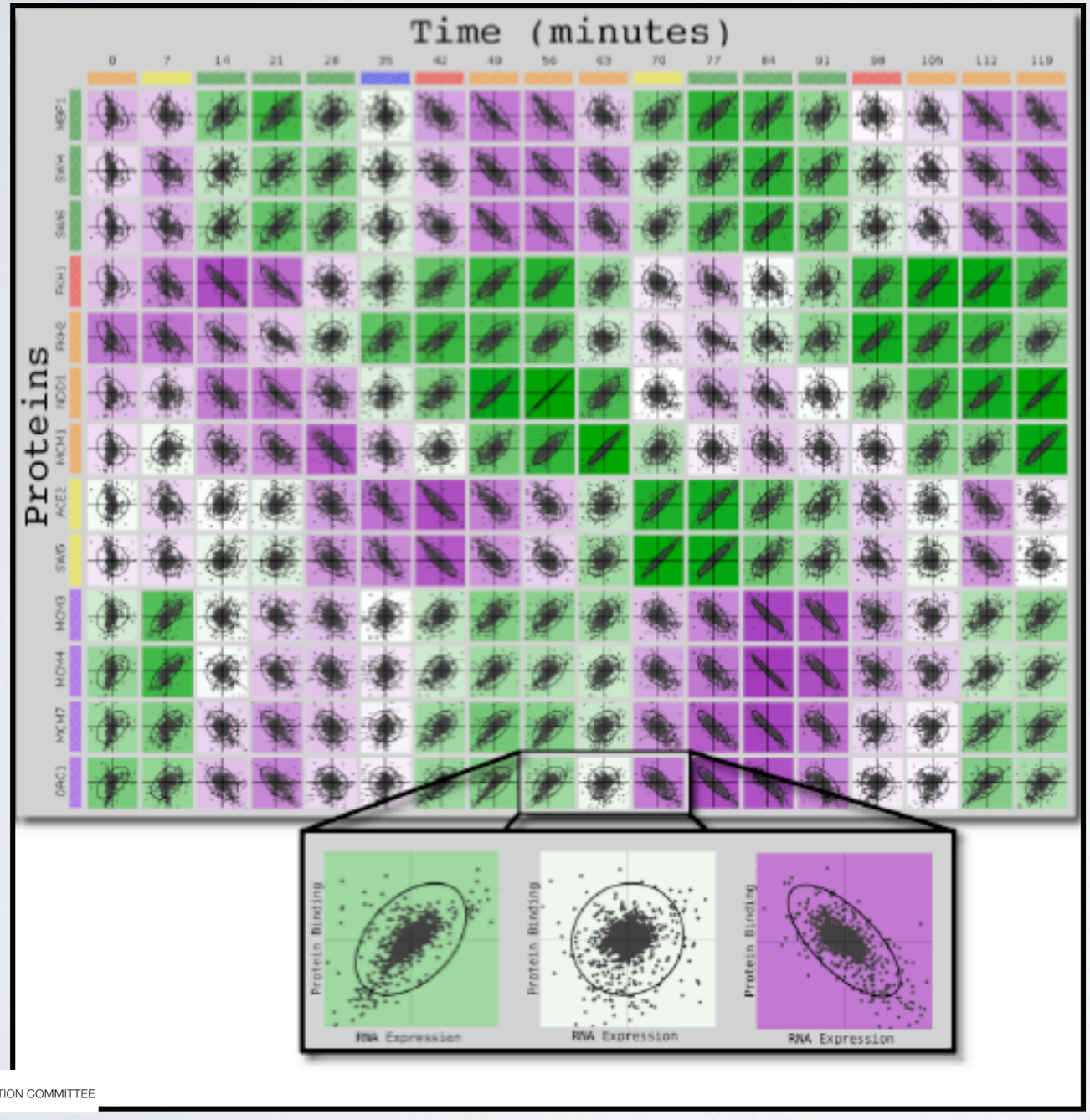
SNAPSHOT OF ANIMATION SEQUENCE EVOLVING IN A NON-LINEAR EDITING SYSTEM:



Time series based on Hurricane Katrina model run at a 2 kilometer grid resolution using the Weather Research Forecast (WRF) model. The animation shows rain isosurfaces, with the purple areas being locations of heaviest rainfall. Dark blue areas are land masses.

CASE STUDY #3: VISUALIZING CORRELATION IN MOLECULAR BIOLOGICAL DATA



Using tiled scatter plot displays with complementary color schemes, coordinated patterns of correlation and anti-correlation are visible.

Reference: "Visualizing Global Correlation in Large-Scale Molecular Biological Data", A.N.M. Imroz Choudhury, Kristin Potter, Theresa-Marie Rhyne, Yarden Livnat, Chris R. Johnson, and Olry Alter, Scientific Computing and Imaging Institute, University of Utah, a poster presentation at BioVis 2011.

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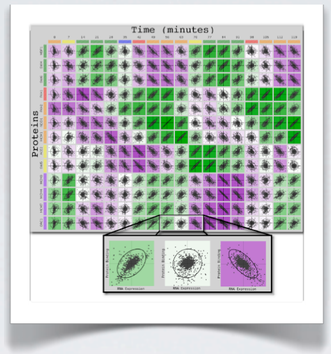
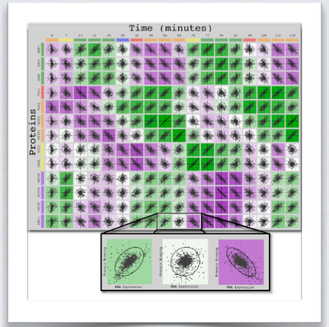


HERE, WE HIGHLIGHT 3 TOPICS:

- Selecting Complementary Color Schemes with Adobe's Kuler Tool.
- Verifying Color Vision Concerns with Vischeck.
- Using the HueVue Mobile App for approximating Color Vision Studies



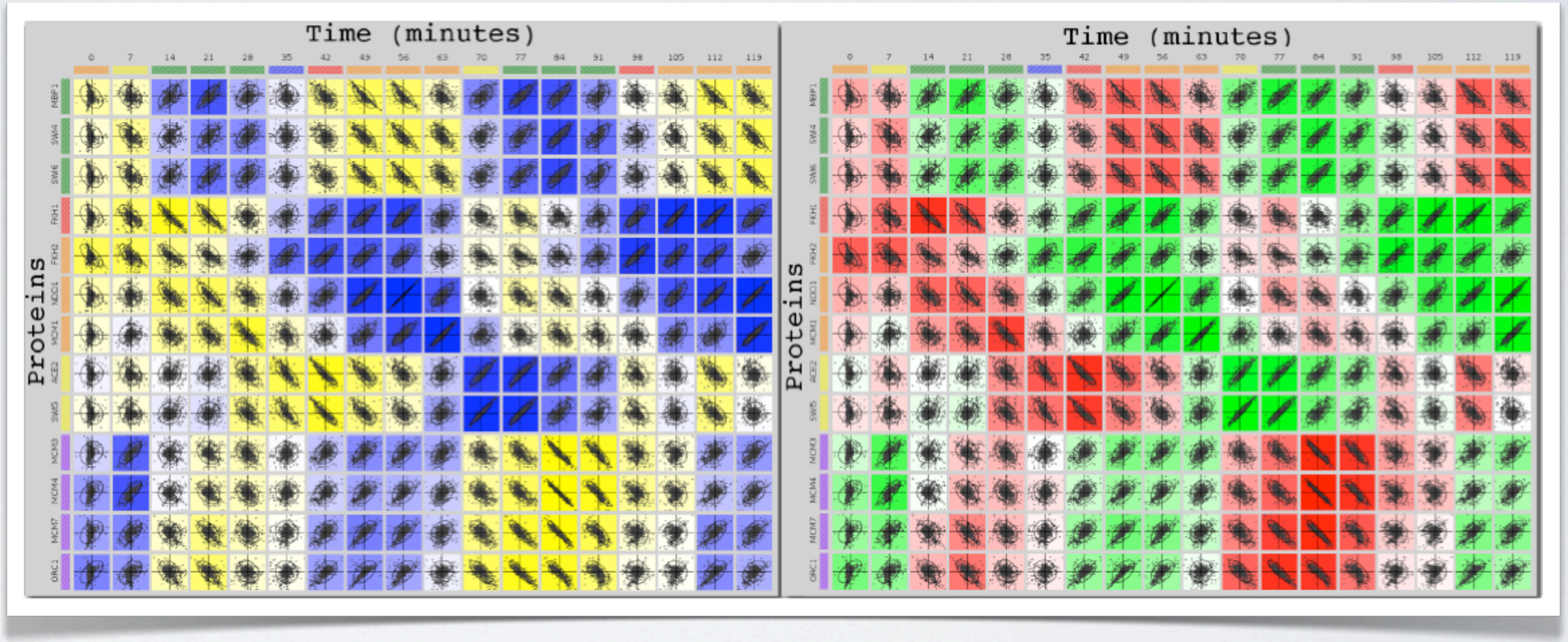
TESTING COMPLEMENTARY COLORS SCHEMES:

- Complementary Schemes: Colors opposite each other on the Color Wheel

- Creates high contrast to designate correlation and anti-correlation variables.

- Here, we show traditional color maps used in biological research.

- Adobe's Kuler tool is used to help create color schemes, see: (http://kuler.adobe.com/).



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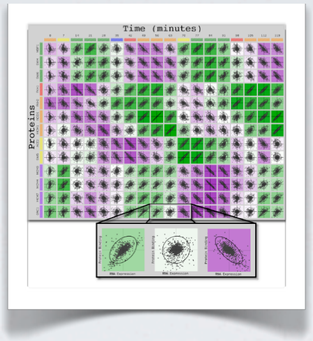


MUTED COLOR SCHEMES TO ADDRESS COLOR VISION ISSUES:

- 3 types of Color Vision Weaknesses: Deuteranope, Protanope, Tritanope.

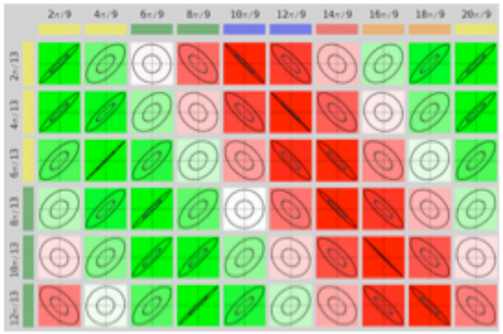
- Use Vischeck simulations to evaluate results. (http://www.vischeck.com)

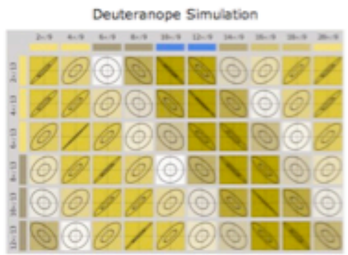
- Here, we show results for the red-green color scheme.

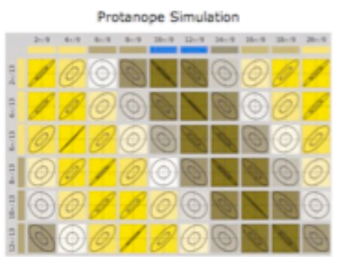
Deuteranope and Protanope are most sensitive to these color schemes.

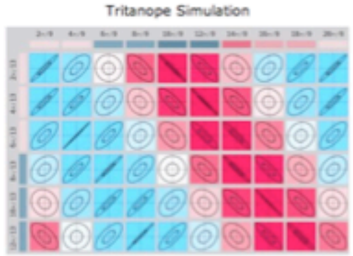
Traditional Red / Green Color Scheme

Color Blind tests using Vischeck (http://www.vischeck.com/)

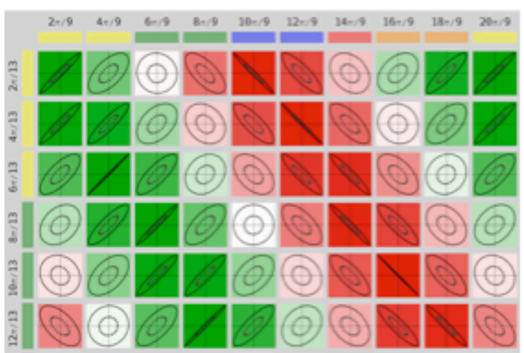


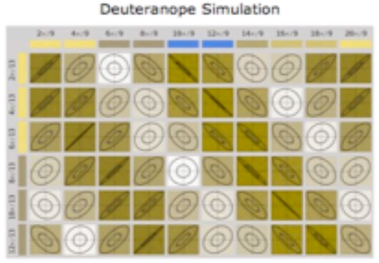


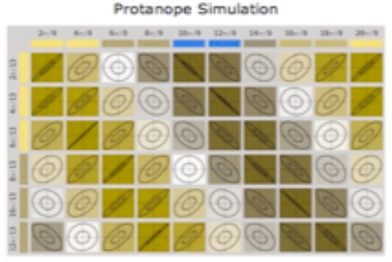


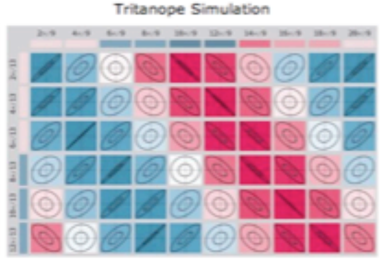


Modified – Muted Red / Green Color Scheme









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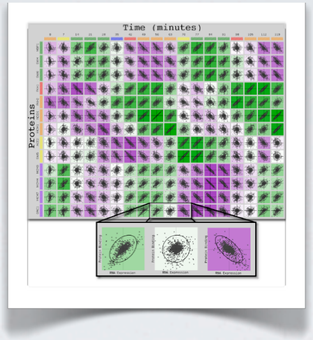


MUTED COLOR SCHEMES TO ADDRESS COLOR VISION ISSUES:

- 3 types of Color Vision Weaknesses: Deuteranope, Protanope, Tritanope.

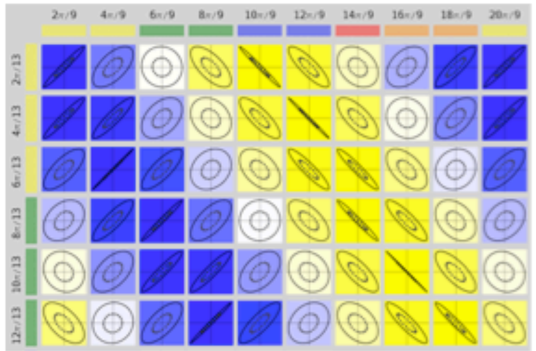
- Use Vischeck simulations to evaluate results. (http://www.vischeck.com)

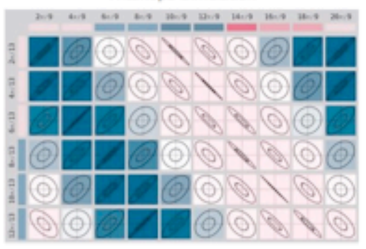
- Here, we show results for the blue - yellow color scheme.

Tritanope is most sensitive to these color schemes.

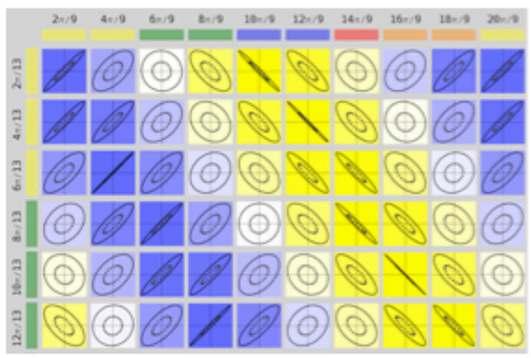
Traditional Blue / Yellow Color Scheme

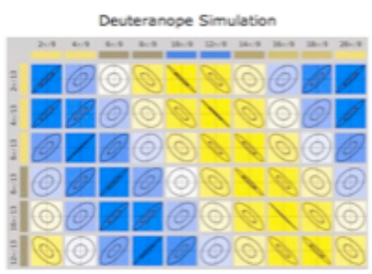
Color Blind tests using Vischeck (http://www.vischeck.com/)

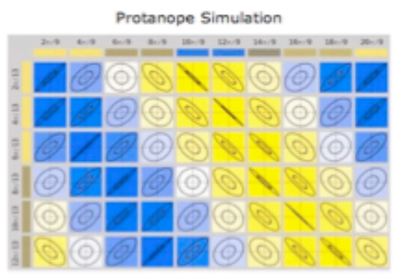


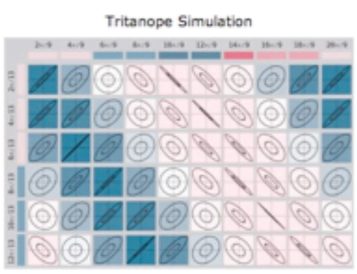


Modified – Muted Blue / Yellow Color Scheme









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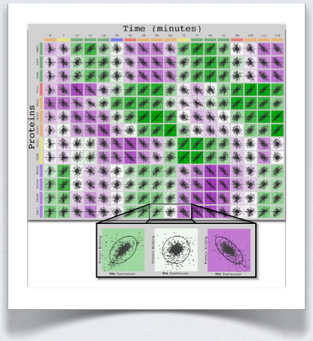
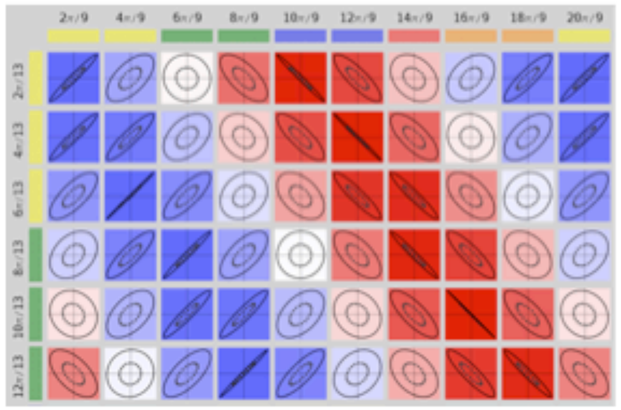
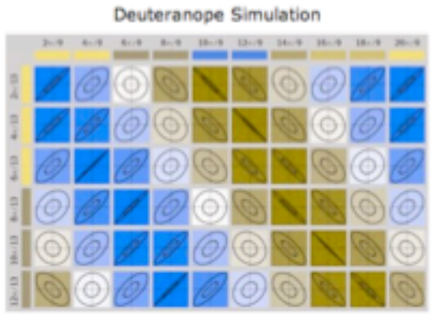


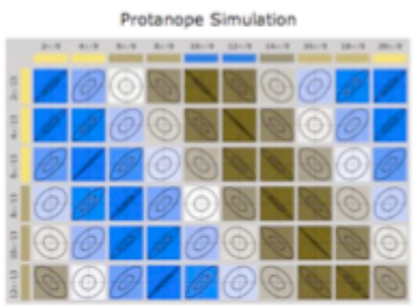
ALTERNATIVE COLOR SCHEME: BLUE-RED COLORS

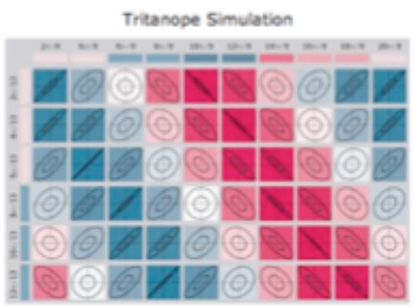
Blue / Red Color Scheme



Color Blind tests using Vischeck (http://www.vischeck.com/)







- **3 types of Color Color Vision Weaknesses: Deuteranope, Protanope, Tritanope.**

- **Use Vischeck simulations to evaluate results. (http://www.vischeck.com)**

- **Here, we show results for the blue - red color scheme.**

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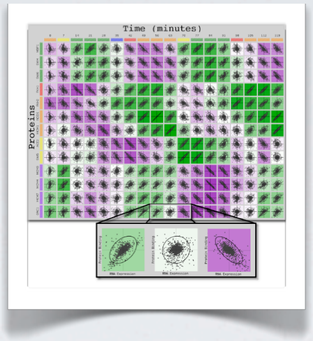
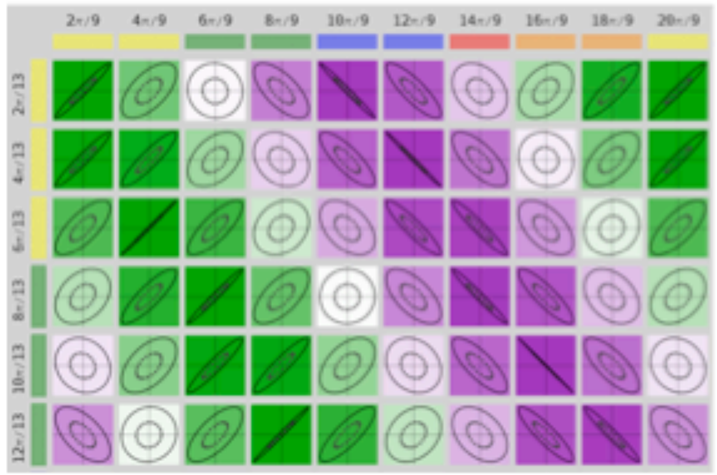
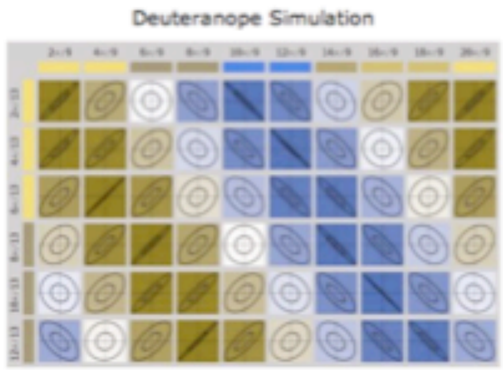
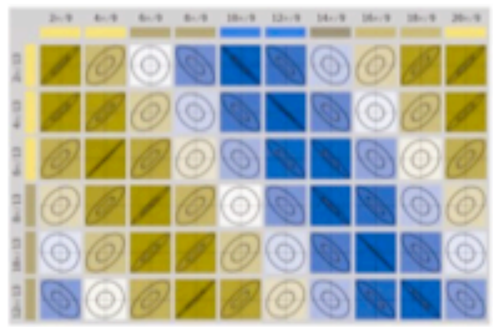


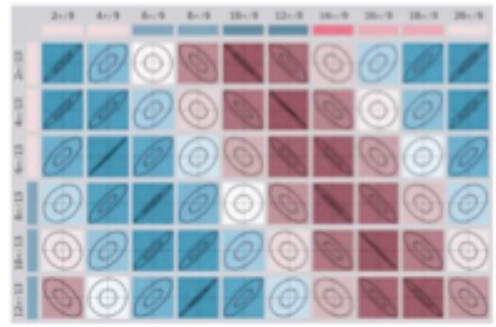
CONTRASTING COLOR SCHEME: GREEN-PURPLE COLORS

Green/ Purple Color Scheme









- 3 types of Color Vision Weaknesses: Deuteranope, Protanope, Tritanope.

- Use Vischeck simulations to evaluate results. (http://www.vischeck.com)

- Here, we show results for the green - purple color scheme.

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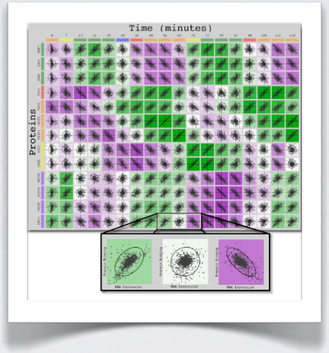
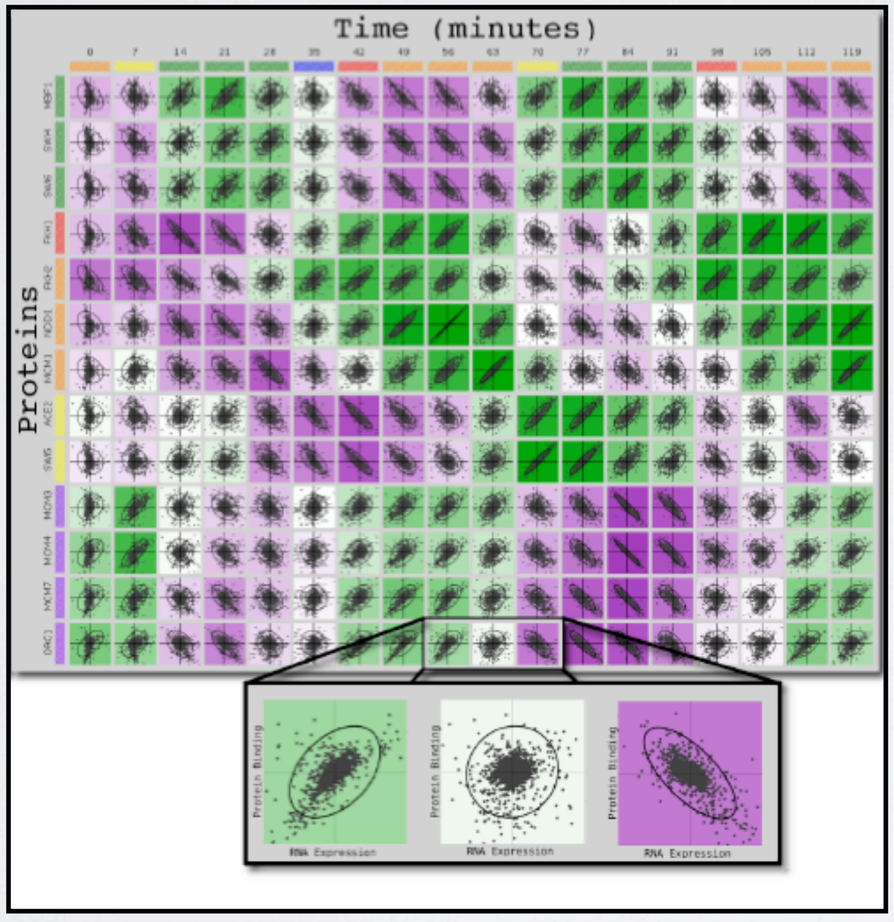


SELECTED COMPLEMENTARY COLORS SCHEME:



Adobe's Kuler tool was used to help establish the color schemes for this work . See: (http://kuler.adobe.com/).

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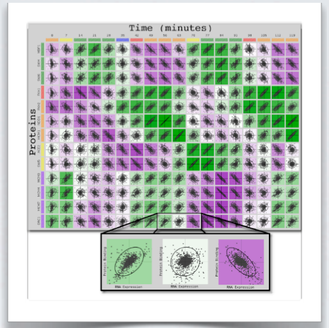
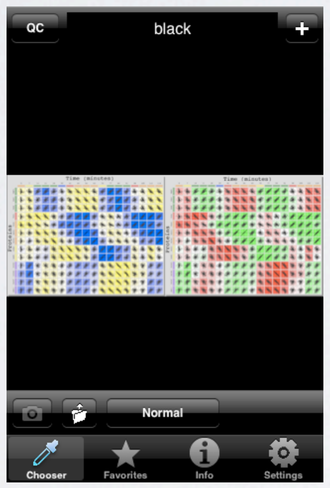
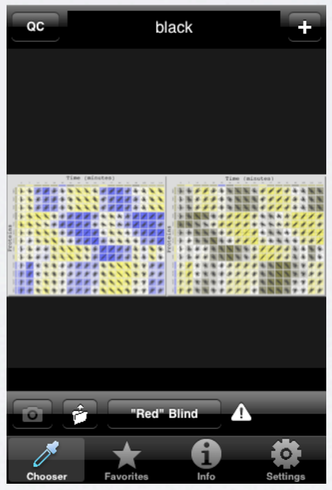
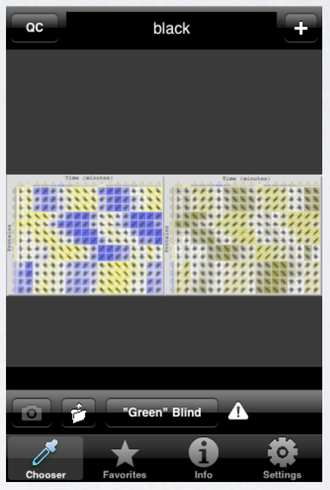


USING HUEVUE APP FOR APPROXIMATING COLOR VISION STUDIES:

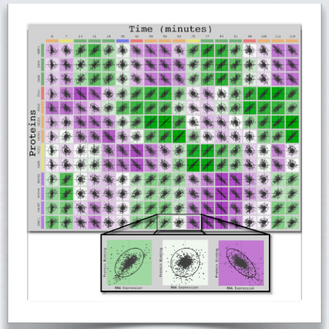
http://itunes.apple.com/us/app/huevue-colorblind-tools/





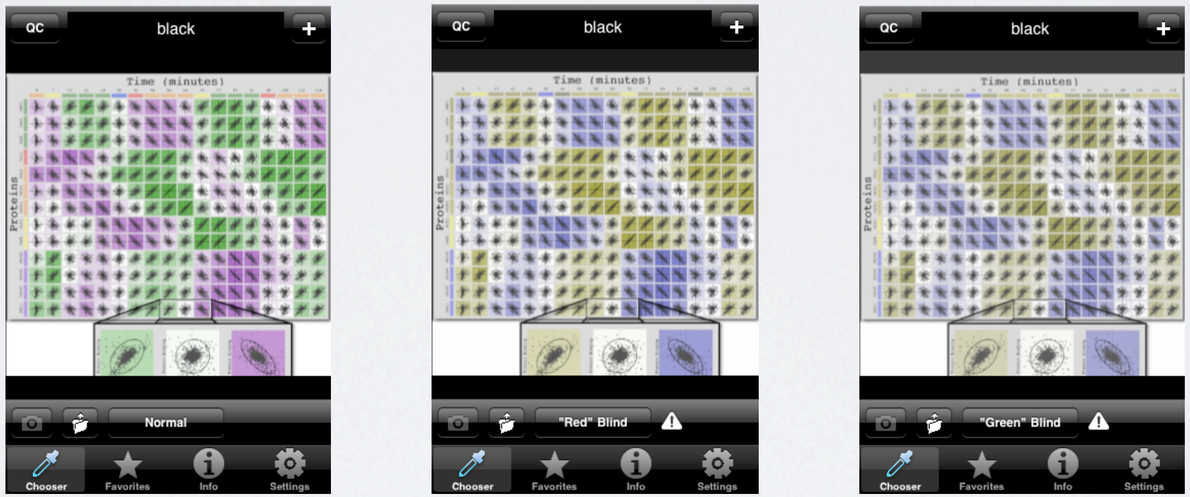


The HueVue Mobile App considers Red Color Blindness and Green Color Vision Weaknesses. HueVue is a useful tool for compensating for color vision weaknesses but is not as robust as the online VisCheck tool.



USING HUEVUE APP FOR APPROXIMATING COLOR VISION STUDIES:

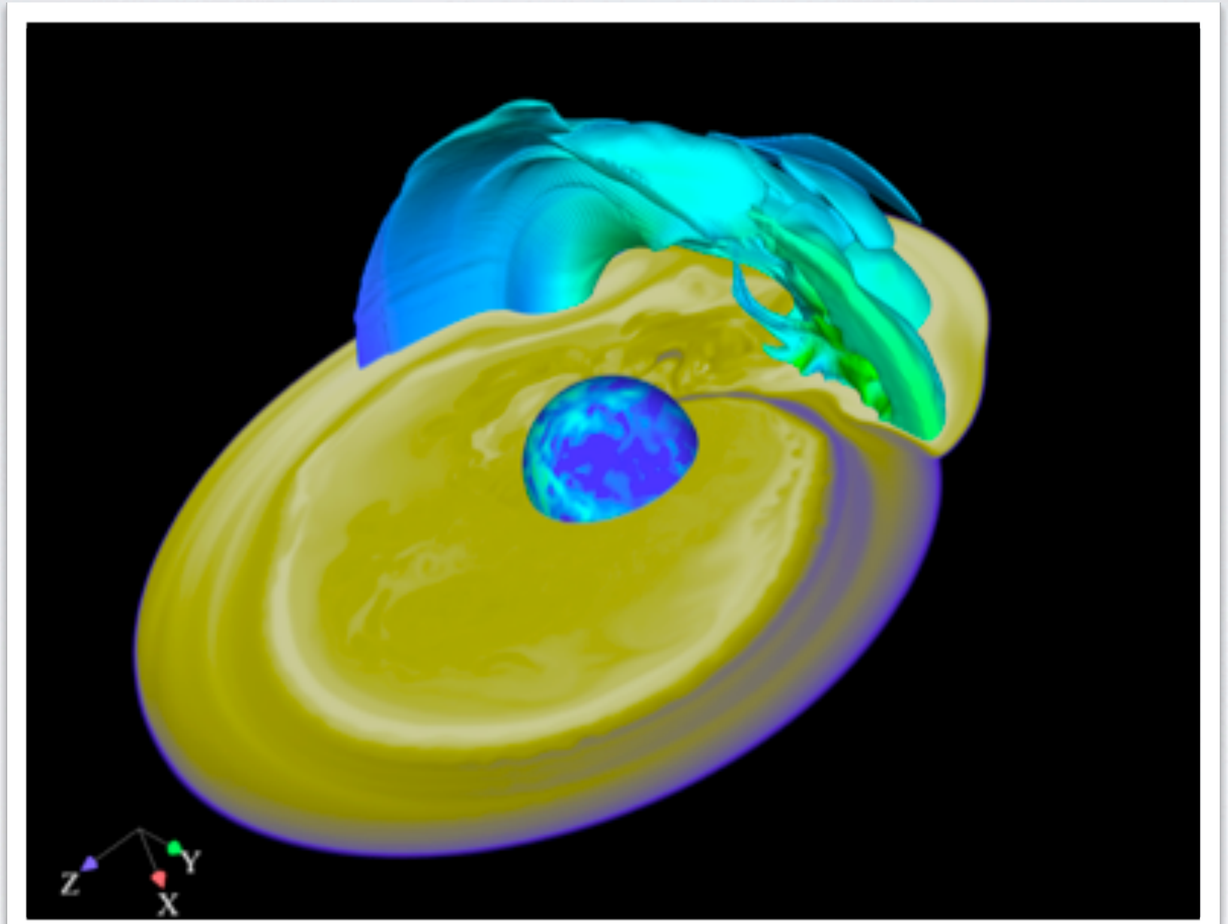
http://itunes.apple.com/us/app/huevue-colorblind-tools/



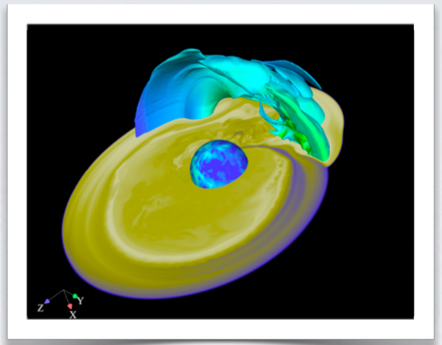
We use the HueVue Mobile App to examine our selected Green & Purple Complementary Color Scheme.

HueVue is a useful tool for compensating for red and green color vision weaknesses but is not as robust as the online VisCheck tool.

CASE STUDY #4: COLORIZING A SUPERNOVA



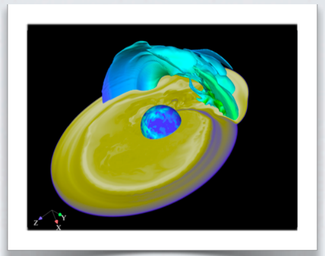
Visualization based on astrophysics data of a supernova shock wave. The computational model was executed on a high performance computer and visualized with CEI's Ensight Visualization software. (http://www.ensight.com)



HERE, WE HIGHLIGHT 2 TOPICS:

- Building the analogous and complementary color schemes with Color Scheme Designer.

- Using Adobe's Kuler tool to analyze an existing Color Scheme.



BUILDING ANALOGOUS COLORS:

- Analogous Colors are color adjacent to each other on the Color Wheel.

- Color Scheme Designer has an “Analogic” option to help select analogous colors.

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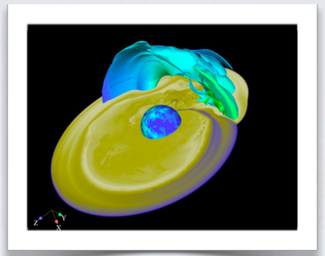

BUILDING COMPLEMENTARY COLORS:

- Complementary Colors are color across each other on the Color Wheel.

- Color Scheme Designer has an "Complement" option to help select complementary colors.

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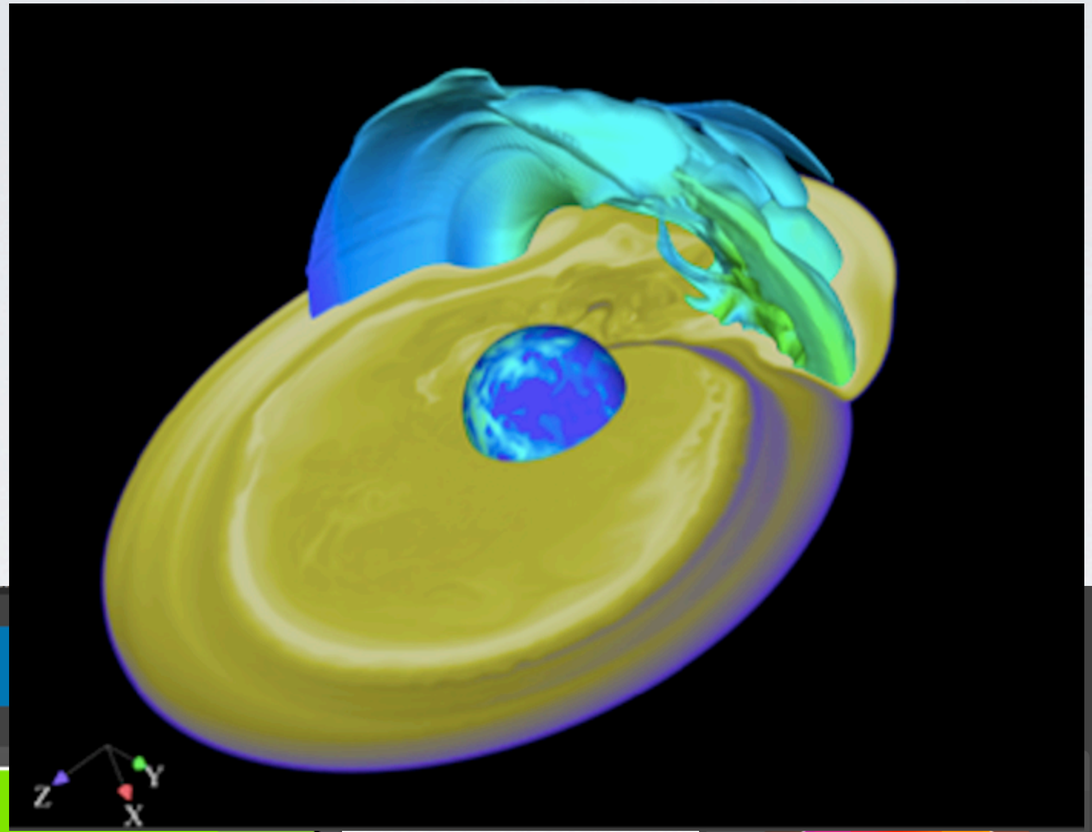
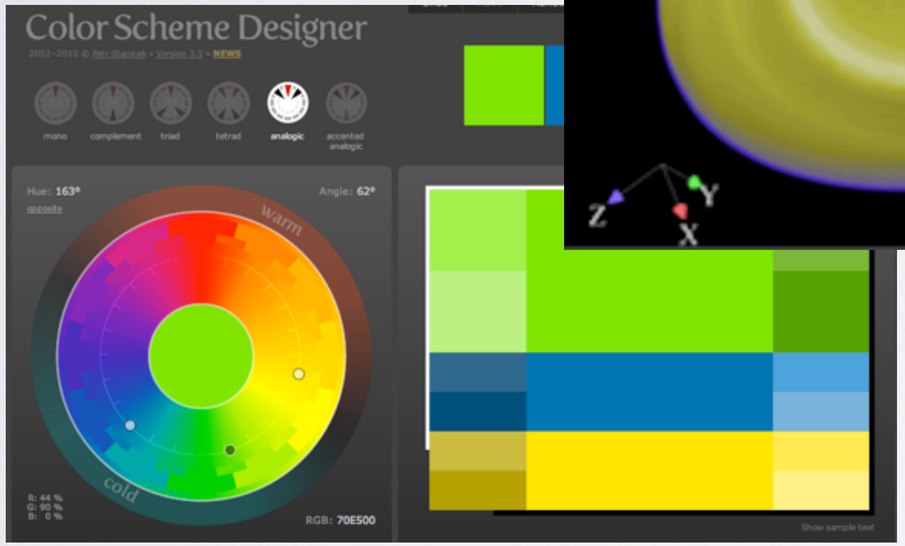
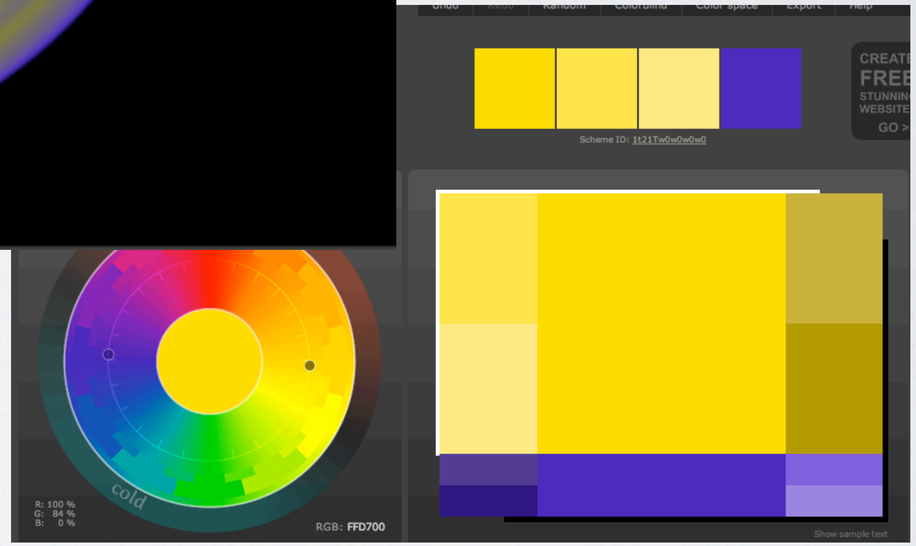
COMBINING ANALOGOUS & COMPLEMENTARY COLOR SCHEMES

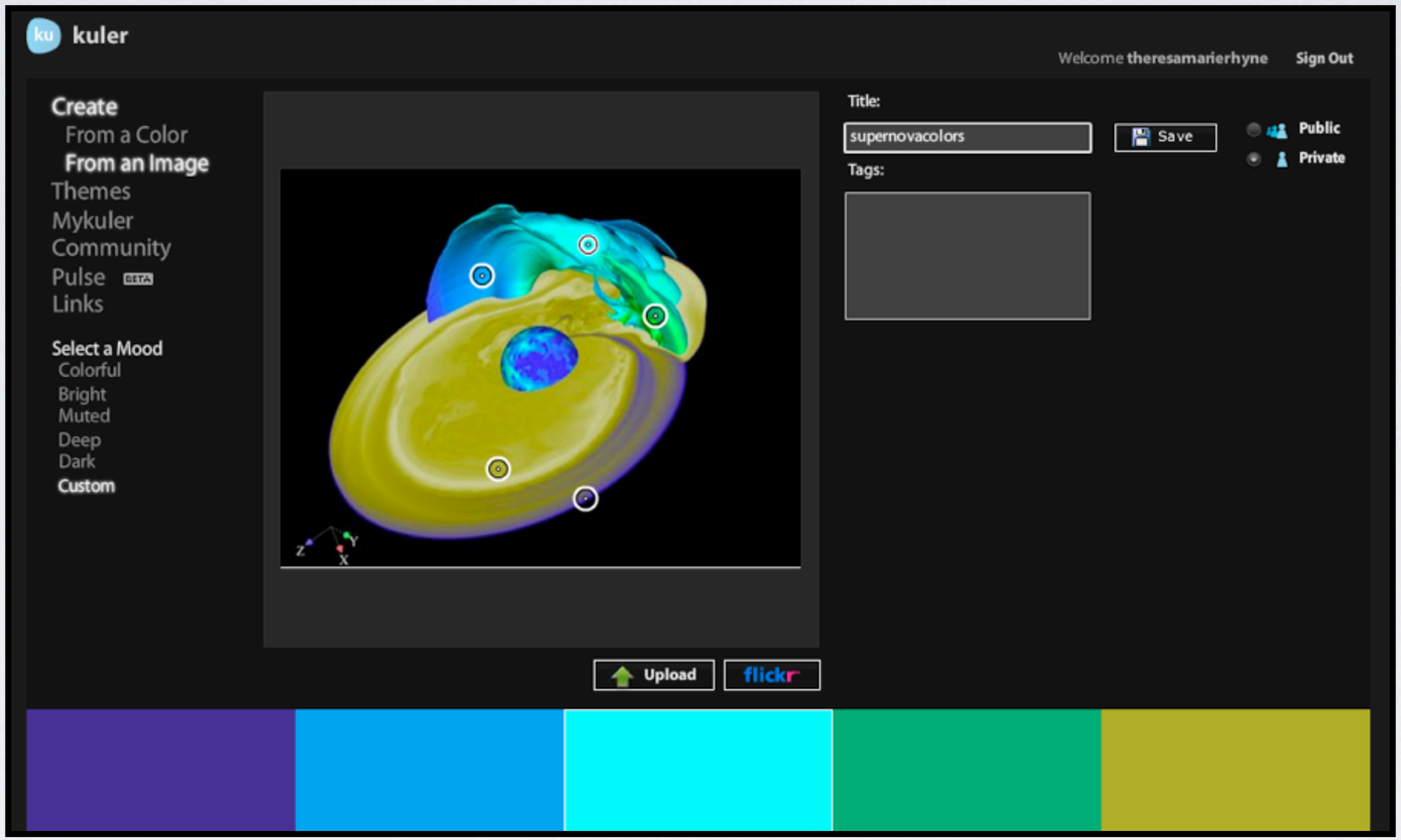


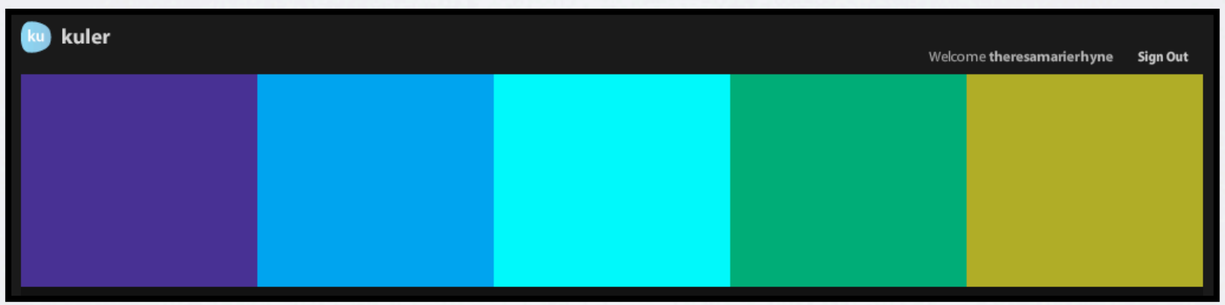




We use the analogous color scheme of Yellow, Green and Blue to colorize our Super Nova object. Next, we use Color Scheme designer to find the complementary color to Yellow. Our intent is to emphasize the ring of data values surrounding the Super Nova with this complementary color. Color Scheme Designer assists us in showing the complementary color to be Blue-Purple.

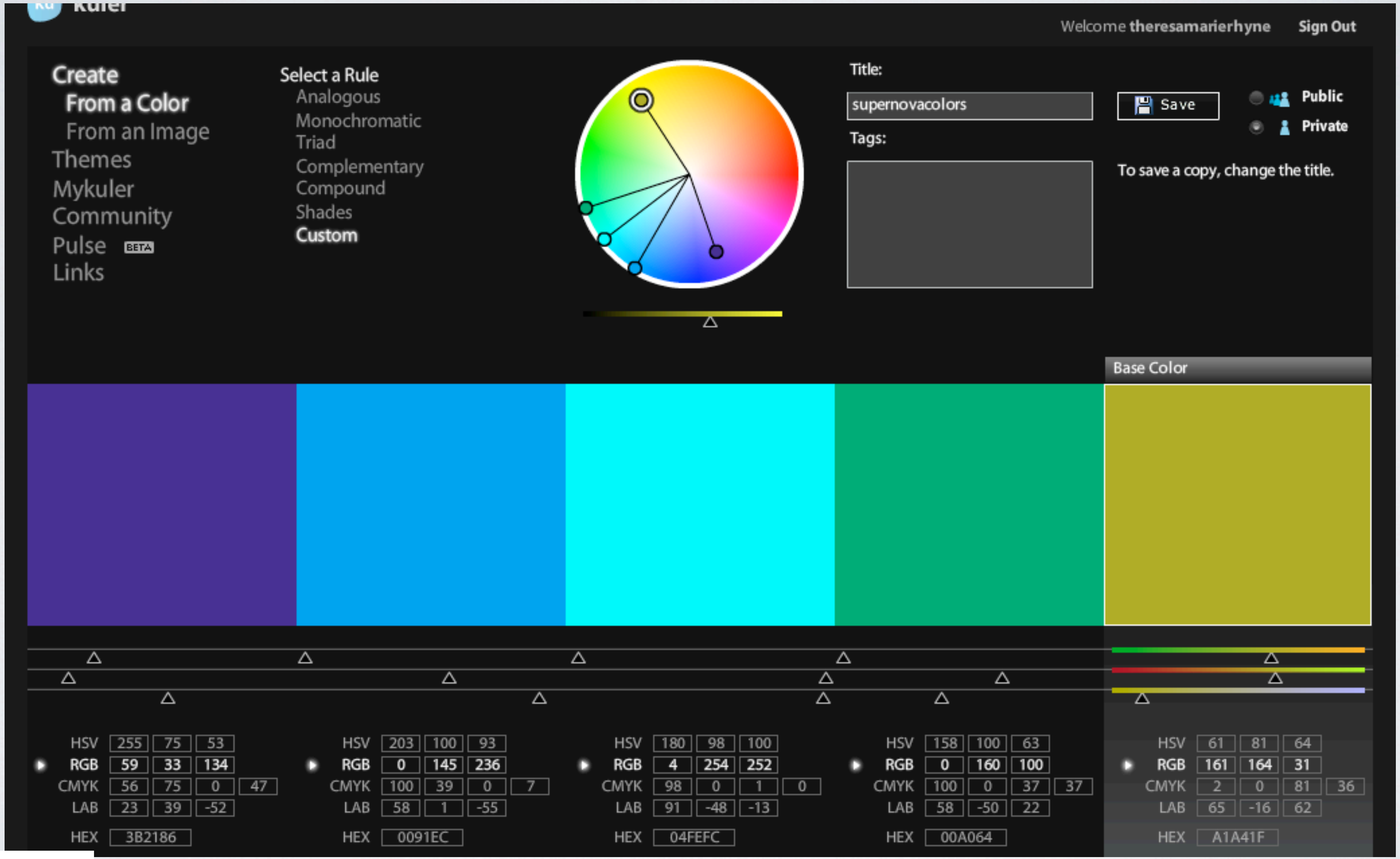
NOW, LET'S USE ADOBE'S KULER TOOL TO ANALYZE THE COLORS IN OUR SUPERNOVA VISUALIZATION:





Adobe's Kuler tool allows us to analyze the colors in a JPEG image. We can save the resulting color palettes for future work. See: http://kuler.adobe.com/.

WITH ADOBE'S KULER TOOL, WE OBTAIN COLOR VALUES AND POSSIBLE COLOR RELATIONSHIPS:



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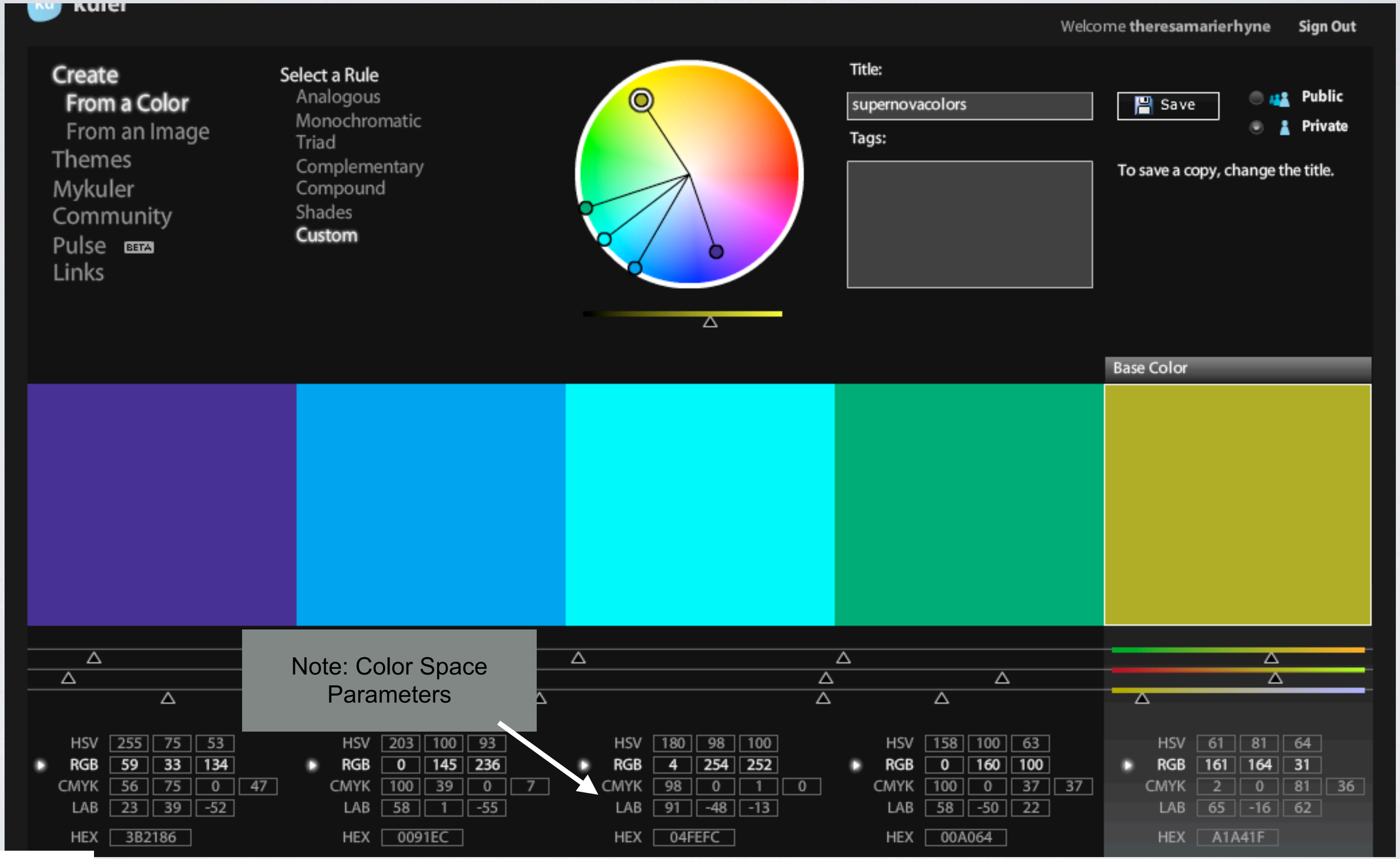


HANDS ON WORKSHOP:
USING ONLINE COLOR TOOLS

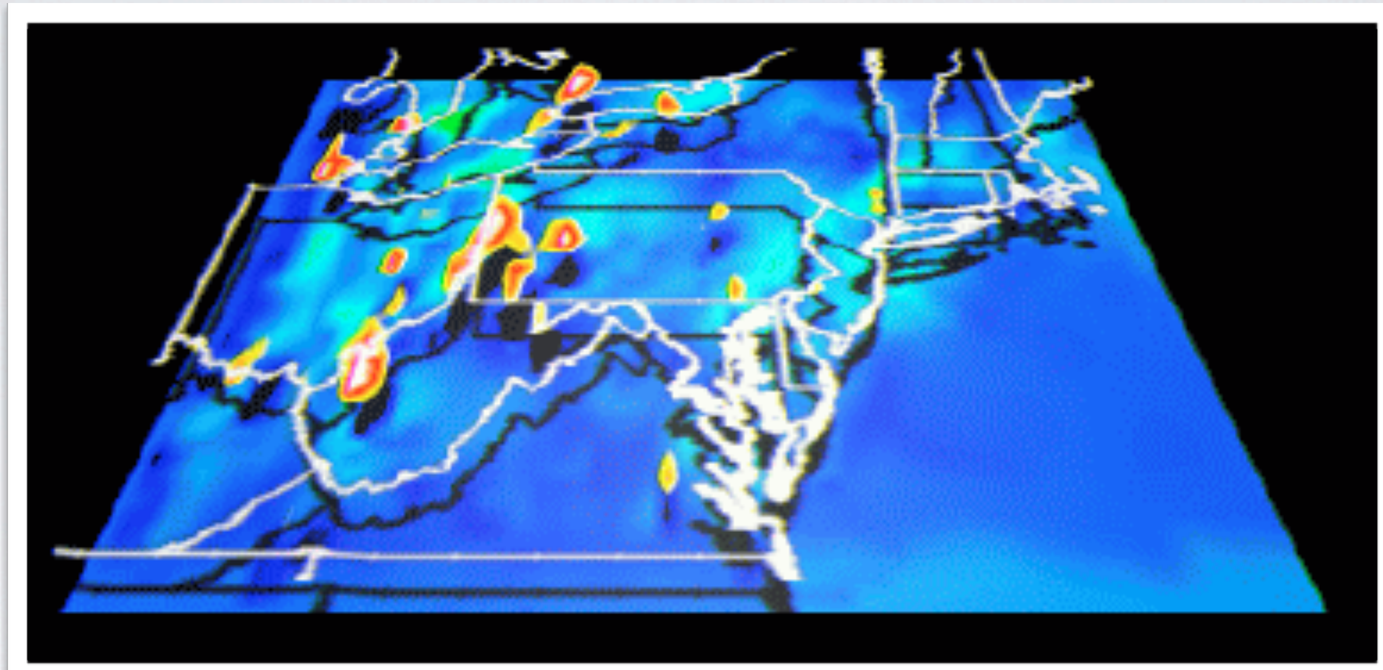
- Adobe's Kuler Tool: http://kuler.adobe.com/

- Color Scheme Designer: http://colorschemedesigner.com/

- Colorbrewer: http://colorbrewer2.org/

- ColorSchemer Touch: http://www.colorschemer.com/touch_info.php

HANDS ON WORKSHOP:
A DATA VISUALIZATION EXAMPLE



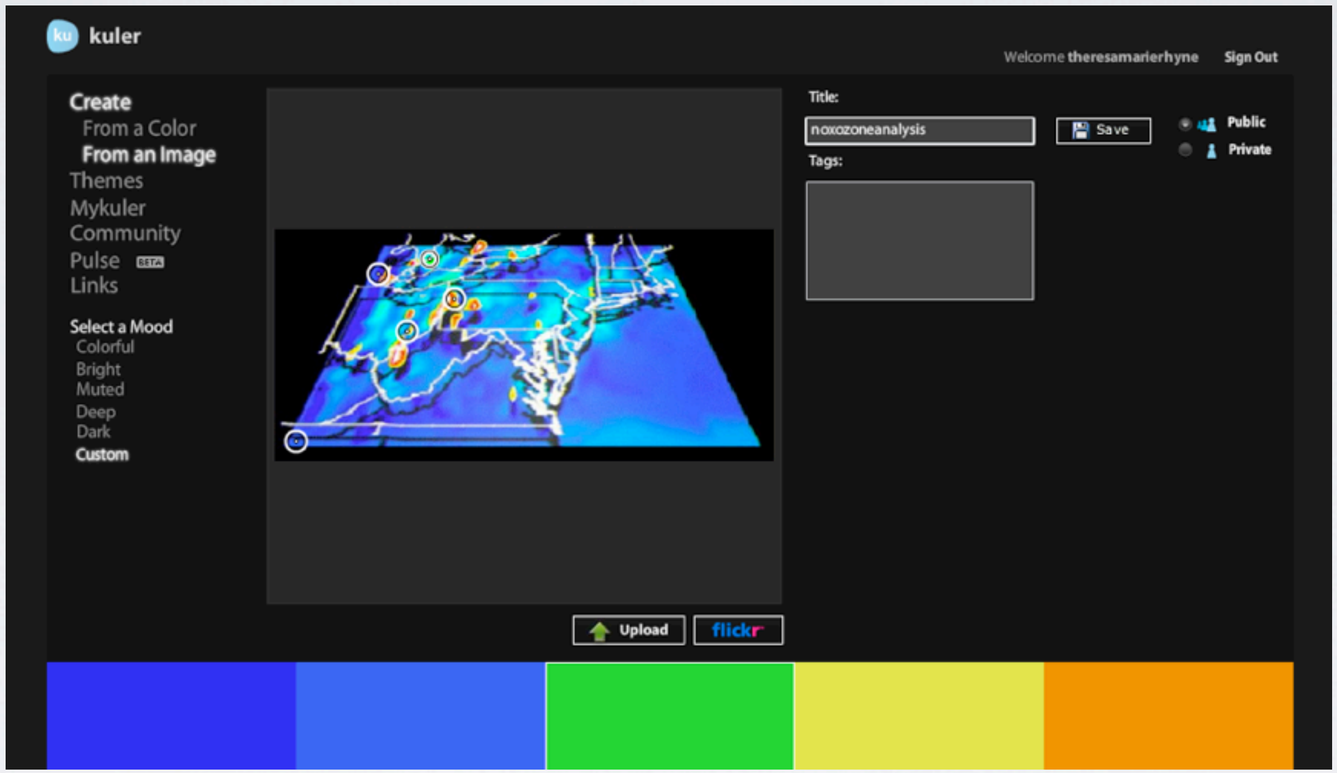
- Adobe's Kuler Tool: http://kuler.adobe.com/
- Color Scheme Designer: http://colorschemedesigner.com/
- Colorbrewer: http://colorbrewer2.org/
- ColorSchemer Touch: http://www.colorschemer.com/touch_info.php

USING ADOBE'S KULER TOOL:

http://kuler.adobe.com/

- Register & Establish an account with Adobe
- Login to Adobe Kuler.
- Select "Create" Option.
- Move 5 sensors to select colors.
- Establish Color Palette.
- Name Color Palette under "Title".
- Save Color Palette.

VISUAL RESULTS WITH OUR JPEG EXAMPLE:



Adobe's Kuler tool allows us to analyze the colors in a JPEG image. We can save the resulting color palettes for future work. See: http://kuler.adobe.com/.

WITH ADOBE'S KULER TOOL, WE OBTAIN COLOR VALUES AND POSSIBLE COLOR RELATIONSHIPS:

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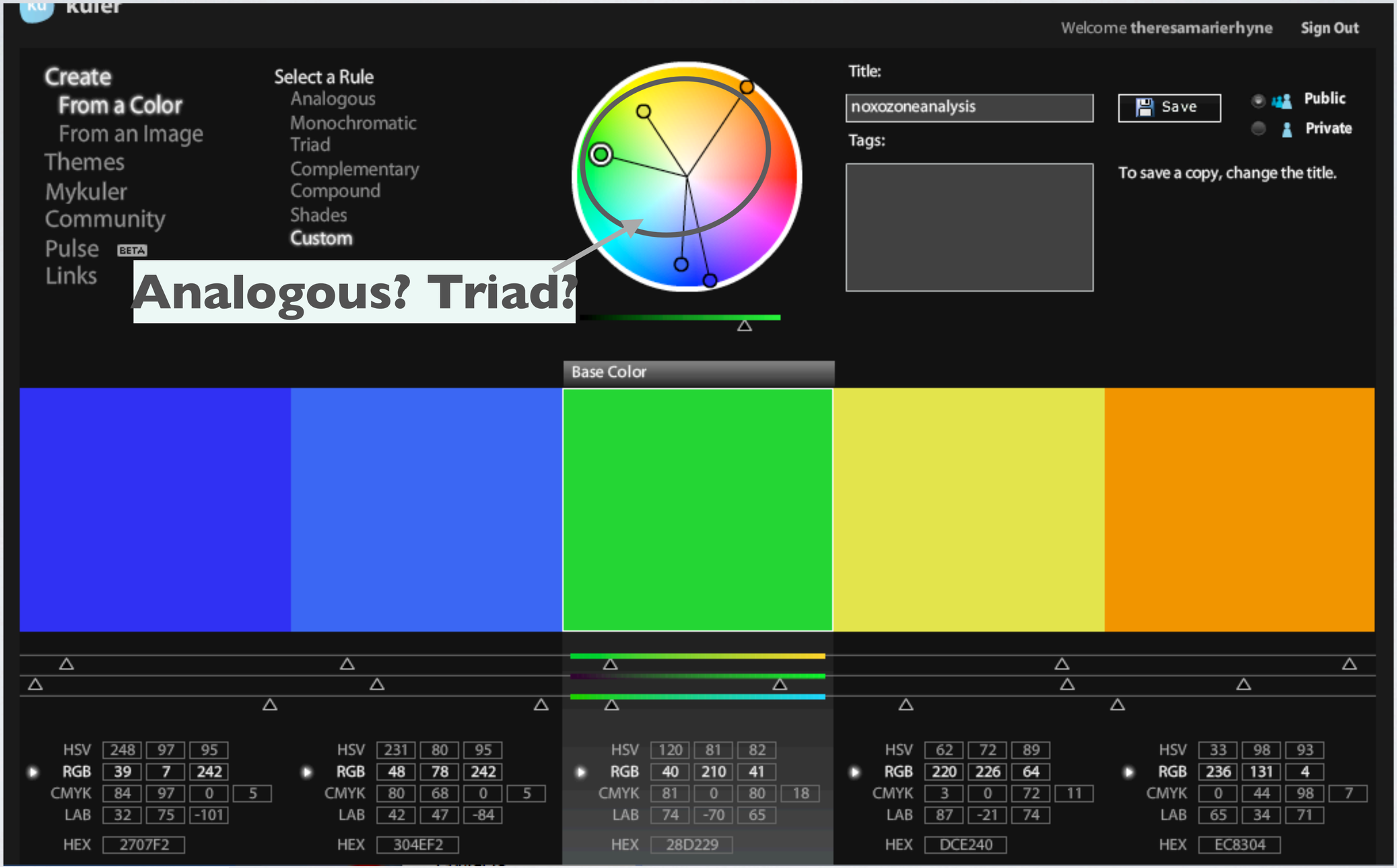

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WITH ADOBE'S KULER TOOL, WE OBTAIN COLOR VALUES AND POSSIBLE COLOR RELATIONSHIPS:

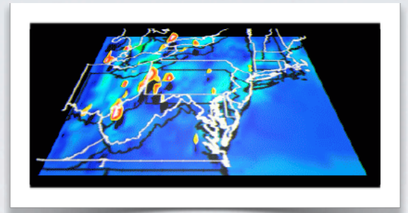
USING COLOR SCHEME DESIGNER:

http://colorschemedesigner.com/

- Use Browser to go to Color Scheme Designer Site.
- Select primary Color Scheme for Project.

  (Our Example uses a Tetrad Scheme)
- Establish Color Options

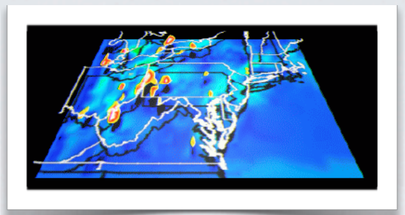
  (In our Example: Orange, Yellow, Blue & Green)
- Select Color List to view selected Colors.
- Establish & Save Color Palette.



VISUAL RESULTS WITH OUR JPEG EXAMPLE:

Note: Hex Triplet Parameters

The Color Scheme Designer tool allows us to select a color scheme. We can save the resulting color palette for future work. See: http://colorschemedesigner.com/.



USING COLORBREWER:

http://colorbrewer2.org/

- Use Browser to go to Colorbrewer Site.

  (Requires Flash Plugin)

- Select “number of data classes”.

  (Our Example uses 4 data classes)

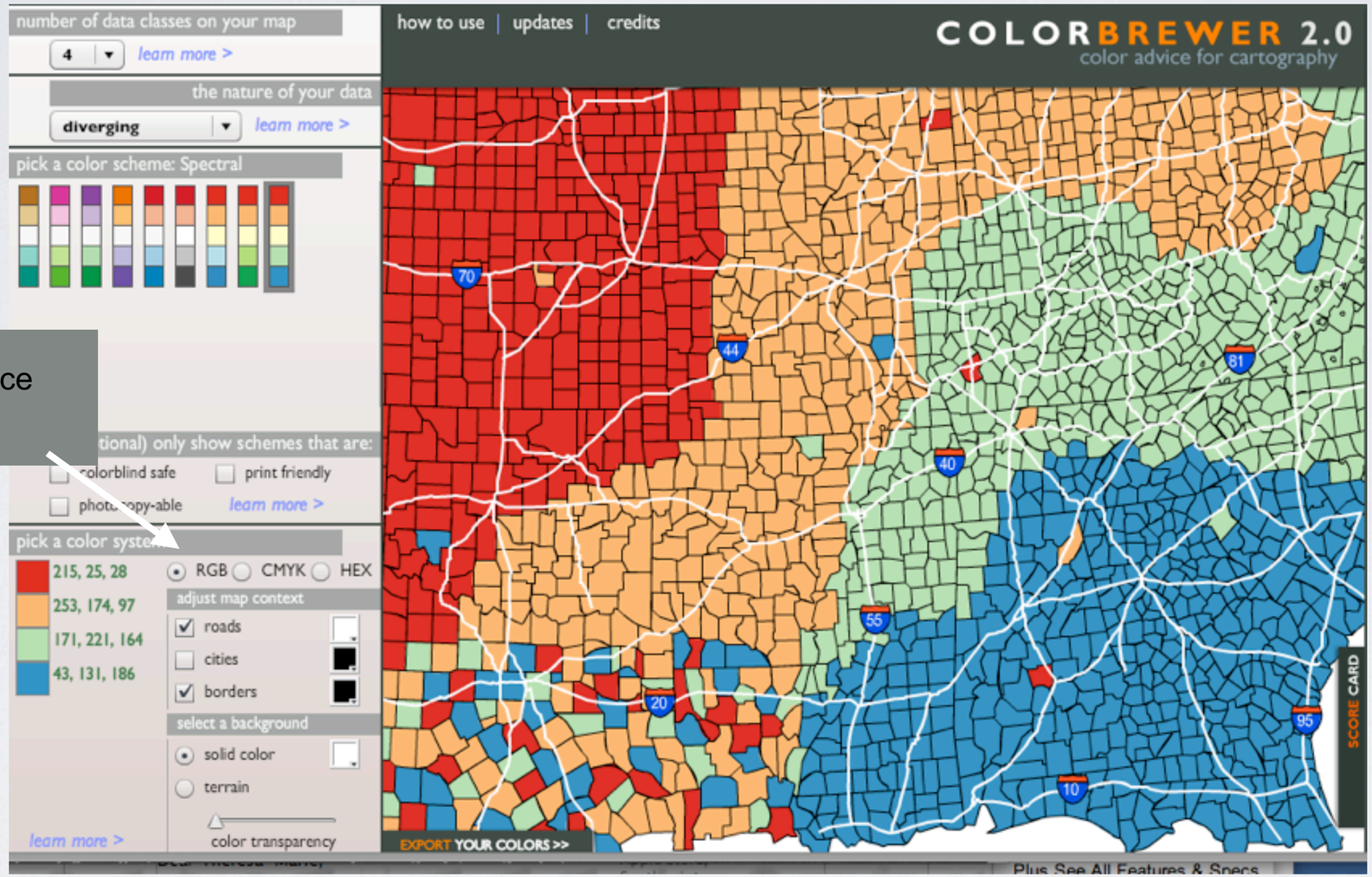
- Establish “nature of your data”.

  (In our Example: Diverging)

- Select “Color Scheme” & view selected Colors.

- Pick a “Color System” & Save Color Palette.

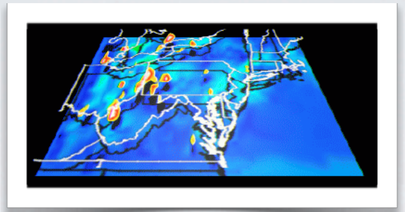
VISUAL RESULTS WITH OUR JPEG EXAMPLE:



Note: Color Space Parameters

The Colorbrewer tool is optimized for selecting colors for building geographic maps but can be used beyond its original intent . We can save the resulting color palette for future work.

See: http://colorbrewer2.org/.



USING COLORSCHEMER TOUCH:

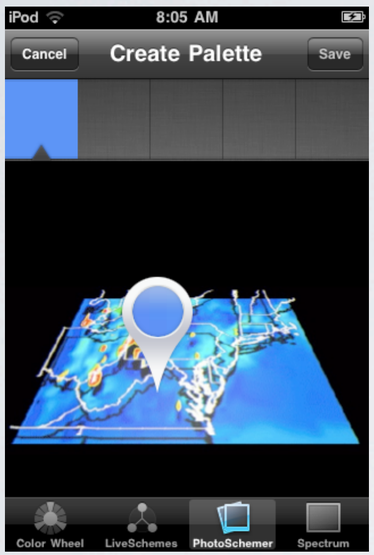
http://www.colorschemer.com/touch_info.php

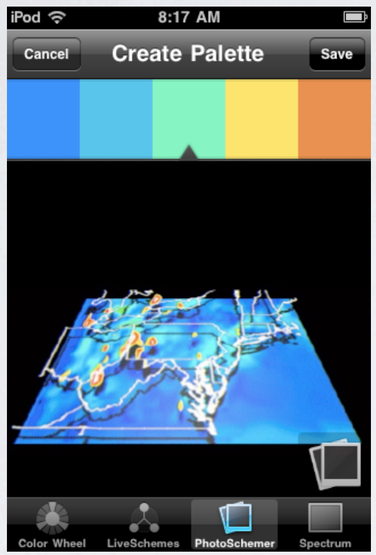
- Select ColorSchemer App on your iPhone/iPod Touch/iPad.

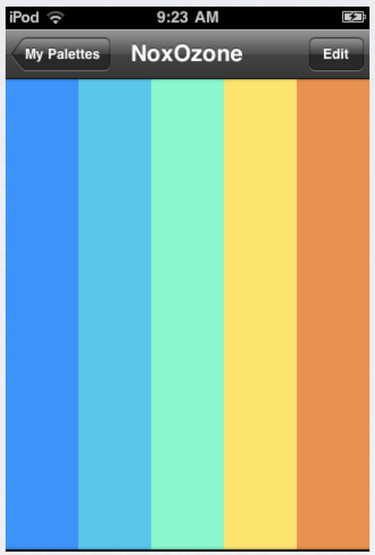
  (This is a free app from the iTunes online store.)

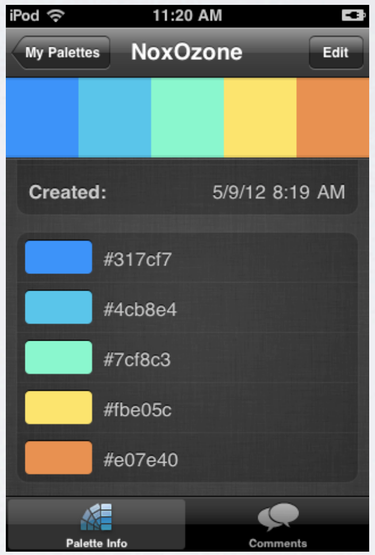
- Select + Option to view “Create Palette” Color Wheel Screen.
- Select PhotoSchemer to begin Photo Import & Select Photos icon.
- Import Photo from Photo Albums into “Create Palette”.
- Brush over Photo to select colors & “Create Palette”.
- Establish & Save Color Palette.

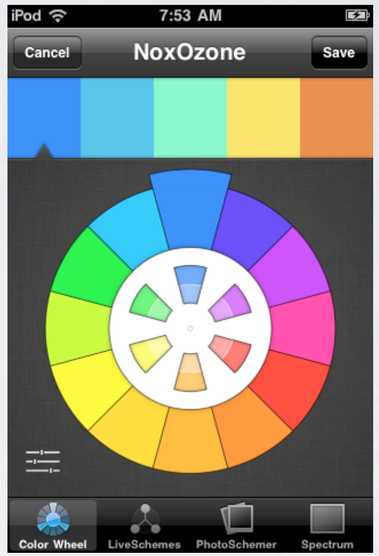
VISUAL RESULTS WITH OUR JPEG EXAMPLE:

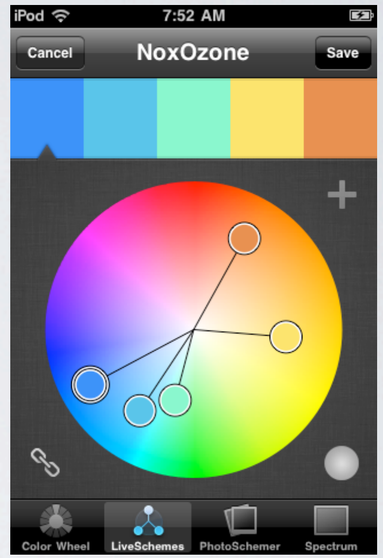












ColorSchemer Touch allows us to analyze the colors in a JPEG image / Photo on our mobile device. We can save the resulting color palettes for future work. See: http://www.colorschemer.com/touch_info.php.

HANDS ON WORKSHOP:
A GENERAL DIGITAL MEDIA EXAMPLE

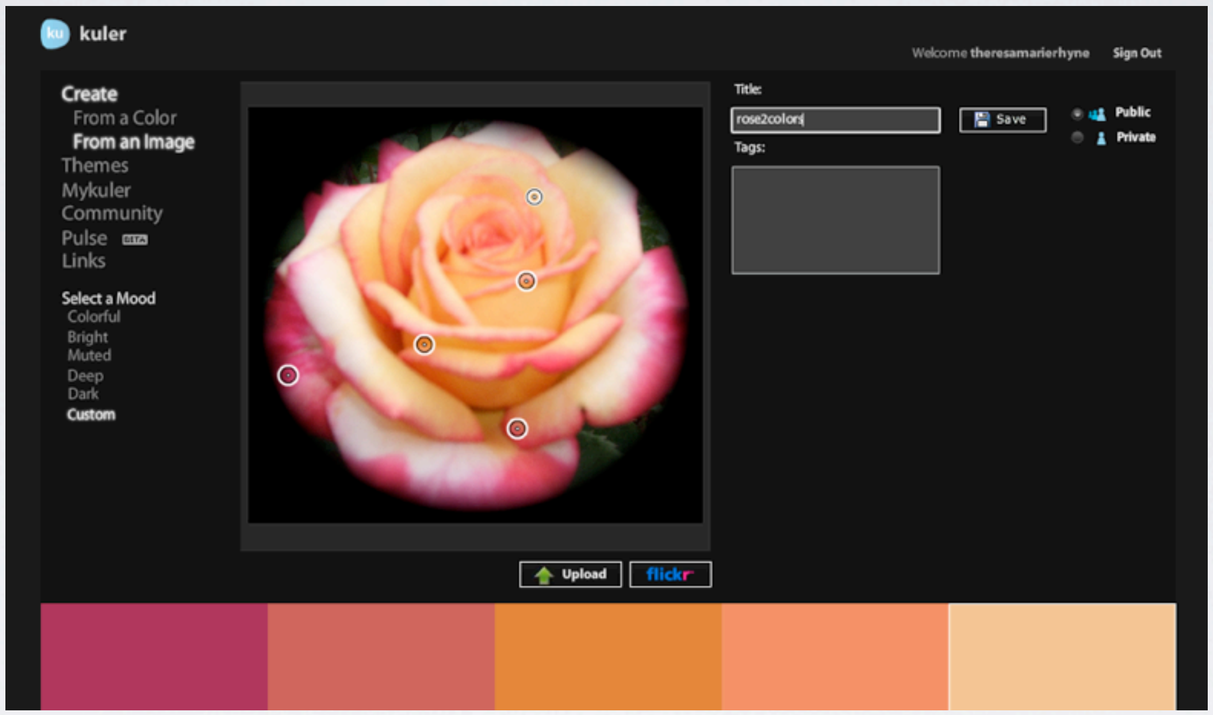
- Adobe's Kuler Tool: http://kuler.adobe.com/
- Color Scheme Designer: http://colorschemedesigner.com/
- ColorSchemer Touch: http://www.colorschemer.com/touch_info.php

USING ADOBE'S KULER TOOL:

http://kuler.adobe.com/

- Register & Establish an account with Adobe
- Login to Adobe Kuler.
- Select "Create" Option.
- Move 5 sensors to select colors.
- Establish Color Palette.
- Name Color Palette under "Title".
- Save Color Palette.

VISUAL RESULTS WITH OUR JPEG EXAMPLE:



Adobe's Kuler tool allows us to analyze the colors in a JPEG image. We can save the resulting color palettes for future work. See: http://kuler.adobe.com/.

WITH ADOBE'S KULER TOOL, WE OBTAIN COLOR VALUES AND POSSIBLE COLOR RELATIONSHIPS:

USING COLOR SCHEME DESIGNER:

http://colorschemedesigner.com/

- Use Browser to go to Color Scheme Designer Site.
- Select primary Color Scheme for Project.

  (Our Example uses an Analogous Scheme)
- Establish Color Options

  (In our Example: Orange, Red & Pink)
- Select Color List to view selected Colors.
- Establish & Save Color Palette.

VISUAL RESULTS WITH OUR JPEG EXAMPLE:

The Color Scheme Designer tool allows us to select a color scheme. We can save the resulting color palette for future work. See: http://colorschemedesigner.com/.

USING COLORSCHEMER TOUCH:

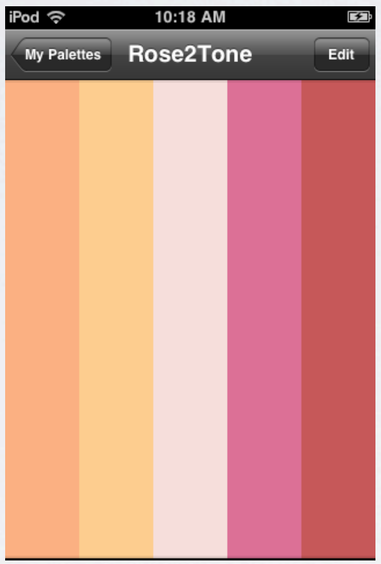
http://www.colorschemer.com/touch_info.php

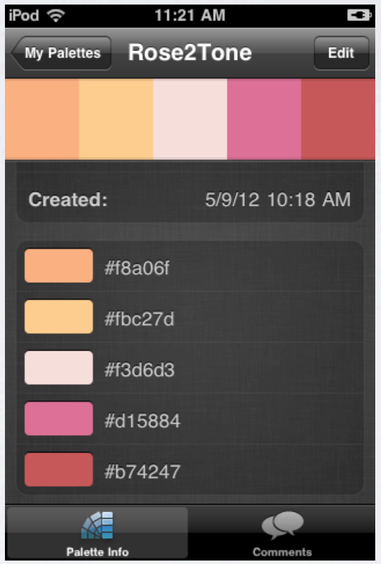
- Select ColorSchemer App on your iPhone/iPod Touch/iPad.

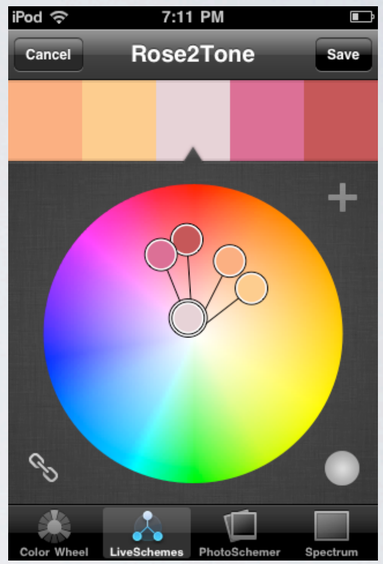
  (This is a free app from the iTunes online store.)

- Select + Option to view “Create Palette” Color Wheel Screen.
- Select PhotoSchemer to begin Photo Import & Select Photos icon.
- Import Photo from Photo Albums into “Create Palette”.
- Brush over Photo to select colors & “Create Palette”.
- Establish & Save Color Palette.

VISUAL RESULTS WITH OUR JPEG EXAMPLE:







ColorSchemer Touch allows us to analyze the colors in a JPEG image / Photo on our mobile device. We can save the resulting color palettes for future work. See: http://www.colorschemer.com/touch_info.php.

USING MYPANTONE:

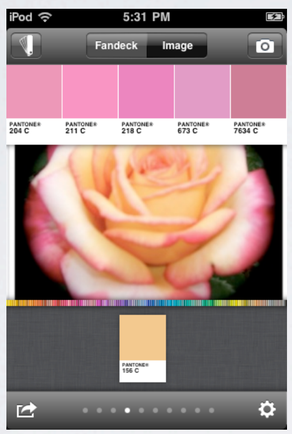
http://www.pantone.com/pages/pantone/pantone.aspx?pg=20696

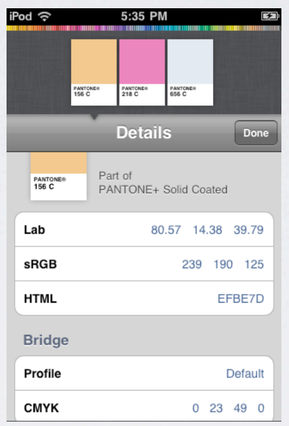
- Select myPANTONE App on your iPhone/iPod Touch/iPad.

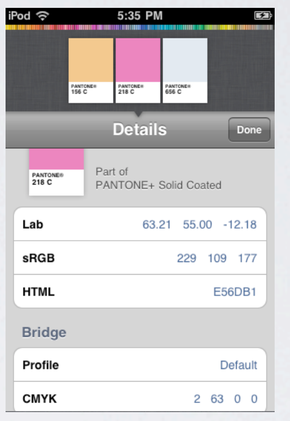
  (This is a $9.99 app from the iTunes online store.)

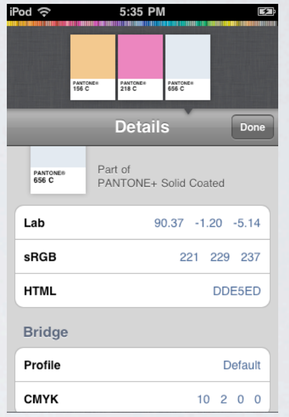
- Select an image to begin extracting Pantone colors/Choose Existing Photo .
- myPANTONE automatically extracts colors and builds color scheme .
- To Create your own color palette, select arrow icon & Clear Colors.
- Brush over Photo to select colors & select individual colors.
- Transfer colors to Color Palette under the image.
- Select Pantone color to view Details: sRGB, HTML, CMYK
- Select Harmonies to view Pantone Color Scheme Rules & Options.

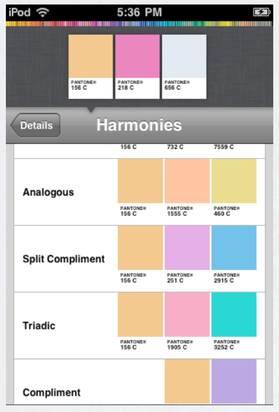
USING MYPANTONE APP: STUDY OF ANALOGOUS COLORS

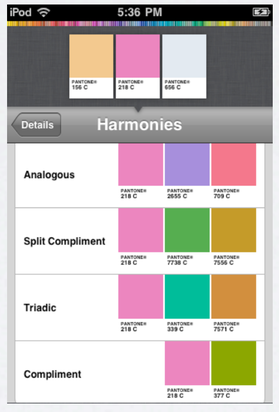


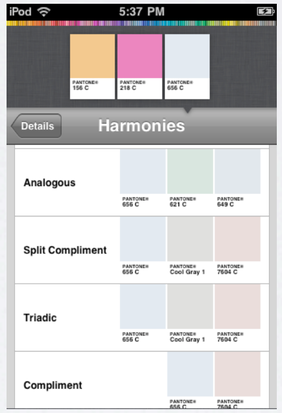


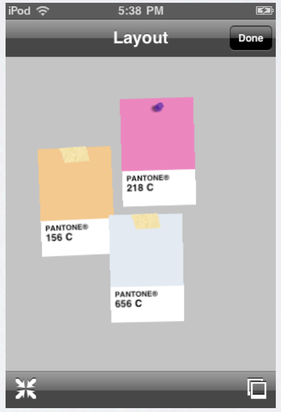












Use the myPantone Mobile App to examine color scheme of digital image for transfer to print media .
See: http://www.pantone.com/pages/pantone/pantone.aspx?pg=20696

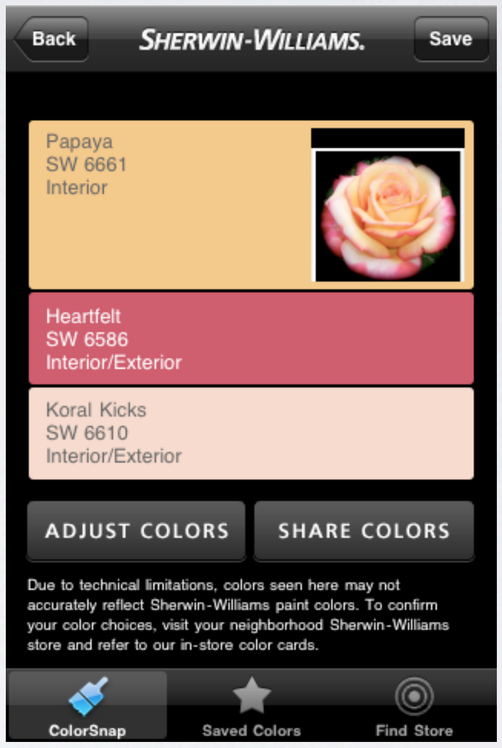
USING COLORSNAP FROM SHERWIN WILLIAMS:

http://www.sherwin-williams.com/architects-specifiers-designers/color/color-tools/colorsnap-for-iphone-android-and-blackberry/

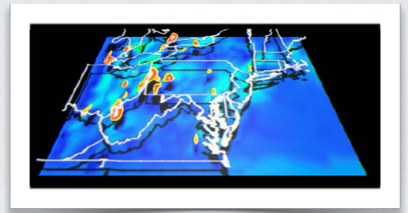
- Select ColorSnap App on your Mobile Platform.

  (This is a free app from the Sherwin Williams Web Site.)
- Select “Use Saved Photo” Menu Option.
- Select a saved Photo to begin Photo Import & Import Photo.
- Brush across Photo to Select a Primary Color.
- Repeat Brush process to Select a Second and Third Color.
- Establish & Save Color Palette.
- ColorSnap indicates corresponding Sherwin Williams paint colors.

VISUAL RESULTS WITH OUR JPEG EXAMPLE:



ColorSnap allows us to analyze the colors in a JPEG image / Photo on our mobile device. From there, Sherwin Williams provides us with corresponding paint colors for interior decorating. As we have learned in this course, the digital colors (using the RGB Color Model) and the Sherwin Williams paints (using the RYB Color Model) might not precisely match. See: http://www.sherwin-williams.com/architects-specifiers-designers/color/color-tools/colorsnap-for-iphone-android-and-blackberry/



IN SUMMARY, WE HIGHLIGHTED 5 TOPICS IN OUR COURSE:

- Additive and Subtractive Color Models.
- Defining Color Gamut, Spaces and Systems.
- Selected Artistic Movements related to Color Theory.
- Case Studies pertaining to Colorizing Visualizations.
- Hands on Workshop using Online Color Tools.

OTHER RESOURCES ON COLOR THEORY:

- "A Field Guide to Digital Color" by Maureen Stone (http://www.stonesc.com/book/index.htm)

- "The Interaction of Color" by Josef Albers (http://yalepress.yale.edu/yupbooks/book.asp?isbn=9780300115956)

- My "recently published" Book Chapter: (http://theresamarierhyne.com/Theresa-Marie_Rhynes_Viewpoint/Color_Theory_Book_Chapter.html)

ACMSIGGRAPH EDUCATION COMMITTEE

theresamarierhyne@gmail.com

ACKNOWLEDGEMENTS:

- Thanks for to the ACM SIGGRAPH 2012 Courses Reviewers & Committee for accepting my proposal.

- Thanks to all who attended this session during ACM SIGGRAPH 2012 in Los Angeles, California.

- Thanks to many colleagues in visualization & digital media who have helped me learn so very much over many years.

- with much gratitude & appreciation...
Theresa-Marie Rhyne

ACMSIGGRAPH EDUCATION COMMITTEE

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URL TO SLIDES

- http://www.youtube.com/user/theresamarierhyne#p/a/u/0/b7reoZMq2EU