Nine Tips for Making Better Prints

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Introduction

New printers released in the last couple of years such as the Epson Stylus series and printers from Hewlett Packard, Canon, Lexmark, Fargo, and Alps break new ground in affordable printing of color and black and white photographs. But to get the best possible results from your new printer means understanding some important concepts in digital imaging and learning to use the features of your image editing software. This series of tips is intended to illustrate how you can improve the prints you get from your printer using Picture Window.

1. Printing Really Big

Tired of making wimpy 8x10" prints that practically disappear when you hang them on the wall? There's something about a really big print that lends impact to almost any image, but most consumer inkjet printers are limited to printing on 8.5"x11" or in some cases 12"x18" size paper. So how can you create a print larger than the size of your printer's maximum paper size? The answer is to break your image into sections called *tiles* and print each tile on a separate page. Then you can trim and reassemble the pages into a single, big print.

Step 1 -- Printing the tiles

While you can do this manually using almost any image editing program, Picture Window's Print command includes an automatic tiling feature that make it easy to print poster-sized images. Simply indicate how many tiles you wish to print horizontally and vertically and how much you want each tile to overlap (more on this later), and Picture Window will automatically split the image into sections and print each one on a separate page. You can even print a subset of the pages in case your printer jams or runs out of ink and you need to restart the print job in the middle.

Step 2 -- Trimming

Once you have printed all the pages successfully, the next step is to trim them to remove the white border around each internal tile. By selecting an image overlap of 1/8" to 1/4", you leave yourself a margin of error in trimming the images and will not have to cut them too precisely. While you can use a pair of scissors, you get a more seamless composite by trimming the prints using a rotary trimmer like a Rotatrim or using a straightedge and a razor blade or Exacto knife with a fresh blade.

Step 3 -- Assembling the Final Print

The last step is to combine all the tiles into a single large image. There are two good ways to do this:

Method 1 -- Tape the backs

This method involves taping the backs of the prints together using a good quality tape such as Scotch Magic Tape. Incidentally, this tape is archival and can, with some care, be removed from most inkjet papers without tearing, as long as you don't press too hard. Carefully align two adjacent tiles and gently tack them together using two small pieces of tape (you can also use Scotch Drafting (not Masking) Tape for this as it is made to be removable) at either end of the boundary to hold the pages in place. Then flip the pages over and tape the entire length of the join with a single piece of tape being careful not to create waves in the paper. Continue this process as necessary until all the tiles have been assembled. With a little practice, you can get excellent prints using this method.

Method 2 -- Glue to foamcore

This method involves mounting each tile to a piece of mat board or foamcore using a good quality archival stick glue such as UHU. Most of the stick glues are somewhat repositionable, so you can make small adjustments to the tiles if you are careful before the glue dries. This method makes it easy to hang your finished print or frame it.

Image Resolution Requirements

At first you may think you need an extremely high quality original image captured at a very high resolution to stand up to the kind of magnification involved in making a huge print, but this is not necessarily the case. Remember that the typical viewing distance for a larger image is usually proportionately greater, so very small detail will disappear anyway when viewed from farther away. In fact, an 8x10 viewed from 10" will look about the same as a 16x20 viewed from 20" even if the images used to make the two prints have the same dimensions in pixels. Of course, if you want the image to look good from close up, you will need to start with a very high resolution original. The relationship between image resolution and print quality is complicated and forms the topic of later tip in this series.

2. Choosing the Right Image Resolution

One of the most common questions about printing is: How big an image file do I need to make the best quality print on my printer? Today’s inkjets print at resolutions from 600 to more than 1000 dots per inch. If you try to print a 640x480 pixel image as an 8”x12” print using a 720 dpi inkjet printer, each pixel in the image is going to be spread out over about 180 dots on the printer. Unless the original image was intentionally very soft, the 8x12 print is going to look a lot blurrier than the same image looked on the screen. On the other hand, you might think you need a pixel for each dot in the print or an image size of 5760x8640 pixels to get a sharp print, but this is not true either due to the nature of the inkjet printing process. A good thing too, because a color image of this size would require nearly 150MB to store. So how big an image do you need to make a good print? The answer to this question depends on a number of variables.

Desired print size

All other things being equal, the bigger you print an image, the more image pixels you need get a quality print.

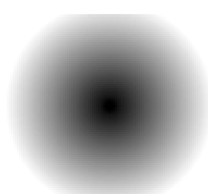
Printer Resolution

Ultimately, the size of the smallest detail your printer can reproduce is limited by its resolution. This number is normally reported in dots per inch (dpi). For example, the Espon Stylus Photo inkjet printer has a resolution of 720dpi. As you can see if you use a magnifier, the printed image is made up of huge numbers of these tiny dots. In some cases a printer’s resolution may be reported as two numbers such as 720x1440dpi. In this case, the higher number in one direction is generally achieved by overlapping pixels and does not represent substantially increased resolution.

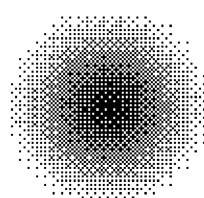
Printer technology

There are two fundamentally different types of printers: continuous tone and halftone. An image printed using a continuous tone printer consists of dots, each of which can be any color at all. A halftone printer creates images out of dots of a limited number of colors.

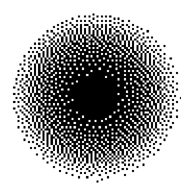
For example, most inkjet printers (and printing presses) are halftone printers and use cyan, magenta, yellow, and black dots printed using four different ink cartridges. Some newer or more expensive inkjet printers achieve improved print quality by using more ink colors or by varying the dot size. To create an image of a photograph using a halftone printer, clusters of dots must be arranged on the page such that their average color approximates the color of the image using a process called *halftoning* or *dithering*:



continuous tone image



ordered dither halftone



error diffusion halftone

Because multiple dots are required to represent each color pixel in the original image, the effective resolution of a halftone printer is considerably reduced when printing photographs. Continuous tone printers such as dye sublimation printers and film recorders do not have this problem, so their stated resolution is comparable to the number of image pixels they can display per inch. This is why a 300dpi dye sublimation printer can usually create prints that look better than those from a 720dpi inkjet printer.

Printer and paper quality

The shape, overlap, color purity, consistency, and other attributes of the dots that make up a digital print combine to determine the actual resolution of your printer. It is also important to use the right paper for your printer to get the best results--using the wrong paper can result in blurry or washed out images.

Viewing distance

The further you are from an image, the less detail you can see. Therefore the viewing distance is an important parameter in determining the optimal print resolution. By convention, the standard viewing distance for letter-size prints is 10 inches, but for larger prints, a larger viewing distance is usually assumed.

Image content

If the image you are printing is blurry (either deliberately or accidentally), then it may be perfectly acceptable to print it much larger than would otherwise be acceptable. If an image is very sharp and contains a lot of high contrast detail such as light objects on a dark background or vice versa, then you may need all the resolution you can get. This is one reason why some inkjet prints just look better than others, even though the images have the same numbers of pixels. Included in this analysis is not only the contrast and detail of the original photo but also the quality of the scanner (or other image capture device) used to digitize the image. Many scanners have a much lower actual resolution (resolving power) than their stated resolution due to pixel overlap, misregistration, poor optics, vibration, gear backlash, noise, and other factors that combine to degrade the digital image from its theoretical resolution. The net result is that a typical image acquired using a scanner with a 600dpi optical resolution, using its maximum optical resolution, will exhibit various artifacts such as blurriness and color fringes when viewed at the level of individual pixels. These problems will only be magnified when the digital image is printed at large sizes using a high quality inkjet printer. Note that scanning using an interpolated resolution greater than you scanner's optical resolution is counterproductive as it simply creates larger files and does not add any image detail.

Your eyesight

Under ideal conditions, normal individuals can resolve high contrast detail at roughly 300 pixels per inch at a viewing distance of 10 inches. For very high contrast images such as crisp black text on a white background, there is some perceivable improvement up to perhaps 1200 pixels per inch, but this generally does not apply to photographic images unless they are extremely sharp and graphic in nature.

The Bottom Line

Here is a rule of thumb you can use to get good prints without using unnecessarily large files:

Assuming a viewing distance of 10 inches, you need somewhere between 150 and 300 (good quality) pixels per inch of print size. At the low end of this range, images are pretty good but a little soft. Beyond 200 pixels per inch, there is generally very little improvement and beyond 300 pixels per inch, virtually no improvement.

For example, to make a 6" by 8" print, you need an image size of somewhere between 900x1200 and 1800x2400 pixels. This assumes that you are using a good quality inkjet printer (at least 600dpi) and that you original images are scanned using a good scanner and properly sharpened.

As an aid in selecting the correct image resolution for making prints, we have created a program called SCANCALC. This program uses information you enter about your printer, the desired print size and viewing distance and computes the approximate image size required to create the print. This program is automatically installed on your computer when you install Picture Window from its CD unless you do a custom install and decline to install the Extras.

3. Sharpening and Unsharp Masking

A common side-effect of many operations performed on digital images is some degree of blurring. Some of the common causes of image softness are:

- In the original: Grainy or out of focus film or print.
- When capturing the image: Overlap between adjacent pixels, diffraction, imperfect scanner optics (or, if you are using a digital camera, imperfect digital camera optics, compression artifacts, interpolation artifacts, or CCD pixel crosstalk).
- When manipulating the image: Resizing.
- When printing the image: Dithering, overlap between adjacent ink dots, ink spreading.

As the effects of these operations are cumulative, getting a really crisp print requires care at each step along the way.

A high quality original must be the starting point; while you can get very good results from 35mm, scans from medium or large format negatives or transparencies are expensive but the best.

Use a film scanner or Photo CD if possible rather than a flatbed scanner as this avoids an extra generation as well as the possibility of color shifts and/or loss of image highlight or shadow detail. For the best possible print quality, a professional drum scan, while expensive, gives the cleanest results. Make sure you capture at a sufficient resolution for the desired print size (see above).

If possible, capture images at the optical resolution of your scanner (or the highest available Photo CD resolution) and use Picture Window's Resize transformation to reduce the image size if necessary. The resampling algorithm in Picture Window has been carefully designed to minimize the blurring that often accompanies this operation.

Finally, you may opt to sharpen (or even slightly oversharpen) your image before printing it. The optimal degree of sharpening depends on your printer, the paper you are using, the type of image you are printing etc. and can only be determined by experimentation. Make several test prints with different amounts of sharpening applied to your image and record which one looks best. For details on how the use sharpening and unsharp masking in Picture Window, please see the companion white paper on this subject: SHARPEN.PDF.

Remember, there is a definite limit to the maximum size print you can make that is really sharp from a given digital image. Sometimes a smaller print that is truly sharp and nicely framed can be a real jewel.

4. Simulated Sepia Toned Prints or Cyanotypes

Picture Window incorporates some very powerful features for converting color images to black and white and for tinting black and white images. Combining these operations lets you take a color image and reproduce it as a toned black and white print.

Step 1: Convert from color to monochrome

What the Monochrome transformation does is to simulate taking a black and white photograph of a color scene using a color filter of your choosing. This gives you considerable control over which colors in the original are reproduced as which gray levels in the result image. For example, using a red filter makes reds come out light and the complement of red (cyan) come out dark. In general, yellow or red filters will darken skies; green filters will lighten foliage, etc. If you are familiar with this aspect of black and white photography, you may find it convenient to specify filter colors by their standard Wratten designation as all the standard Wratten and CC filters have been programmed into Picture Window's color picker. You can even use create a custom color filter image of the same size as your original. This filter image can then be used with the Monochrome transformation to vary the filter color used for different parts of the image.

Here's how to use the Monochrome transformation:

Open the color image you want to start with and select the Transformation/Color/Monochrome command from the main menu. This brings up the Monochrome dialog box. The default filter color is a yellow-green; using this color causes the Monochrome transformation to compute the luminance of the input image. Luminance is a measure of the perceived brightness of a color image and is based on the relative sensitivity of the eye to red, green, and blue light.

Click on the Auto preview checkbox in the upper left corner of the dialog box. This will cause Picture Window to immediately compute a preview image and to update that preview every time you change a setting in the dialog box.

Click on the small colored square labeled Filter and choose Select Solid Color from the popup menu. This brings up a color picker. Experiment with clicking on different parts of the color hexagon, watching the result of each choice in the preview window. When you have the result you want, click OK in the Monochrome dialog box and Picture Window will close up all the extra windows and create the result image.

Step 2: Tint the monochrome image

What the Tint transformation does is to create a color image from a black and white image by mapping each possible gray level in the input image to a specific color. The sequence of colors is specified using a Color Line control. This control lets you specify colors corresponding to a set of gray levels and interpolates between these "control points" to compute the colors for intermediate gray levels.

Here's how to use the Tint transformation:

Open the black and white image you want to start with and select the Transformation/Gray/Tint command from the main menu. This brings up the Tint dialog box. The color line is displayed at the bottom of the dialog box – by default it has two control points, one at each end – one black and one white. You can add control points by Shift-Clicking on the color line and you can remove control points by Ctrl-Clicking on them. To set the color of a control point, double click on it and use the color picker that pops up; to move a control point, simply click and drag it along the color line. Finally, you can select how Picture Window interpolates between any two control points by clicking on large button on the underside of the control line between any pair of control points.

Click on the Auto preview checkbox in the upper left corner of the dialog box. This will cause Picture Window to immediately compute a preview image and to update that preview every time you change a setting in the dialog box.

Adjust the color line as necessary, watching the results in the Preview window. When you have the result you want, click OK and Picture Window will close up all the extra windows and create the result image.

To create a simulated sepia toned print, you need to create a color line that varies smoothly from a very dark brown at the left end to white at the right end. This keeps whites white but makes grays come out brown. Similarly, to create a simulated cyanotype, you need a color line that goes from very dark blue to white. One of the other features of color lines is the ability to save and reload color lines for later reuse (this feature is accessed via the Opt button just to the right of the color line control). For your convenience, Picture Window comes with two color line files: SEPIA.CLN and CYANOTYPE.CLN which you can use a starting points for creating your own prints. These two files (located in the same folder Picture Window is installed in) represent color lines with three control points: the left one is black; the right one is white, and the middle one a dark brown (or blue). This lets you hold onto the full black in shadow areas of your original while still applying a colored tint to the midtones. If you modify these color lines, you might want save the new ones so you can restore the settings later.

Once you have your final image, try printing it out and make any necessary adjustments to the color line (this is why it’s a good idea to save the color line in a file).

5. Creating Professional Text Overlays

Getting printed text embedded in an image to look sharp requires special care. When text is converted to a digital image, it is important that it be *antialiased* at the proper resolution

The term antialiasing is borrowed from the mathematical discipline of signal processing. In the context of working with digital images, it refers to a method of making text or other hard-edged geometrical objects look sharper by paying special attention to their edges. For example, when rendering black text on a white background, if only black and white pixels are used, the edges of characters, especially those edges that are neither horizontal or vertical (like the diagonal stroke of a capital N) will exhibit a characteristic stairstep appearance sometimes referred to as "the jaggies". If we allow the use of gray pixels as well as black and white, it is possible to make these diagonal edges look much smoother and the characters look sharper and better formed. Antialiasing works by computing, in effect, the percentage area of each edge pixel covered by the character and setting its gray level accordingly:.

Even though Picture Window antialiases text automatically when applying it to images, for antialiasing to work properly, it must be done at the resolution at which it will be sent to the printer or other output device. Unlike most photographic subjects which can be scaled up or down while retaining their general appearance, antialiased text when scaled up looks blurry and when scaled down the jagged edges reappear. For continuous tone devices like dye sublimation printers and film recorders, this means creating your image at the size and resolution you are going to print. For halftone devices like inkjet printers, you can generally divide the printer resolution by a factor of three. For example, using a 720dpi inkjet printer, you should create antialiased text at roughly 240dpi for good results. Regardless of printer resolution, 300dpi is about the maximum useful value, unless you expect to view the prints from very close up or with a magnifier.

One of the easiest ways to add antialiased text to an image in Picture Window is to use the Layout transformation. For more detailed information on using Layout, see the companion document: LAYOUT.PDF. For your convenience, here is a brief summary of how the use it to add text to one or more images at a specific resolution:

First open the image(s) you want to print.

Next select Transformation/Layout from the main menu. This pops up the Layout dialog box. Enter the size (in inches) and resolution of the image you want to create.

Next add a panel by clicking the button with the plus sign in the Layout dialog box's tool bar (not the main tool bar). This creates a new blank panel in the Layout preview and pops up a Panel Properties dialog box. Resize to panel in the preview area to reflect the size and location of the image in the overall layout. Then select the image you want to print into the Properties dialog box.

Continue adding panels as necessary until all the images you want to print are in the layout.

To add text, create a new panel and set its background to Transparent (unless you want a solid color background to the text). Then enter the text and select the font, style, point size, alignment, color, etc. You can reposition the text panel in the Layout preview as necessary.

When you are done, save the layout in case you want to make some change later, and then click OK.

At this point Picture Window will crop and resize all images to the desired resolution and generate properly antialiased text at the desired resolution as well. All images and text are then composited into a single output image, ready for printing.

When you print this image, use the *Scale to Image Dimensions* option to get the image to print at the correct size. If you wish, you can go back and reload your saved layout and replace or reposition images or text and create a new image.

6. Monitor Calibration and Monitor Gamma

This tip covers part of a very large topic, namely getting the print you make to match the image on your computer screen. A related problem is getting the image or your screen to look like the image you just scanned. This overall topic is called *color management* and is much more complicated that most people realize. Windows 98 incorporates color management as an integral part of the operating system and this will enable much more accurate rendering of colors across different devices. However, before you can even use color management, you must understand some basic concepts about how color is represented in the computer.

The human eye can, under ideal conditions, distinguish perhaps 200 different shades of gray. For this reason, images using 256 gray levels or 256 levels or red, green, and blue can theoretically represent pretty much any color we can see. But the eye's sensitivity is roughly logarithmic which means that while we can distinguish fine variations in dark areas we can distinguish only coarser variations in bright areas. For this reason, it is vitally important to match the 256 available gray levels in the computer to the eye's sensitivity curve in order to take full advantage of the full perceptible scale of grays from black to white. While a black and white photo in the computer is made up of pixels whose values run from 0 to 255, this does not, in itself, define how bright each gray level is. The curve that maps from gray level numbers in the image (0..255) to actual brightness on the screen is called the *gamma curve*. Color scientists have determined that a good match to the sensitivity of the eye is obtained using a mathematical relationship of the form:

$$\text{Brightness} = A*(v/255)^{1/\text{gamma}}$$

Where *v* is the gray level (0..255) and *gamma* is a constant equal to roughly 2.22 (*A* is a constant that depends on the units of measurement of brightness). The gamma value 2.22, sometimes simplified to just 2.2, is part of the video, Photo CD, and sRGB standards and is very close to the value incorporated into most PC display adapter hardware. Just to make things more complicated, the prepress industry standardizes on a gamma value of 1.8 to correspond more closely to the characteristics of printing presses, and some Macintoshes use a gamma of 1.4 for no reason that anyone has ever been able to explain to me.

When viewing a gamma 1.4 or 1.8 image on a monitor with a gamma of 2.2, the result will appear too dark and oversaturated, especially in the midtones. Conversely, when viewing a gamma 2.2 image on a gamma 1.4 or 1.8 monitor, the result will appear too light and washed out.

This problem is made much worse than necessary by the fact that most of the industry tries to ignore the fact that there are different gamma standards so scanning, image editing, and printing software often simply assumes certain fixed gamma values and does not tell you what assumptions they are making or let you change those assumptions. For example, HP's Deskscan scanning software appears to scan assuming that your monitor has a gamma of 1.8, even though most PC monitors have a gamma of 2.2. This makes scanned images look too light and desaturated. The gamma problem also rears its ugly head when viewing multimedia CDs created on a Mac platform with a PC or vice versa, or when downloading images from the web. Some help is on the way in the form of new standards and file formats (e.g. FlashPix, sRGB, and PNG) that either standardize the gamma value assumed in the image or that let the computer writing the files store the gamma value in the file so the software that reads the files can compensate for any gamma mismatch. Unfortunately, at present there is mostly chaos so your best defense is to learn to recognize gamma problems and compensate for them manually.

Picture Window incorporates a gamma conversion feature that lets you change the gamma value of an image, and you can experiment with this to explore the effects of gamma changes. Of course, you can also use it to convert an image from one gamma to another.

Even if you have an image with the correct gamma, to get consistent results you need to standardize your viewing conditions, properly adjust your monitor's brightness and contrast controls, and adjust its white point and gamma curves.

Viewing conditions make a huge difference in how an image looks on the screen. If you are working in a brightly lit room, there is no way you can make critical adjustments to an image on the screen. You must work in an environment with very subdued or no ambient light or at least place a viewing hood around your monitor to keep stray light from hitting the screen.

The positions of your monitor's brightness and contrast controls also have a huge effect on how images look on the screen. Most people have their brightness control set much too high. The optimal settings for viewing photographs are as follows:

1. Set the contrast control all the way up.
2. Turn the brightness control all the way down; then turn up the brightness control just until it starts to make black look slightly gray and then back it off a little. This is best judged with respect to a standard image with a step bar of different grays.
3. If the image seems uncomfortably bright, turn down the contrast control.

Most uncorrected monitors have a color temperature of about 9300 degrees. Put another way, images displayed on the screen have a very distinct bluish cast to them. While this may not be apparent by just looking at the screen, it is easily demonstrated by placing a white piece of paper next to the screen for comparison. If your monitor's white point is uncorrected, you will end up with prints that are too yellow since you will adjust them on a screen that is biased toward blue.

Finally, if your monitor does not follow a precise gamma 2.2 response curve, you should adjust its gamma to bring it into compliance.

All of these monitor calibration steps are handled in Picture Window with the help of the File/Calibrate command and a patented film overlay that is shipped with the full version of the software. Please refer to the help information for this command for more details on its use.

While using the correct monitor gamma and calibration will not guarantee accurate color matches between the screen and your prints, it is a prerequisite for getting consistent results. In combination with a good color management system such as the one that will be shipping with Windows 98, you should be able to get very predictable prints from your images.

7. Use the Full Tonal Range of Your Printer

Do your prints sometimes look muddy and lifeless? Or, at the other extreme, do they look harsh, with blocked shadows or washed out highlights? Both problems can be solved by optimizing the tonal range of your images.

Prints will appear washed out if they are using just a fraction of available range of tonalities. They will look harsh if either the highlights or the shadows are beyond the tonal range capabilities of the printer.

The first step in avoiding these problems is to make sure your monitor is set up correctly (see Tip #6). If your monitor is not properly set up, it can mislead you when you adjust your image.

Adjusting Image Brightness and Dynamic Range (Contrast)

In Picture Window, you can use the Levels and Color transformation to quickly set brightness and contrast. It offers separate sliders for setting shadow, highlight, and midtone levels for quick and precise adjustment. It also lets you make simple adjustments to color balance and saturation. This turns out to be useful as there are often subtle interactions between brightness and contrast and saturation and color balance.

The first step is to adjust the dynamic range (contrast). The basic idea for most images is to make the highlights in your finished image as bright as possible and the shadows as dark as possible. This makes optimum use of the full range of your printer from black to white. But be careful. Do not make the settings too extreme. You want to be able to see just a hint of detail in the brightest highlights and darkest shadows. Using the Levels and Color transformation, simply drag the black slider to black and the white slider to white. Once the extremes of the dynamic range are positioned properly, adjust the brightness of the midtones for the most pleasing image.

For most images, that's really all there is to it. However, like any simple rules, you need to know when to break them. If your subject matter has no deep shadow areas (for example a photo of white clouds against a blue sky), making its darkest areas black will make your image way too dark. Similarly, to convey the impression of dim lighting, you may very well not want to make the lightest parts of the image as bright as possible. To create a subtle effect, you may want to compress the dynamic range of your image. To create a dramatic, graphic effect, try increasing the contrast so much that you lose shadow and/or highlight detail (by moving the black slider beyond black and/or the white slider beyond white).

Advanced Adjustments and Special Effects

Of course, there are some images that are more demanding. For instance, you may want to stretch out the contrast in one part of the tonality scale, to bring out a texture for instance. Or you might want to play with the brightness curve to create various special effects like solarization or posterization. For these occasions, the Picture Window Brightness Curve transformation gives you full control of every aspect of the brightness curve, letting you turn it into almost any arbitrary shape you want to achieve the effect you desire. Detailed information on using histograms, curves, and the Brightness Curve transformation is available in the document HIST.PDF on our web site (www.dl-c.com). To apply tonal corrections to just part of an image, you need to start by creating a mask for the image. This will let you define which parts of the image will be adjusted and which will stay as they are. For details on creating and using Masks in Picture Window, please see the help file and the document MASK.PDF on our web site. Alternatively, you can use the freehand lighten and darken tools (see Miscellaneous Tools), but these can be difficult to control.

8. Color Balance Your Image

For a print to look it's best, the colors in the image must be properly balanced - free of any bias toward one end of the color spectrum. Unfortunately, such color biases sneak into our pictures all too often. They may be caused by the light. For instance fluorescents are notorious for making everything, including skin tones, look a somewhat sickly green while available-light photos shot under incandescent light will be overly orange giving faces a decidedly ruddy appearance. Processing problems, over age film, and incorrect compensation during scanning can be additional sources of color casts.

Creating a Neutral Image

One way to cancel out the color cast in an image is to simply make adjustments until it looks neutral. However, in practice this takes quite a bit of skill and training. Our eyes are so accommodating to color casts that it is really very hard to judge when an image simply looks right.

Another way to make the adjustment is to pick an area of the image that is known to be neutral and use it as a reference. For instance, in a portrait this may be the white of the subject's eye. In other kinds of images it could be an architectural detail, clouds in the sky, or anything else that you know should have no color cast.

Once you have found your reference, adjust the color balance to make the reference neutral. Picture Window makes this adjustment more or less automatic by letting you use the mouse to point to the reference object. Picture Window then automatically adjusts the image's color balance until the reference point is neutral. This results in accurate color compensation, independent of confounding subjective factors.

For more information on color balancing techniques using Picture Window, please see the document *Color Balance.pdf*.

9. Printing Multiple Images on a Page

Whether you want to arrange a set of images on a page to save paper or to create a pleasing album page, Picture Window’s Layout transformation can do the job. The general idea is to use Layout to create a single, composite image containing all the component images optionally placed against a background and labeled with text. Once you create the final composite, you print it just like any other image. Here’s the procedure:

Collect the Images

Start by opening each of the images you want to arrange. You can open new ones after you start the layout process, but it's easier to plan ahead.

Start the Layout Transformation

Next, select the Layout transformation from the main menu. This pops up the Layout dialog box. The first thing you need to consider is the size and resolution of the final image you are going to print. Set the units to inches (or whatever units you prefer) and set the desired image size so that it will fit within the desired page margins. Next set the resolution (in dpi) according to the resolution of your printer. For inkjet printers a setting of 200-250 dpi is usually about as high as necessary; for a continuous tone printer (such as a dye sublimation printer), set the resolution to the actual printer resolution.

Add the images and text

Next it's time to arrange the images on the page. To enlarge the page preview easier to see, you can resize the Layout dialog box as necessary. To add an image or text to a layout, you need to add a panel -- each panel can be independently resized and repositioned within the layout and you can adjust the order of the panels to control how they overlap. To add a panel, click the + button on the mini tool bar inside the Layout dialog box. This will pop up a Panel Properties dialog box. Use the Color/Image control to select which image you want to drop into the new panel, or leave it blank and enter text into the Text control to create a text label. You can then resize or reposition the panel by dragging its corners, sides, or interior in the preview area. Repeat this process as necessary until you have created the final page layout. You can save the layout for future re-use -- the layout file is very small as it does not contain copies of the images, just their names. To create the final image, click OK -- you will be prompted to save the layout for future re-use at this time. This is generally a good idea as the layout files are very small and saving the layout will let you go back and reposition panels if the final print does not look right. Or you can reopen the layout and replace some or all of the images and text.

When the final image is created, all the images are automatically resampled to the correct resolution and composited into the final image, and all the text is properly antialiased as well.

For more information on Layout, see the Help file or the white paper: *layout.pdf*.

Print the final image

Once the final image has been created, use the Print command to print it just like any other image.