Short Course on Photo Printing
Part 1 - Setting the Stage

Hot Springs Village Camera Club January 14, 2020

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The Method to My Madness - Suggested Prep for Presentation

- Part 1 of this series describes the issues around color management and human color perception. In the following Parts, specifics of using the print functions are shown, but I believe having a bit of understanding as to why we have to do these things helps us learn how to do it better. Also discussed here is a brief look at equipment and preferred editing environment.
  - Please read through Part 1 lightly, prior to the meeting to get a taste of the issues. This part will not be reviewed at the meeting.
- Part 2 and Part 3 show step-by-step instructions for setting up and printing in LR and PS. We will walk through Part 2 at the meeting and leave Part 3 for self-study. It is less complicated than Part 2.
  - It would be best to become familiar with this material prior to the meeting.
- Part 4 is a bonus on exporting in PS and LR, and changing file size in PS. As this covers different material, I will include this at the meeting if it looks like everyone is still awake.

Presentation Notes

- The entire presentation was prepared on a Mac. The Windows versions of LR and PS will have somewhat different interfaces and menubars.
- Where critical, I have included a few screenshots on a Windows machine.
- The presentation was prepared on the latest CC versions of the software as of mid December 2019. If you are working with different versions, again there may be some differences from what is presented here.
- The dialogue boxes that are shown throughout the presentation are again, Mac based, and in many cases specific to the equipment on my system. Your dialogue boxes may differ from what is shown here. That may cause some confusion until you are able to work through the translation to your system specifics.
- The information presented is based on my workflow and preferences. You are encouraged to click every option box and try values for settings other than as shown here. That is how you will discover what works best for you.
- To those new to image printing, this is a rather overwhelming amount of info. It is my hope that with the aid of the step-by-step examples, you will be able to follow through successfully and eventually come to be in your comfort zone with this work.
- This presentation is intended to get you started with the core printing techniques. Additional options are available in some of the dialogues that can be explored as you

Print DPI (dots per inch)

Today's printers have very high resolution print heads ranging from 480 to as much as 2400 dpi capability. So getting a good print is mostly a matter of setting up the image and output selections correctly.

Part of the process of making good prints is training the eye. When new to printing we tend to see the colors and composition of an image. As we learn more we see into shadows, look for smooth gradations of color and fine detail of features. For me, I get out the magnifying glass and look super-close to see just how good my print really is.

I determine what my Viewing Intent is before printing, and break that down into 3 quality levels:

1. Postcard, memorabilia shots. - low resolution is fine
2. Prints to hang up for awhile to enjoy the moments represented. - medium resolution.
3. Fine art prints. Images that I think are really special and want to make them look as good as possible - high resolution.

How Many DPI

For lower quality - postcard, 4x6 images

1. 150 DPI is a good minimum. More is fine.
2. In reality virtually every camera and smartphone has more than enough pixels for this.

For medium quality - want it to look good for awhile, or will only be seen from distances greater than several feet.

3. 200 DPI or more.
4. Again, unless severely cropped, most cameras will have plenty of resolution for medium to larger prints.

For high quality - Fine art that will be looked at up-close and critically.

5. 250 DPI, 300 DPI is better yet.
6. The largest sizes of prints will be limited by the available number of pixels, even for the best cameras.

Megapixels and Aspect Ratio

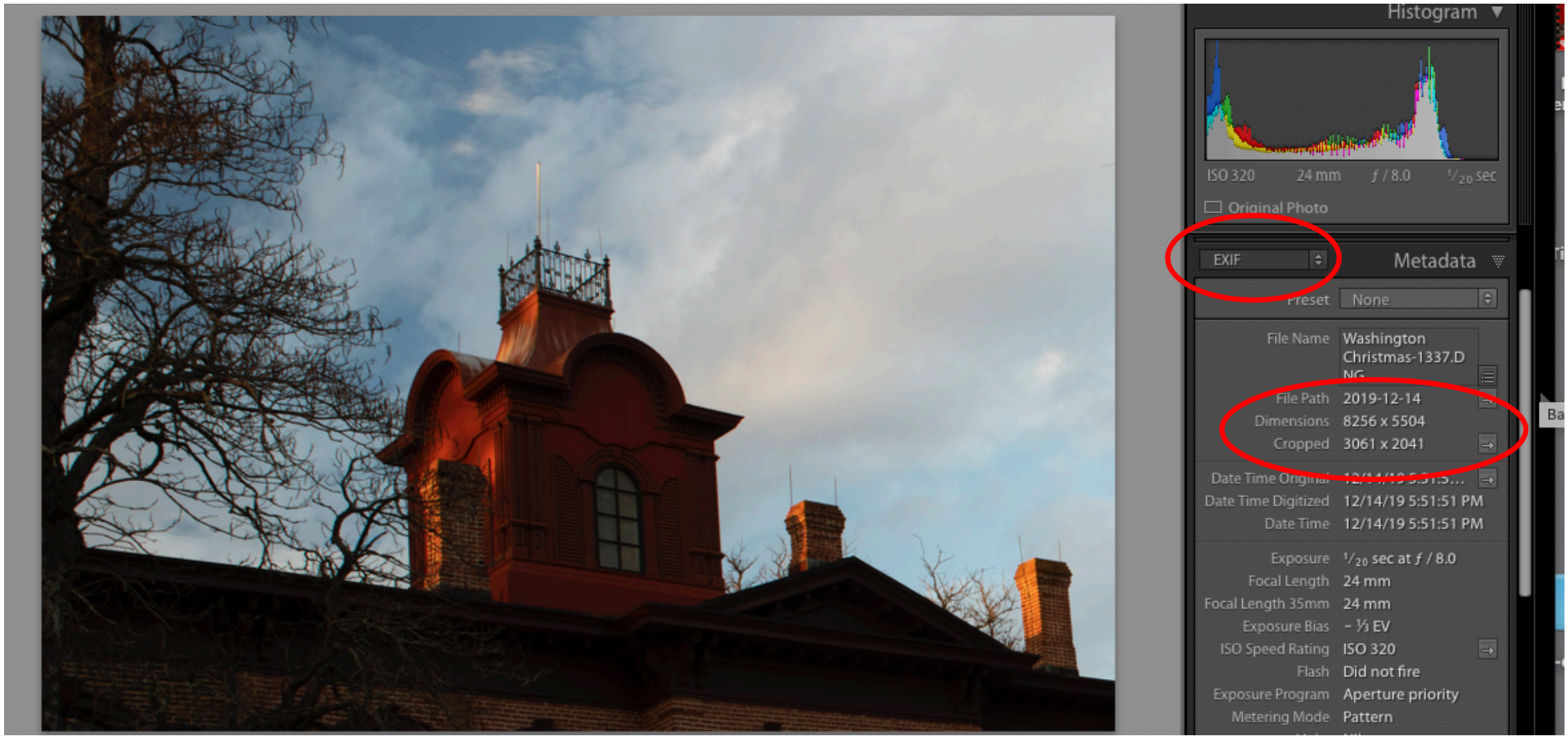
If you know how many megapixels your camera has, and you are using the full image, look up the available pixels per side based on the Aspect Ratio.
The example shows that a 24 Megapixel Camera with a 3:2 Aspect Ratio (35mm format), has 6144 pixels on the long side and 4096 on the short side

Table 1

	Pixels Available per Side of Print									
Print Aspect →	16 X 9		3 X 2		4 X 3		5 X 4		1 X 1	
Image MegaPixels	Long Side	Short Side	Long Side	Short Side	Long Side	Short Side	Long Side	Short Side	Long Side	Short Side
4	2731	1536	2508	1672	2365	1774	2290	1832	2048	2048
6	3344	1881	3072	2048	2896	2172	2804	2243	2508	2508
8	3862	2172	3547	2365	3344	2508	3238	2591	2896	2896
10	4318	2429	3966	2644	3739	2804	3620	2896	3238	3238
12	4730	2660	4344	2896	4096	3072	3966	3173	3547	3547
16	5461	3072	5017	3344	4730	3547	4579	3664	4096	4096
20	6106	3435	5609	3739	5288	3966	5120	4096	4579	4579
24	6689	3762	6144	4096	5793	4344	5609	4487	5017	5017
30	7478	4207	6869	4579	6476	4857	6271	5017	5609	5609
36	8192	4608	7525	5017	7094	5321	6869	5495	6144	6144
40	8635	4857	7932	5288	7478	5609	7241	5793	6476	6476
44	9057	5094	8319	5546	7843	5882	7594	6075	6792	6792
50	9654	5431	8868	5912	8361	6271	8095	6476	7241	7241

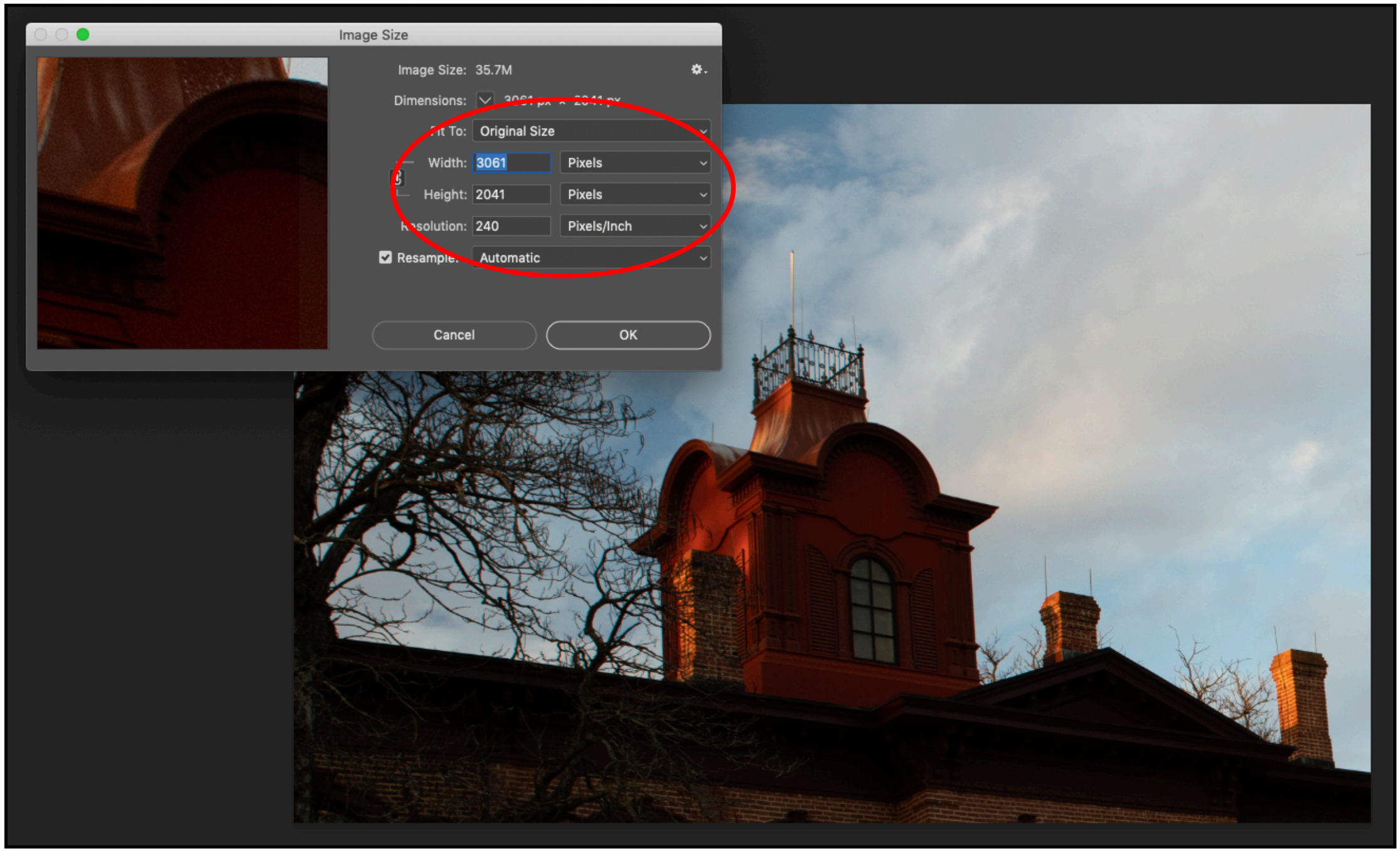
Megapixels and Aspect Ratio

If you have cropped the image, you can find the pixel amounts by looking at the metadata for the image.
in Lightroom, go to the Library Metadata Panel, choose the EXIF display



Megapixels and Aspect Ratio

in Photoshop, go to Image/Image Size on the menu bar



Pixel Count and Image Size

The chart shows the size a print can be made to for a given number of pixels and desired DPI.

In the example 200 DPI has been chosen with a pixel count of 6000 by 4000.

Table 2

	Pixels per Inch of Print														
	Size of Print (inches)														
Pixel Count	4	6	8	10	12	15	16	18	20	24	28	30	32	36	40
1000	250	167	125	100	83	67	63	56	50	42	36	33	31	28	25
1500	375	250	188	150	125	100	94	83	75	63	54	50	47	42	38
2000	500	333	250	200	167	133	125	111	100	83	71	67	63	56	50
2500	625	417	313	250	208	167	156	139	125	104	89	83	78	69	63
3000	750	500	375	300	250	200	188	167	150	125	107	100	94	83	75
3500	875	583	438	350	292	233	219	194	175	146	125	117	109	97	88
4000	1000	667	500	400	333	267	250	222	200	167	143	133	125	111	100
4500	1125	750	563	450	375	300	281	250	225	188	161	150	141	125	113
5000	1250	833	625	500	417	333	313	278	250	208	179	167	156	139	125
5500	1375	917	688	550	458	367	344	306	275	229	196	183	172	153	138
6000	1500	1000	750	600	500	400	375	333	300	250	214	200	188	167	150
6500	1625	1083	813	650	542	433	406	361	325	271	232	217	203	181	163
7000	1750	1167	875	700	583	467	438	389	350	292	250	233	219	194	175
7500	1875	1250	938	750	625	500	469	417	375	313	268	250	234	208	188
8000	2000	1333	1000	800	667	533	500	444	400	333	286	267	250	222	200
8500	2125	1417	1063	850	708	567	531	472	425	354	304	283	266	236	213
9000	2250	1500	1125	900	750	600	563	500	450	375	321	300	281	250	225

Image File Types

Any type of file that you can work with from LR or PS, can be used to print an image.

16 Bit files have WAY more color depth than 8 Bit files. The following are 16 Bit:

1.Raw (native camera file if it takes raw images)
2.PSD (Photoshop)
3.DNG (Adobe universal raw file, converted from your camera raw file)
4.TIFF (used in PS, often used by other editing programs)

The following are 8 Bit files:

5.JPEG (often used on the web and by simple editing programs)
6.PNG (used for certain Windows apps, and for watermarks in LR)
7.GIF

Color Space

The range of visible colors for humans was defined in 1932 (CIE1932) and has become a worldwide standard for representing color range (gamut) and color accuracy.

There are no cameras, printers or monitors which can record or display the full range of colors. As color computer monitors came on the market, a gamut for display on those devices was defined based on the technology at that time (~1980). That is called SRGB (Standard Red, Green, Blue). That gamut is still used as the standard for Websites.

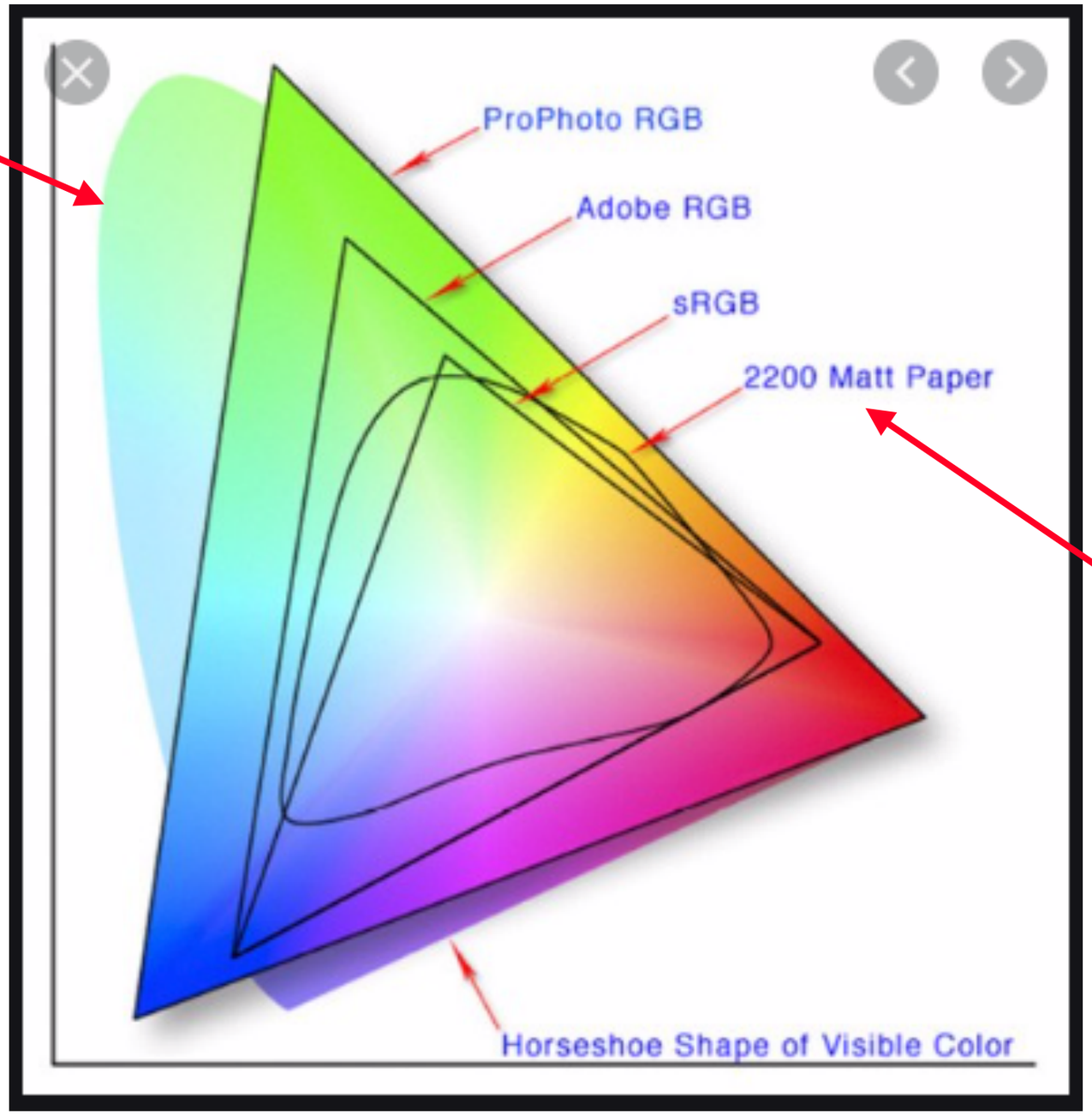
With advances in camera and display technology, a greater range of colors has become available. In 1998, Adobe created a new color space (AdobeRGB 1998) which defined a substantially larger gamut than SRGB. Today's better cameras usually offer AdobeRGB as an option for the working color space. If so, use it.

About 2 years ago Adobe introduced an even larger color space - ProPhotoRGB. This space is larger than AdobeRGB, but still less than full visible gamut. Some of it extends outside of the range of human vision. It is available as a working space for both LR and PS, and is what I work with.
I do this because I want my images to have the greatest range of colors to work with, especially as technology continues to improve the gamut of cameras and printers. You will not be able to show all those colors on your monitor or on the print, but that is handled through color profiling which we will touch on later.

Summary: Set your camera to AdobeRGB (or ProPhotoRGB if that is an option), set LR and PS to ProPhotoRGB.

Color Space Illustration

CIE1932
full gamut



This is the color space for a Matte print paper

Printer Capability

Basic "office" or "multi-function" printer.

1. These have a 4-color print system (CMYK - Cyan, Magenta, Yellow, blacK)
2. They are suitable for the low resolution - postcard type prints.
3. They usually have a single cartridge with CYM colors. When one color runs out you have to replace the whole color cartridge.
4. Color rendition will be fair. Color changes may be "stagey", not smooth.

Photo printer - 6 color. This the minimum recommended for photo work.

5. A step up from the basic. adds LC (Light Cyan) and LM (Light Magenta).
6. Designed specifically for photo work. Higher dot count in the print heads.
7. Smoother color transitions and larger gamut especially in light tones.
8. Usually has individual cartridges for each color - less costly to run.

Photo printer - 8 color

9. Adds LG (Light Gray) and LLG (Light Light Gray). Some other combinations may be used, but this is the most common. Some provide the LG and a different black for matte media.
10. Provides much better control of blacks for B&W images. Better shadow details.

Photo Printer - 10 or more colors. Top of the line, but costly to get started.

11. Adds B (Blue), G (Green), R (Red), O (Orange), Gloss Leveler, or some other combinations.
12. Typically will add 2 colors, a matte black, and perhaps the gloss leveler.
13. Provides the widest gamut of available printers.
14. Often has larger ink tanks for greater economy.

Calibration

We use our monitor to edit our photos until we get them looking just as we want.

If your monitor is not calibrated, your editing will not be accurate, and your print results may be far from what you see on the screen.

Ordinary computer screens - desktop or laptop - typically are only capable of SRGB color space.

Better desktop monitors and some very recently offered laptops have full AdobeRGB capability.

There are also monitors which offer “wide gamut” - not a defined space, but typically near to or larger than AdobeRGB.

Regardless of which type of monitor/laptop you have, calibration will optimize its performance AND let you know just how good/bad it is.

That requires a calibration device. These are available from several vendors, and run between $90 to $300.

Calibration

Many computers and monitors have built-in calibration tools. These are fairly rudimentary, but they are free and a good place to start until you are ready to spend the time and money on better tools.

Over the years I have used calibrators from LaCie, Datacolor, Macbeth and X-Rite. The life expectancy of these units is only a few years before they are no longer supported with updates. Currently there are only three brands for the home market that I am aware of. Those are:

1. Datacolor SpyderX Pro - $170
2. Datacolor SpyderX Elite - $270
3. Datacolor Spyder5 Elite - $200 (now obsolete)
4. Wacom EODIS3-DCWA Color Manager - $199 (uses X-Rite sensor and Wacom software)
5. X-Rite ColorMunki Smile - $90
6. X-Rite ColorMunki - $139
7. X-Rite i1Display Studio - $169
8. X-Rite i1 Display Pro - $235

I strongly suggest you research these carefully before making a purchase. Software in the past has been a bit clunky, manuals/instructions may be difficult to follow. Try checking YouTube for support videos. If you are using a Mac, the latest OS (operating system),(Catalina), will only support 16 bit apps, so be sure the unit you buy is 16 bit capable.

Calibration

The trend in displays and in presented art has been to show more vivid colors, highly saturated and bright. Our household lighting tends to brighter colors in decor and higher levels of illumination.

The ideal editing environment is completely opposite from that. Kind of like working in a dungeon. I was a Kodak employee for a few short years. For editing and comparing photos we had a room painted entirely neutral gray - wall, ceiling and floors - and lit with 5500K low brightness lighting.

If you are viewing your monitor in a bright area, reflections from the colors around you will impact what you see on the screen. If you are in a bright room, that affects how your eyes perceive color and your monitor will look duller.

My best editing is done in the office. Shades closed, no direct room lights, barely enough light to read comfortably, no light sources behind me or overhead. If you purchase a calibration tool the manual will likely have a discussion and recommendations about the room environment. Try to get as close to that as reasonable.

Lastly, our trends toward brighter, more vivid images must be put aside as we calibrate. The goal is to get the most accurate color representation on the screen as we can. Then, images with more vivid colors will pop as your eyes adjust to the editing environment. The prints we make will never be as bright or vivid as what we see on the screen, but we can achieve a perceptual balance that makes the print look right.

Media and Profiles

We have discussed the color space available on monitors. Similarly, print media (paper, canvas, film) each have their own color space - gamut. The available gamut is a function of the media itself and the printer used to make the print.

This gamut is described in a special file called an ICC profile. Your computer uses this file to determine which colors in your image can be printed, and which can't. It then modifies the output to the printer to adjust the colors to obtain the best balance of tones. Not all the colors you see on the monitor can be reproduced in the print, so compromises must be made.

LR and PS have the ability to show you approximately what the printed image will look like before you print it! This is called a "softproof". We will see how this can be done as we step through the printing process. When you view the softproof you may see substantial differences in some areas of the image. You can then re-edit the image to make it look more the way it was without the softproof. NOTE: Make a snapshot, or save the image as-is before re-editing. Then apply the edits as needed for printing, and save that with another snapshot or new file copy.

When you install the print driver for your printer, the ICC profiles provided with the printer will be loaded into your computer. Canon will load profiles for Canon media, Epson for Epson, etc. You can obtain profiles from other media providers on their websites, specific to your model of printer.

I use media from Hahnemuehle, Ilford, Canon and Epson. There are many others: Moab, Red River, Canson … We will look at loading these as we step through the printing process.

Media and Profiles

Print media can be broken down into several categories as follows:

1. Glossy, Pearl, Satin, Semi-gloss.
   1.1.These will typically provide the widest gamut - the greatest range of colors and the most vivid colors.
   1.2.They also will take high resolution images and show fine detail.
2. Matte, Smooth, Fine Art (not textured).
   2.1. These have a medium gamut, not quite as good as type 1. Nice choice for softer images, pastel look, watercolor look, portraits. Typically are quite white in color.
   2.2. Will show detail well, but not as fine as type 1.
   2.3. Usually a good choice for B&W images with strong blacks.
   2.4.Your printer should have a matte black cartridge for these media.
3. Fine Art Textured
   3.1. Great for adding an extra depth to images due to the media texture.
   3.2. The gamut will be somewhat reduced from type 2 media.
   3.3. Many of the media are off-white in color.
   3.4. I love Hahnemuehle Museum Etching, William Turner, Torchon and others.
   3.5. These are matte finish media, so will need the matte black cartridge.
   3.6. Architecture, landscapes, painterly images.
4. Canvas
   4.1. Adds a lot of texture to the image.
   4.2. Will not show fine detail, yet still produces a vibrant image.
   4.3. Can require software/interface adjustments to the printer to deliver the right amount of ink.
   4.4.Will require matte black cartridge.

End of Part 1