

# MONITORS

## **Manual and Colorimeter Calibration**

TRILLIUM PHOTOGRAPHIC CLUB

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November 15<sup>th</sup> 2022

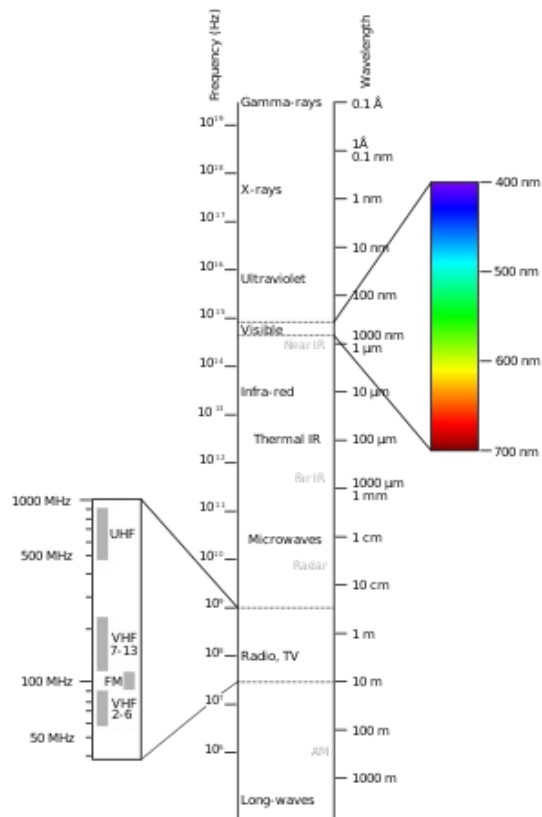
# Colour – What is it?



**Color** or **colour** is the visual perceptual property deriving from the spectrum of light interacting with the photoreceptor cells of the eyes.

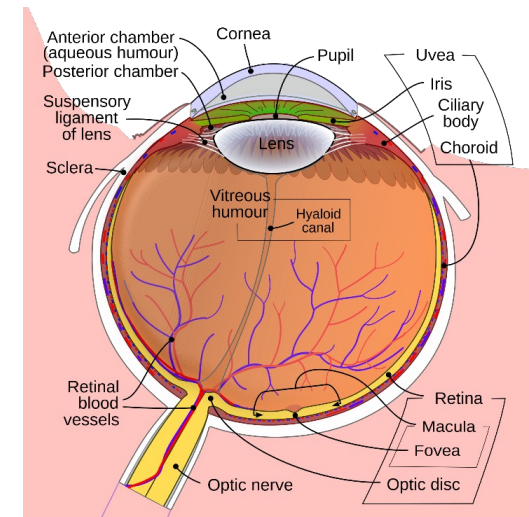
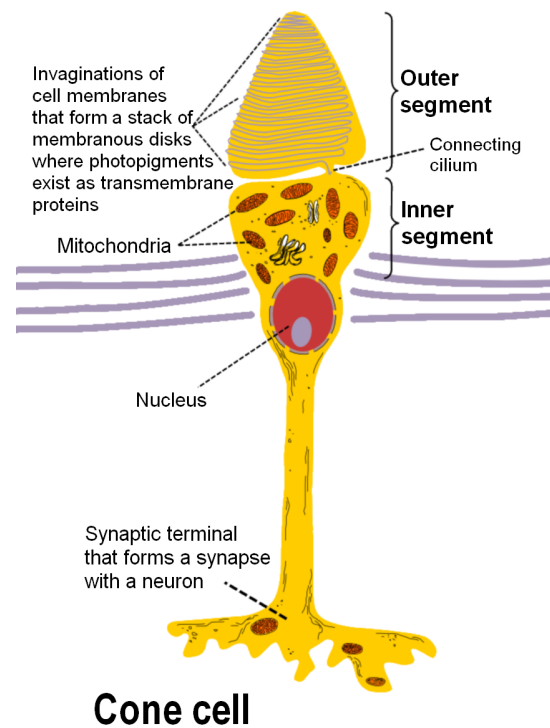
By defining a **colour space**, colours can be identified numerically by their coordinates.

# Visible light – What is it?



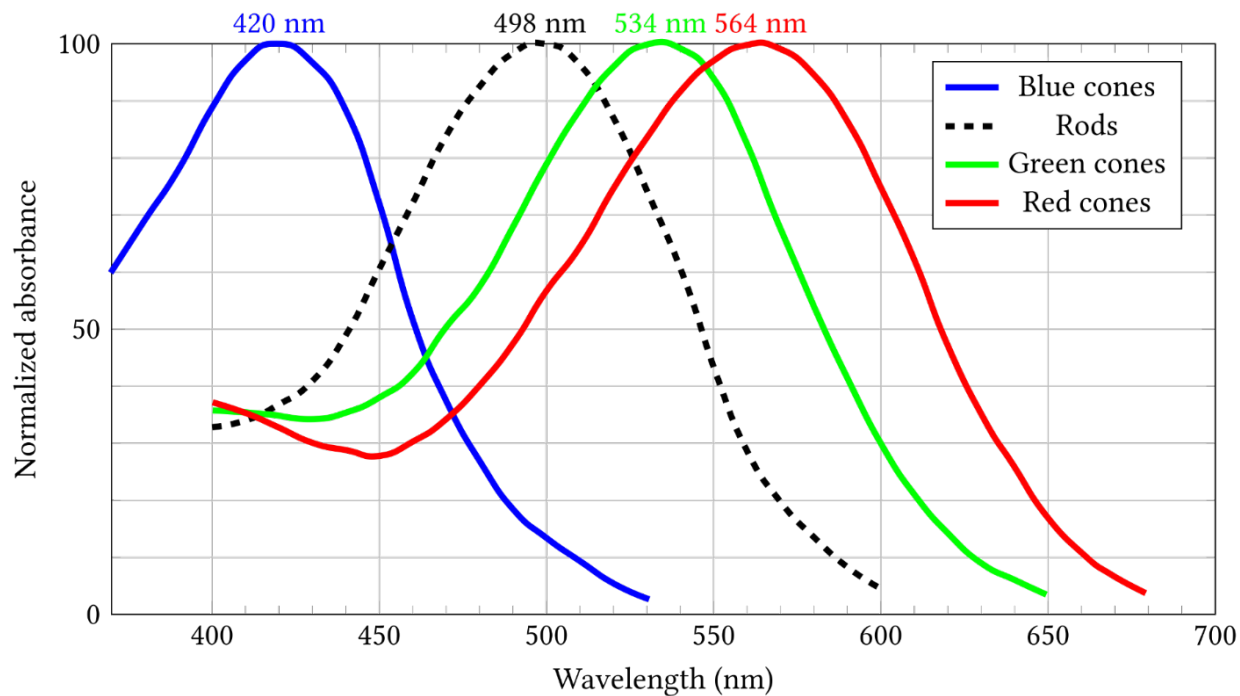
- ❖ By definition, visible light is the part of the **Electromagnetic spectrum** (think radio waves) the human eye is the most sensitive to. The light that excites the human visual system is a very small portion of the electromagnetic spectrum.
- ❖ Electromagnetic radiation with a wavelength between 380 nm and 760 nm (400–790 terahertz) is detected by the human eye and perceived as visible light.
- ❖ White light is a combination of lights of different wavelengths in the visible spectrum. Passing white light through a prism splits it up into the several colours of light observed in the visible spectrum between 400 nm and 780 nm.
- ❖ If radiation having a frequency in the visible region reflects off an object, say, a bowl of fruit, and then strikes the eyes, this results in visual perception of the scene. The brain's visual system processes the multitude of reflected frequencies into different shades and hues, and through this *insufficiently-understood psychophysical phenomenon*, most people perceive a bowl of fruit.

# Human eye



**Each human retina  
has approximately  
6 million cones and  
120 million rods**

# Human sensitivity to light



We perceive colour as

R – red

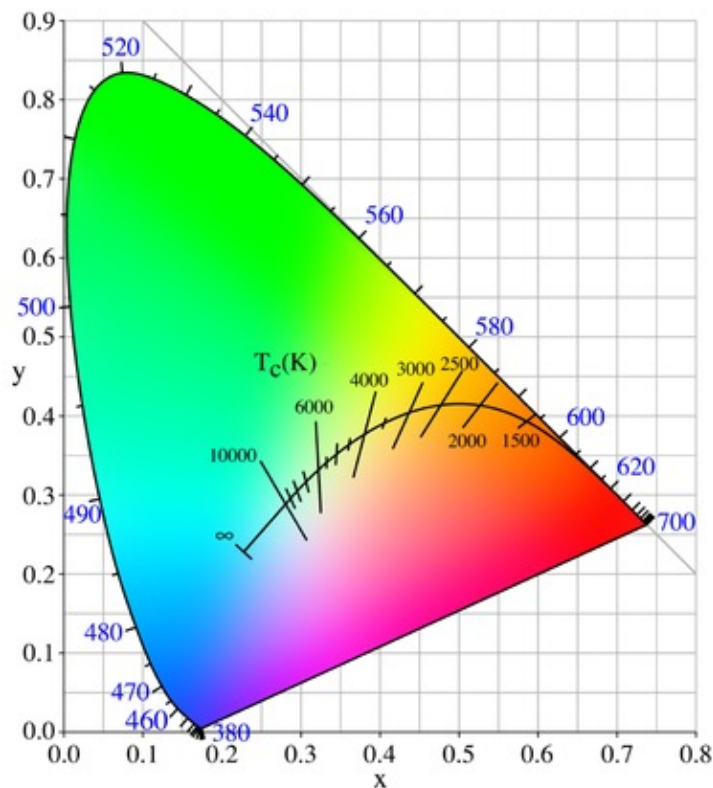
G – green

B – blue

Digital cameras record colours as RGB Pixels

Monitor reproduce colours as RGB Pixels

# Colour Space or Gamut



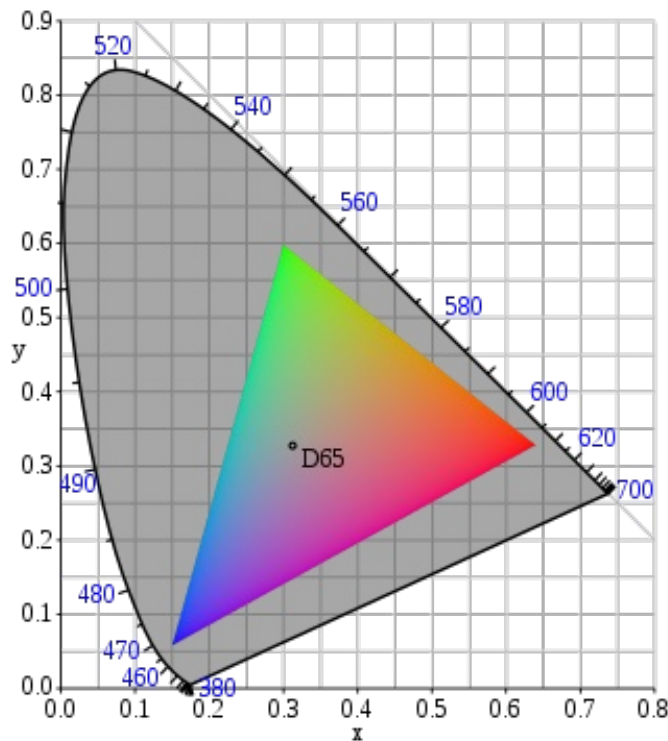
**The full colour space, or gamut of human vision.**

By defining a colour space, colours can be identified numerically by their coordinates.

**Chromaticity** is an objective specification of the quality of a colour regardless of its luminance. Chromaticity consists of two independent parameters, often specified as hue (h) and colourfulness (s), where the latter is alternatively called saturation, chroma, intensity, or excitation purity.

The CIE 1931 xy chromaticity space, also showing the chromaticities of black-body light sources of various temperatures, and lines of constant correlated color temperature

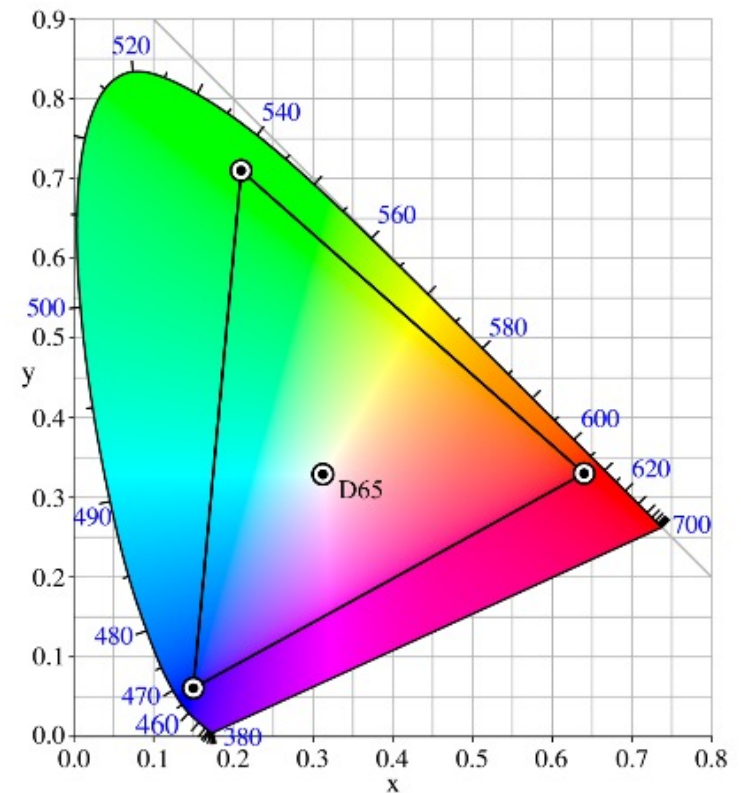
# The sRGB colour space.



- **sRGB** is a standard RGB (red, green, blue) gamut.
- Encompasses less than 40% of the human gamut.
- Created by HP and Microsoft cooperatively in 1996
- Used on monitors, printers, and the World Wide Web.
- It was subsequently standardized by the International Electrotechnical Commission (IEC) as IEC 61966-2-1:1999.

# The Adobe RGB (1998) colour space or opRGB

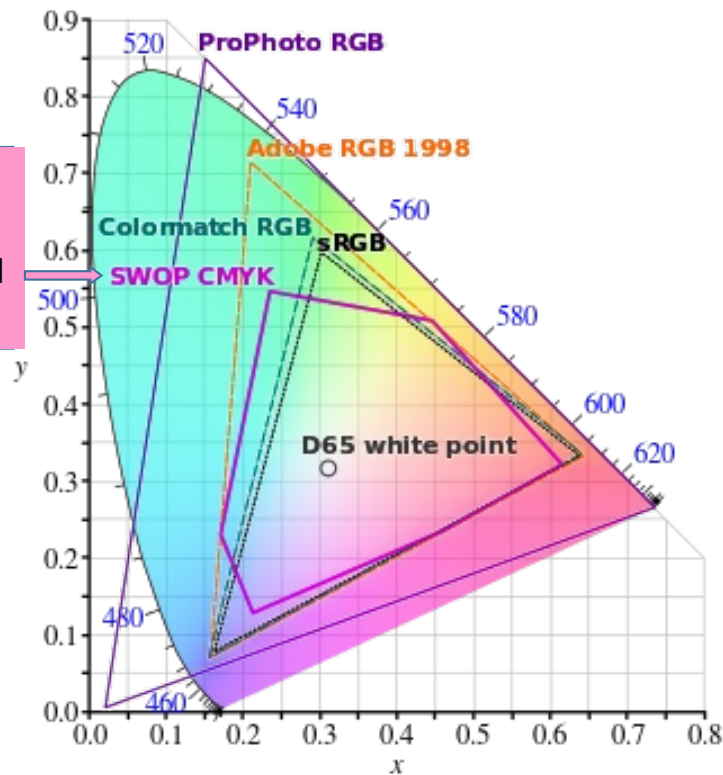
- opRGB is a colour space developed by Adobe Systems, Inc. in 1998.
- The Adobe RGB (1998) colour space encompasses roughly 50% of the human gamut.
- opRGB improves upon the gamut of the sRGB colour space, primarily in cyan-green hues. It does not improve upon the reds or blues.
- It was subsequently standardized by the IEC as IEC 61966-2-5:1999 with a name opRGB (optional RGB color space) and is used as the **HDMI** standard.





# The human gamut still outshines the majority of electronic gamuts.

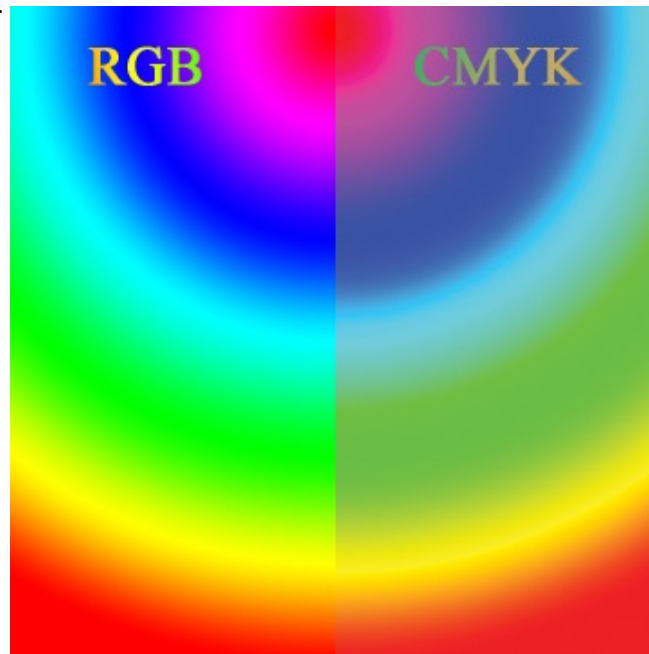
The CMYK is the colour Space of printed photos. Cyan Magenta Yellow and Key (Black)



# A comparison of RGB and CMYK color spaces

The image demonstrates the difference between the RGB and CMYK color **gamuts**.

The RGB color gamut is larger than the CMYK color gamut. Therefore, the CMYK colors look muted.



If you were to print the image on a CMYK device, say an inkjet printer, the two sides would likely look more similar.

Therefore the combination of cyan, yellow, magenta, and black cannot reproduce the range (gamut) of color that a computer monitor displays.

**This is a constant issue for those who work in print production.**

Clients produce bright and colorful images on their computers and are disappointed to see them look muted in print.

# Monitor Gamut or Colour Space.

## Things to know...

- Every RGB monitor has its own color gamut, bounded in chromaticity by a color triangle.
- Some of these triangles are smaller than the sRGB triangle, some are larger.
- Colors are typically encoded by 8 bits per primary color. The RGB value [255, 0, 0] [0,255,0] and [0,0,255] represents red, green and blue respectively, but slightly different colors in different color spaces such as Adobe RGB and sRGB.
- Displaying sRGB-encoded data on wide-gamut devices can give an unrealistic result. The gamut is a property of the monitor.
- As long as the monitor gamut is wider than the color space gamut, correct display is possible, if the monitor is calibrated.
- A picture which uses colors that are outside the sRGB color space will display on an sRGB color space monitor with limitations.
- Still today, many monitors that can display the sRGB color space are not factory nor user calibrated to display it correctly. Color management is needed both in electronic publishing and in desktop publishing targeted to print.

# Standard colour cards can be handy and need not be expensive!



Calibrite  
ColorChecker

**CA\$118.20**

B&H Photo-Video-...  
\$89.00



DGK Color Tools  
WDKK Waterproof

**CA\$21.24**

B&H Photo-Video-...  
\$15.99



Calibrite  
ColorChecker

**CA\$129.99**

Amazon CA  
Free shipping



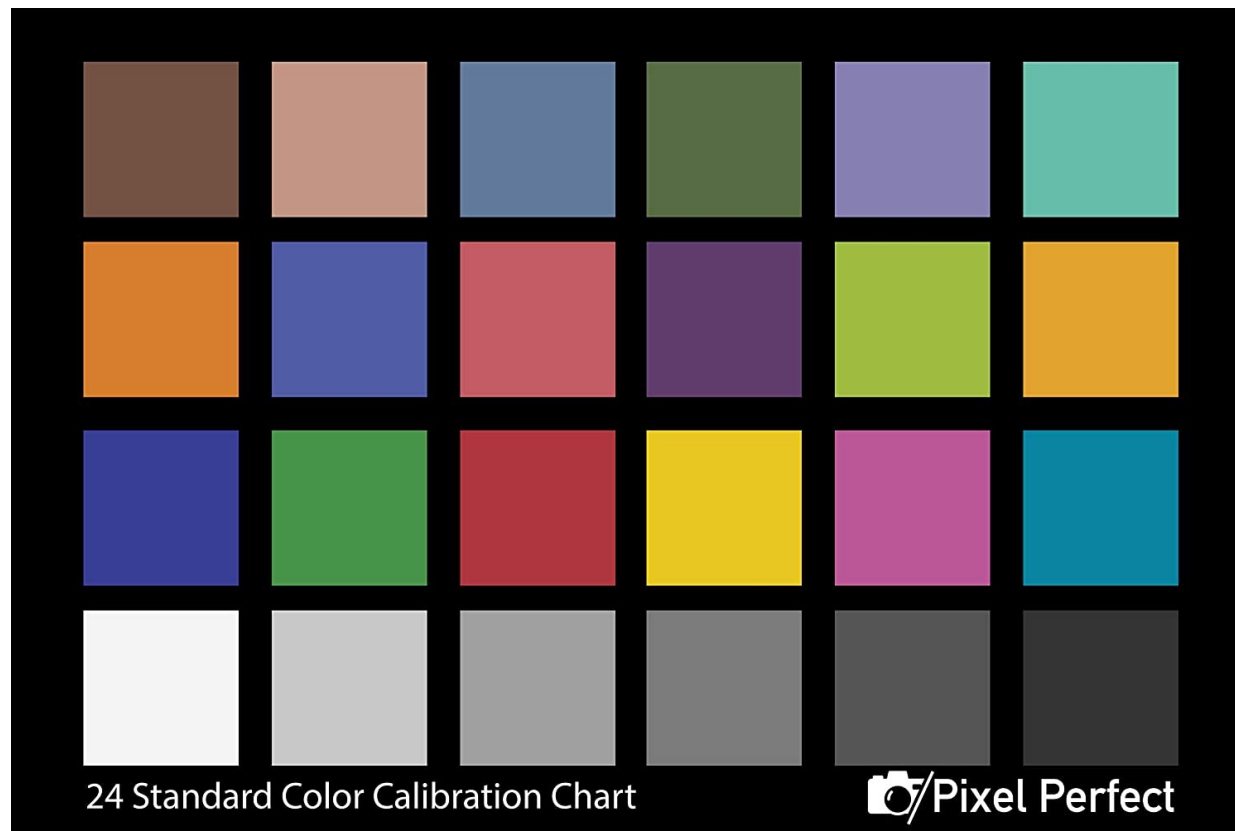
ColorChecker  
Classic

**CA\$109.00**

Gosselin Photo & ...  
Free shipping



# Standard Colour Card



There are two principal ways of calibrating a monitor:

1. Manually.
2. Using a colorimeter.

**REMEMBER:**

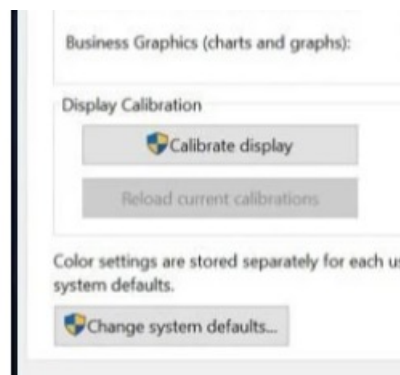
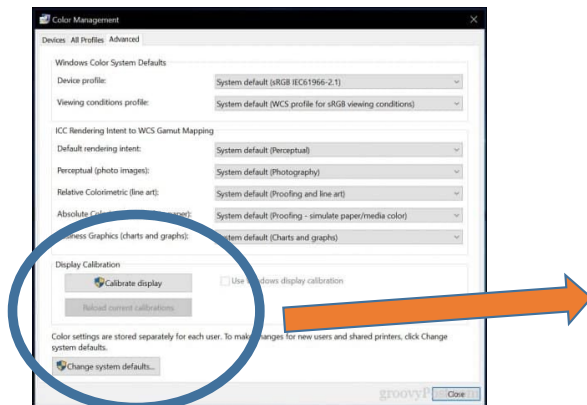
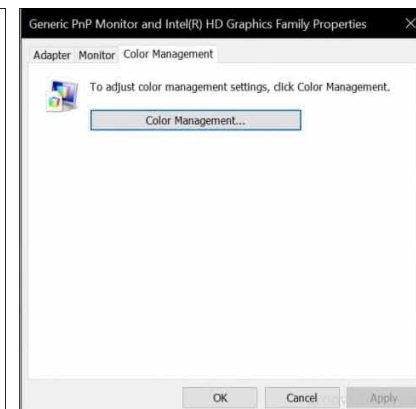
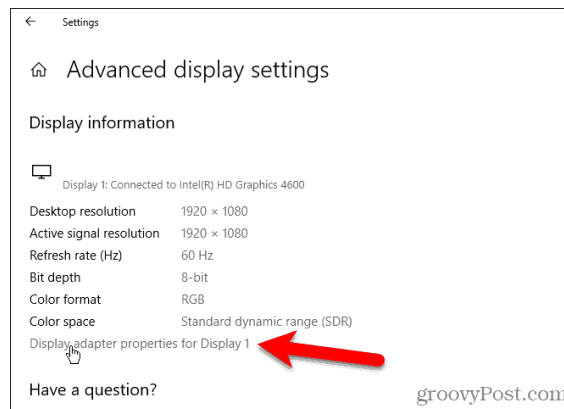
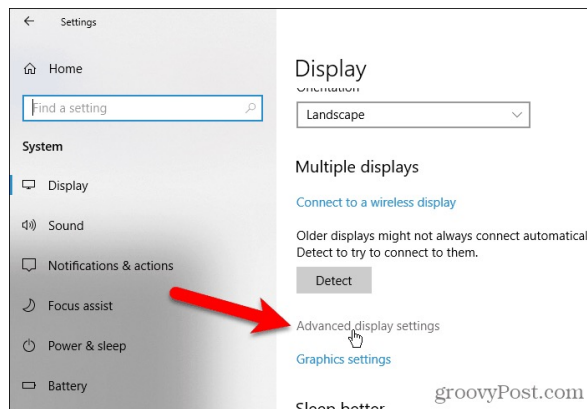
Calibration of the monitor is performed **ON THE MONITOR** by using the on-screen-menus or the buttons on the sides. The computer is just there to project the images and test patterns.

**From Amazon at \$15.00**

# **CALIBRATION...**

## **MANUALLY**

# Calibrating using Windows 10/11



The normal sequence is:

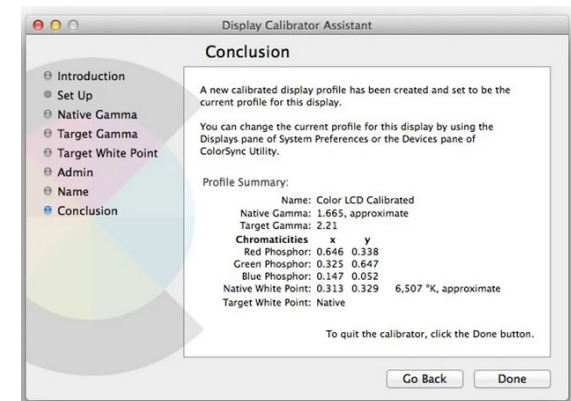
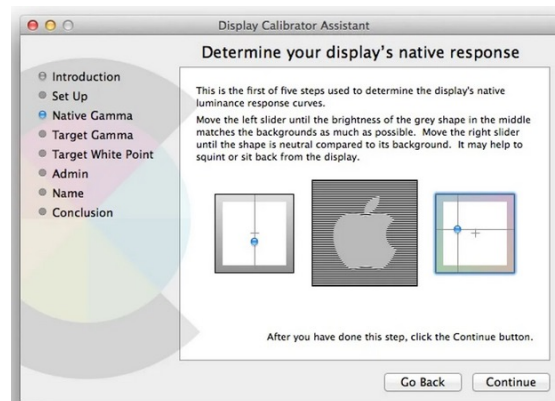
1. Gamma – Reds, Greens, and Blues
2. Brightness and Contrast
3. Colour Balance

# How to Calibrate Screen Colour in Mac OS

1. Open System Preferences and go to the “Display” preference panel, then go to the “Color” tab as usual

2. Hold down the OPTION key and click on “Calibrate” to access the Expert Mode options in Display Calibrator

3. Proceed through the screen color calibration process as usual in Mac OS X





# **CALIBRATION... USING A COLORIMETER**



# **Calibrating using a colorimeter**

Step 1. Buy a colorimeter

Step 2. Read the instructions. All of them!

Step 3. Follow the instructions. All of them!

Step 4. You're DONE!

# **FREE**

## **Monitor Calibration Software**

- [1. Calibrize](#)
- [2. Quick Gamma](#)
- [3. Lagom LCD Monitor](#)
- [4. DisplayCal](#)
- [5. CalMAN ColorMatch](#)
- [6. Natural Color Pro](#)
- [7. W4ZT](#)
- [8. Photo Friday](#)
- [9. Online Monitor Test](#)
- [10. Atrise Lutcurve](#)
- [11. Monitor Calibration Wizard](#)
- [12. Gamma Panel](#)



Excellent

# Monitor calibrators in 2022

Check out the website for Pros and Cons

<https://www.digitalcameraworld.com/buying-guides/best-monitor-calibrators>

Model	Manufacturer	Current Price (Amazon.ca)
Datacolor SpyderX Pro	Datacolor	\$236
Calibrite ColorChecker Display	Calibrite	\$250
Datacolor SpyderX Studio	Datacolor	\$660
Datacolor SpyderX Elite	Datacolor	\$269
Calibrite ColorChecker Display Pro	Calibrite	\$399
Calibrite ColorChecker Display Plus	Calibrite	\$459

## Datacolor SpyderX

One of the most popular models



# Calibration cheat sheet

Here's a quick summary of what you must do prior to calibrating a monitor.

- ☐ Set the display resolution of Windows or MacOS to the native resolution (highest) of your monitor.
- ☐ Select a scaling setting that makes small text and interface elements readable. Try to keep it small.
- ☐ Reduce brightness to about 200 lux (using a smartphone light meter for measurement).
- ☐ Adjust contrast so that all bars on the Lagom LCD contrast test image are visible.
- ☐ Set sharpness to the level you prefer.
- ☐ Adjust gamma so that bars on the Lagom LCD gamma test image indicate a gamma value of 2.2(PC) or 1.8(Mac).
- ☐ Set monitor color temperature (also known as white point) to 6500K if that setting is available, or change it to your preference if it's not.
- ☐ Switch to an sRGB mode if your monitor has a standard color gamut, or DCI-P3 if your monitor has a wide color gamut.
- ☐ If you're willing to spend some cash for better image quality, buy a calibration tool like the Datacolor SpyderX Pro or X-Rite i1Display Studio.

# **Some web sites...**

## **There are lots more!**

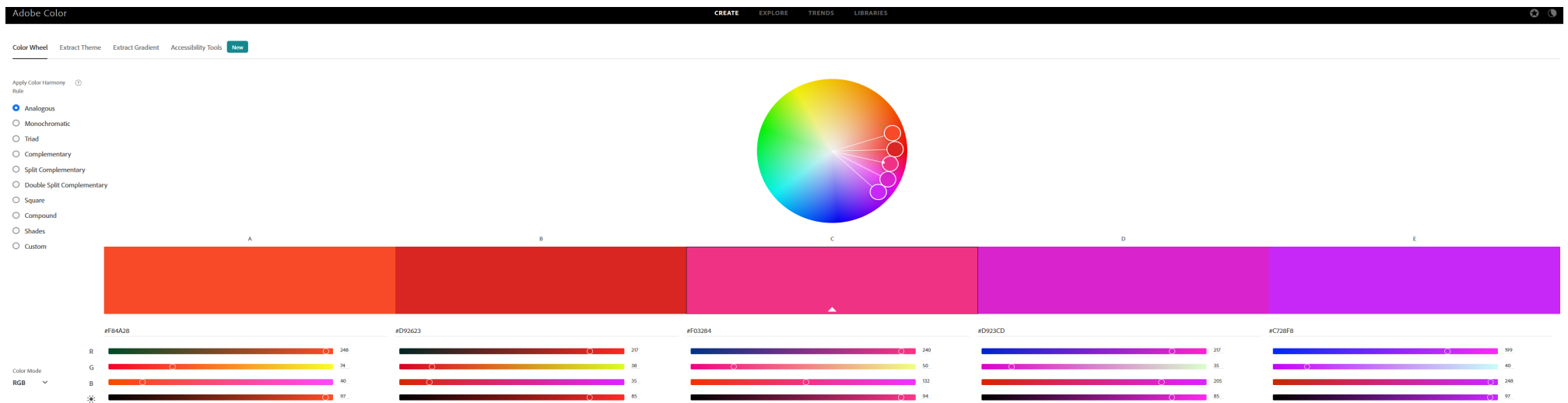
<http://www.lagom.nl/lcd-test/>

<https://color.adobe.com/create/color-wheel>

<https://www.digitalcameraworld.com/buying-guides/best-monitor-calibrators>

# Add-ons & Tools – An example!

## ~ Create your own colour palette ~



Color wheel (or image in Extract Theme tab) can be used to generate color palette, which can be saved into Creative Cloud, after signing in.

You can then use your saved color palettes in Adobe products (Photoshop, Illustrator, Fresco, etc.), via CC Libraries.