curves…

source: http://www.thegoldenmean.com

Introduction to the Photoshop Curves Command

originally written for the GurusNetwork.com

Fundamentals of a powerful tool for improving the color and contrast of digitized photos.
(Covers RGB and Grayscale; CMYK and detailed print-related issues are beyond the scope of this piece)

[This is a long one. For your own comfort and safety, please insure an adaquate quantity of nourishment and caffinated beverages; please designate a trusted loved one to force quit the computer if you're not out by tomorrow …]

 I'm going to start this essay with a provocative statement: **Anyone who is, or wants to be doing image editing at a professional level needs to be as comfortable with Curves as they are with breathing**. Is that bold enough? Do I have your attention now? If I were forced to give up all but one image adjustment tool, the one I would keep would be Curves. Think of Curves as your one–stop–shopping source for improving images the way the pros do.

Let's clear up some misconceptions right away:

- Curves are **not a filter**
- Curves are **not hard to understand**
- Mastering Curves will make you dramatically **more productive**
- Curves will not make you more attractive to the **opposite sex**

There is a proliferation of photographs now such as the world has never seen before. If you get an image from an experienced digital photographer or a reputable service bureau, chances are you can confidently use it as is. But many images you will run across have poor contrast or an objectional color cast. If it came from a PhotoCD, or the HR secretary's consumer level digital camera or scanner, or from the local one–hour minilab or from your well–meaning Uncle Bud, or from one of the many free graphics sites on the internet — well, chances are very good you are going to have to improve it before you can use it. Even a "good" photo often needs to be adjusted to work in a collage, or to intensify a mood.

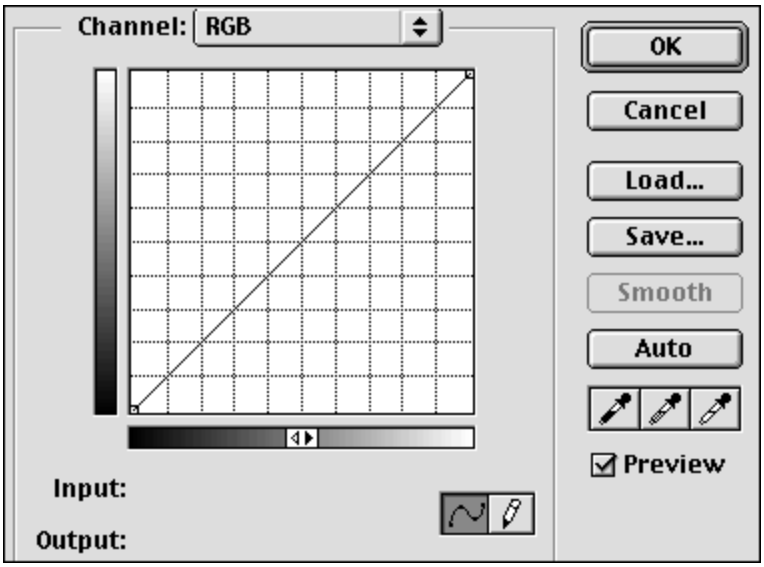
This essay shows a bias towards Photoshop (especially the illustrations), but a Curves adjustment function is an integral part of every professional image editing package I know of, and is included in the interface of every quality scanner, so even if you don't use Photoshop you can still get something useful here. This essay also does not address using Curves for special effects!! Although it certainly has its place in the special effects toolbox, this essay is geared towards the folks who do image editing every day, getting photos to look their best. I'm a commercial photographer. Not a day goes by that I don't call up the Curves command, and I have yet to do a snazzy metallic over–the–edge logo for pay! I promise you: Curves will become part of your tool box just like the hammer is in a carpenter's.

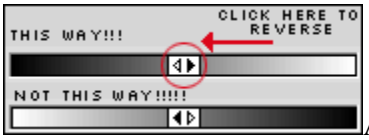
One of the true joys of Photoshop is the many different ways the software offers you for dealing with a problem. Curves is related to all of the other options in the Image>Adjust menu. Just because I use Curves the most doesn't mean I have stopped using Levels, or even sometimes Variations (although I **never** use Brightness/Contrast or Color Balance anymore). You have tools and you use the appropriate one. I like curves the most because in one pass you are able to:

- Adjust the **over-all contrast** or tonal range
- Adjust the **LOCAL contrast** or tonal range
- Adjust the **COLOR**

These changes can be made with with great precision, and can dramatically improve even photos that appear unusable.

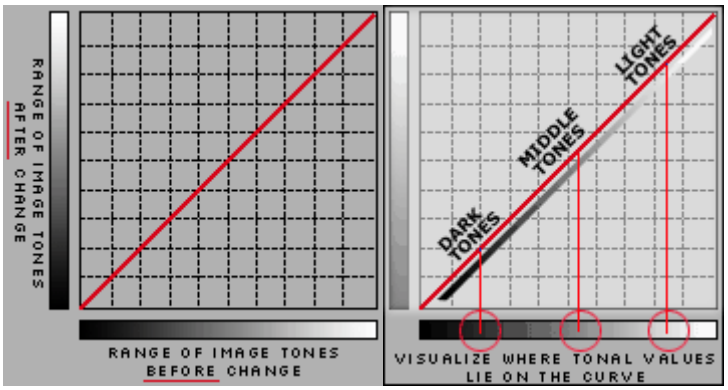
So let's get on with it! Where do you find the Curves command? **Slow way**: from the menus at the top of the screen, select Image>Adjust>Curves. **Fast way**: command/control+m.



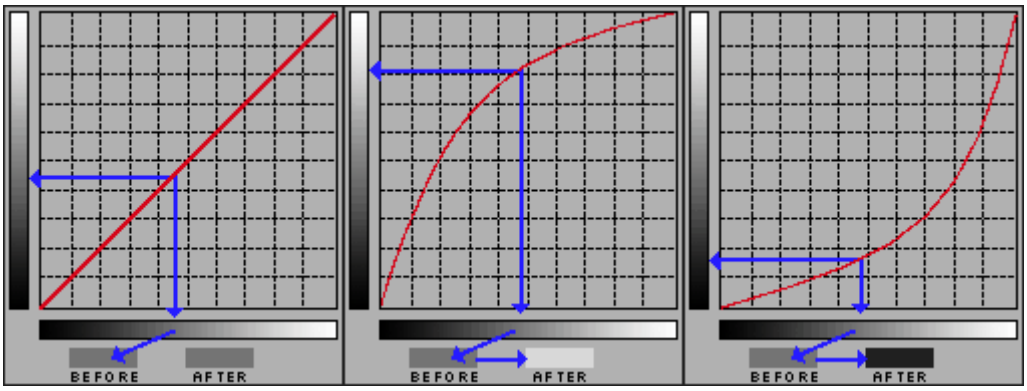


And there you have it. We'll go over the individual components of this dialog as the need arises, but first a few preliminaries. If your Curves dialog does not have as many grid increments as those shown, try this trick: option/alt click in the grid area. This does not affect the functionality of the curves in any way, but does help in visualizing the tonal steps. Also note the two triangles in the middle of the bottom gray scale. The convention in RGB is to display **black at the left** and **white at the right**. Oddly, the convention for CMYK is exactly the opposite! To avoid confusion, I recommend you set yours to the way I have it - the example curves will make much more sense.

So what's the first, most obvious thing you notice? **There's NO CURVE**!! What's up with this? The idea behind Curves is all about **re–mapping brightness values**. Does that make sense? A pixel starts out at a certain brightness, and you change it to be brighter or darker. Have a look at these simplified versions:



Think of the gray ramp at the bottom as the image's tonal values **before any changes**; think of the vertical gray ramp as representing what the image's tonal values **will be changed to**. I hope it's clear that the Curves dialog opens as a straight line because **you haven't made any changes yet**. That means that the brightness values before and after are the same. You will effect a change by changing the shape of the curve! You accomplish this by clicking once somewhere on the line. This will establish a "point"; this point can now be dragged to a different place within the grid, which causes that tonal value to change, either lighter or darker depending on whether you drag it up or down. The reason it's a curve is so that the change blends smoothly throught the image. An abrupt change in value can be very noticeable. The increasingly gradual change of the brightness values on either side of the change permit a very smooth and believable adjustment. These next illustrations demonstrate how a certain value is affected by a curve, and how you can start to visualize how the shape of the curve affects tonality. (Note: I have drawn pretty exaggerated curves for illustration purposes. Sometimes you need curves this strong, but for many images the curves will be much more gentle. A little bit goes a long way!)



Enough already - let's get to some pictures! Page two »

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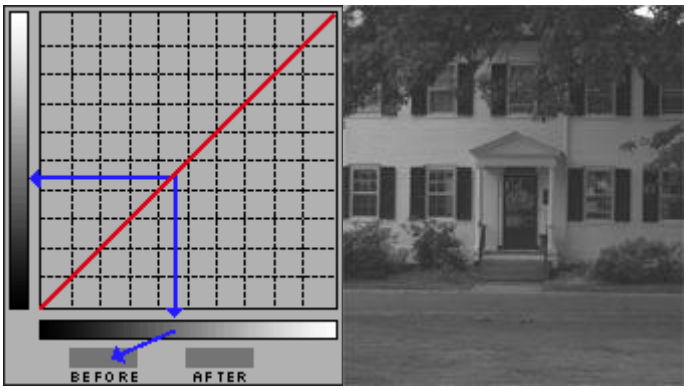
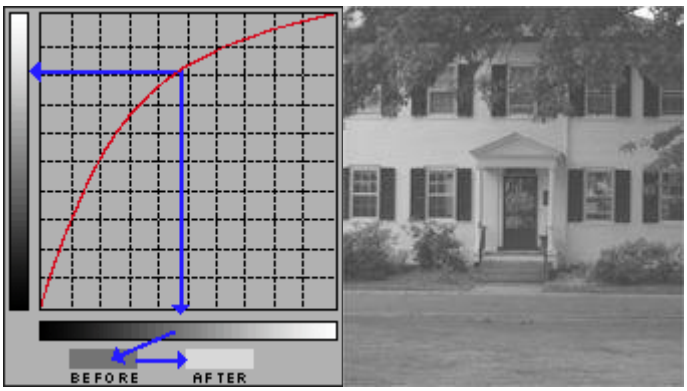
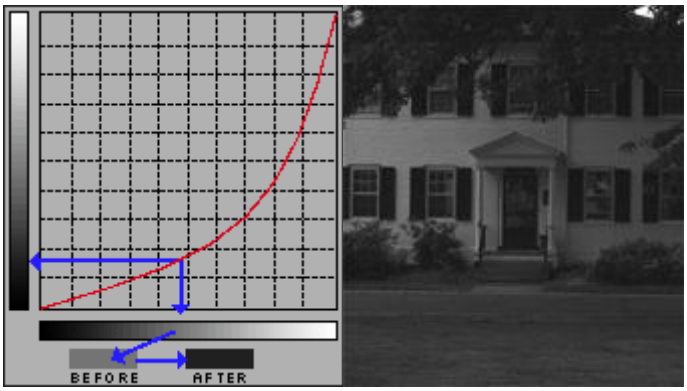
Introduction to the Curves Command, Page 2

Applying the concepts to improving the tonal range of grayscale photos.

Now it's finally time to apply this tool to an image. For the first part of our discussion I am going to stick to a grayscale image. Color images introduce other issues and we'll get to them soon enough; but for now we look at the following sad example. Shot with a digital camera on a hazy evening, it's severly lacking in contrast — "snap". It could happen to you! Can we improve it with curves? Let's look at the previous curves and their effect. (A larger version is available here if you'd like to mess with it on your own.)

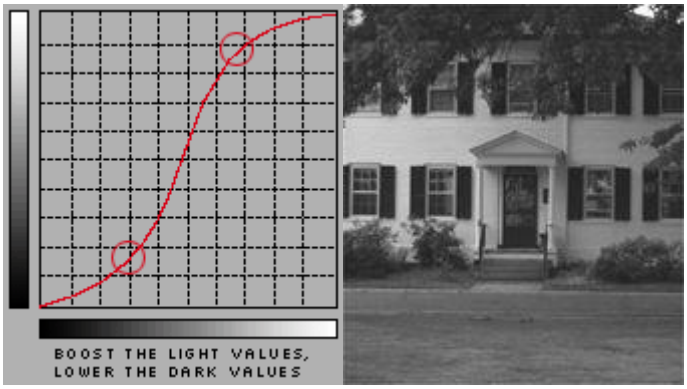


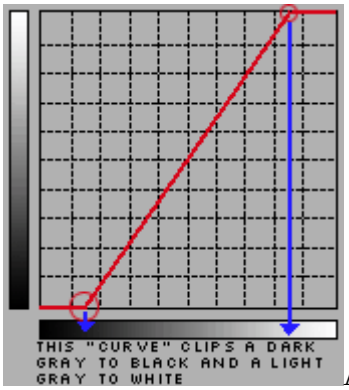




Neither the lighten or the darken curve is particularly effective at fixing all the problems, but you may have noticed that each of them had at least something going for it. Can we combine the best of both? You bet. A

curve can have just about as many points on it as you could practically ever need. We'll see what happens with two points — boosting the light values and lowering the dark values, all in one curve:





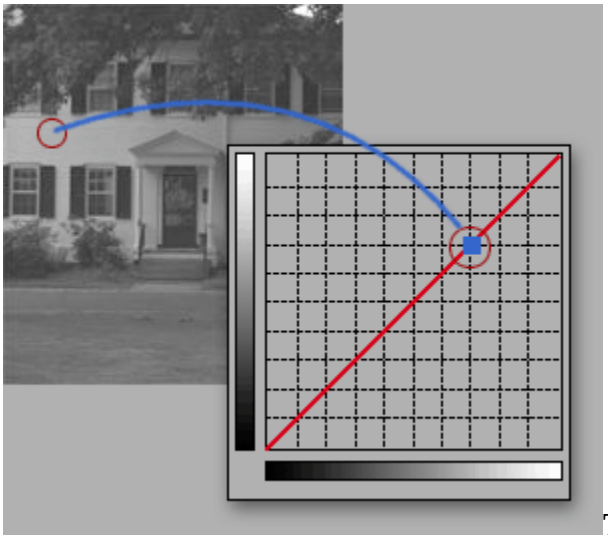
Actually, in an image such as this one with no black or white, the first thing I would do would be to force the range of tonal values to include the full scale. Did you know that the white and black end points in the grid can be moved too? If we keep the "curve" a straight line, but with a steeper slope, black and white come into the image and all the tones in between gain contrast. This trick alone is all lots of dull flat images need! The parallel to this technique is moving the black and white sliders in the Levels dialog to the beginnings and ends of the histogram (although as we will soon see, there are still some instances where there is an advantage to using Curves over Levels). (Micro Tip: to quickly invert an image, reverse the line: drag the black endpoint from the bottom left to the top left; drag the white endpoint from the top right to the bottom right.) Now you may be thinking not every image has a black or a white in it. True, but **most do**, and all your images will have more "pop" if the whole available dynamic range is utilized.

We've covered the conceptual basics. Before moving on to color images, here are three **Power User** techniques that will earn you the respect and admiration of your less informed colleagues. These three tips apply to color images as well (it's just simpler to explain in grayscale), so don't skip over this even if you never plan to work in grayscale.

TIP ONE: Set Range With Eyedroppers

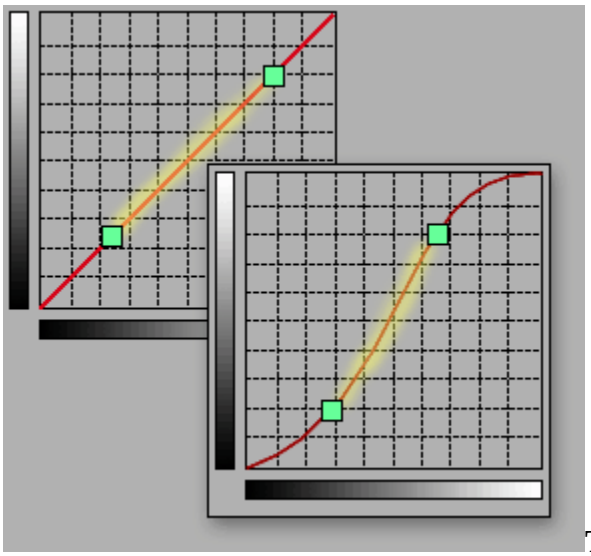
Let's look at the right side of the dialog. "Preview" should always be checked so the image window reflects what you are doing. The "Auto" button should be used with caution; clicking the button will set the lightest value to white and the darkest value to black. This can of course be a time saver, but giving up control to an automated function is seldom the best course of action (it's even more dangerous with color images, where it

assumes the lightest and darkest points should be neutral!). Often the lightest **meaningful** tone and the darkest **meaningful** tone can only be detemined by you, and in the context of the specific image! However, the eyedroppers can be a help. (Since we have a grayscale image here, the middle, "neutral" dropper is meaningless.) Click on the black (left) eyedropper and then, in the image window, click on the tone you want to move to black. Do the same thing with white. Fast and precise. If you have been given target values (as you might if preparing files for print), a double click on one of the eyedroppers calls up the color picker, and you can define what exact value the eyedropper will set the image tone to!



TIP TWO: Locate Values on the Curve

How's this for cool: If you want to locate where on the curve a particular value in your image falls, move the curser into the image window. It turns into an eyedropper icon. Click and hold, and notice how a little marker shows up on the curve! Really helpful. Want to open up the subject's face? Click and find out where on the curve that value lies. If that's not good enough, it gets better! Hold down the command/control key while you click in the image, and Photoshop not only shows you where that tone lies, it automatically places a point on the curve for you! (Just make sure you don't have one of the eyedropper tools active when you do this, or you'll accidentally set a white or black or neutral point.)

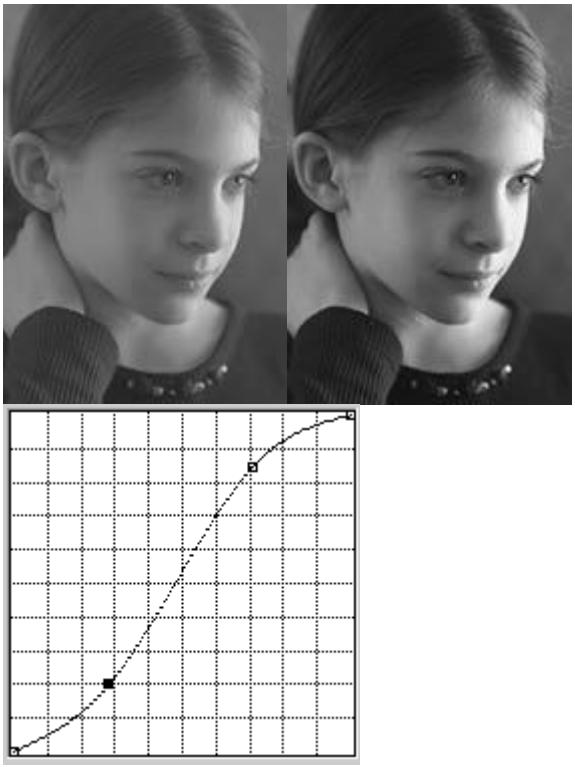


TIP THREE: Strengthen Local Contrast

The final tip for this section is related to tip 2 above. We have talked about maximizing the available tonal range for your image. Now we get a little more deliberate. We're going to talk about maximizing the tonal

range **for the subject** of your image! Many photographs have a subject and a background or a foreground. Think about a portrait for instance. In most cases, we care more about the subject than we do about the background, so the effort should be to get as much snap and sparkle into the subject as possible. We've seen how the contrast is increased where the slope of the curve is steeper. Click and hold in the image window and move the curser around the subject, and make a mental note of the approximate parts of the curve the marker slides around. Now you know how you can find where on the curve the majority of your subject lies! Steepen the slope of that part and you will gain a great deal. You have to try it to believe what this tool can do for average photos. What you gain in the subject will be to some extent at the expense of what is not the subject, but in many cases that's a fair trade–off — it's background!

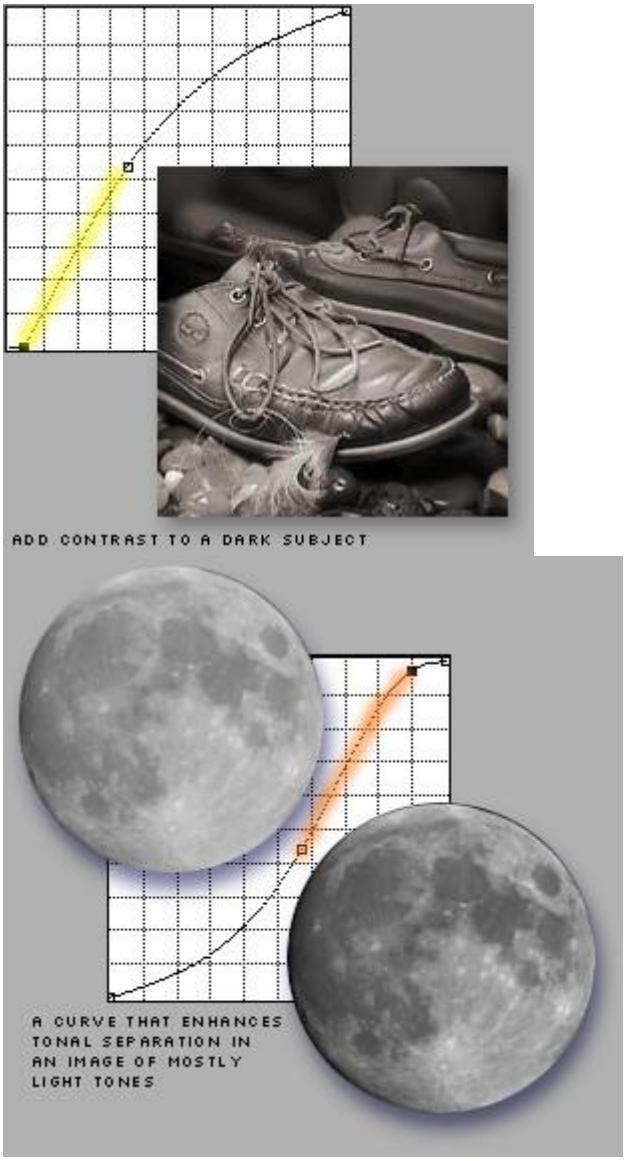
Here's a before and after example of what I'm talking about, with the real life curve below:



With experience you will begin to see tones in relation to their position on the curve, and you will become much more sure and decisive. It's a good idea to do a rough "mental analysis" before invoking the Curves command so you start off with a general idea of what needs to be done. Once placed, the points remain moveable. And you will find that as you place a point and begin to adjust the curve, the image preview becomes a powerful feedback tool — your hand will adjust the **position of the point** and the **slope of the curve** together as one gesture. You are not committed to the change until you click "OK", and you are certainly not limited to one or two points (though I try to keep it to as few points as possible - often times 2 is enough; regardless of what you read in Photoshop books, don't fall into the trap of making things more complex than they need to be). It's not unusual for me to stay in the Curves dialog for several minutes, making subtle changes, tweeks and fine tunings before saying "OK".

A little thought will help you realize that there is no such thing as a curve apart from an image, and no such thing as a generic curve. Every image is unique, and so is every curve. Visualize how the optimum curves might differ for photos where the important information lies in the light tones (a polar bear on a glacier), versus one where the important area is in the dark tones (a black cat in a basement), versus one where the subject matter is predominately middle values (as in the portrait of Becky, above). Now you know how to approach different

images: run your mouse around the image window; note where the range of values lie and steepen that part of the curve! Here are two more examples:



It's finally time to move on to Part 3» **COLOR IMAGES**, and Power User Tips!
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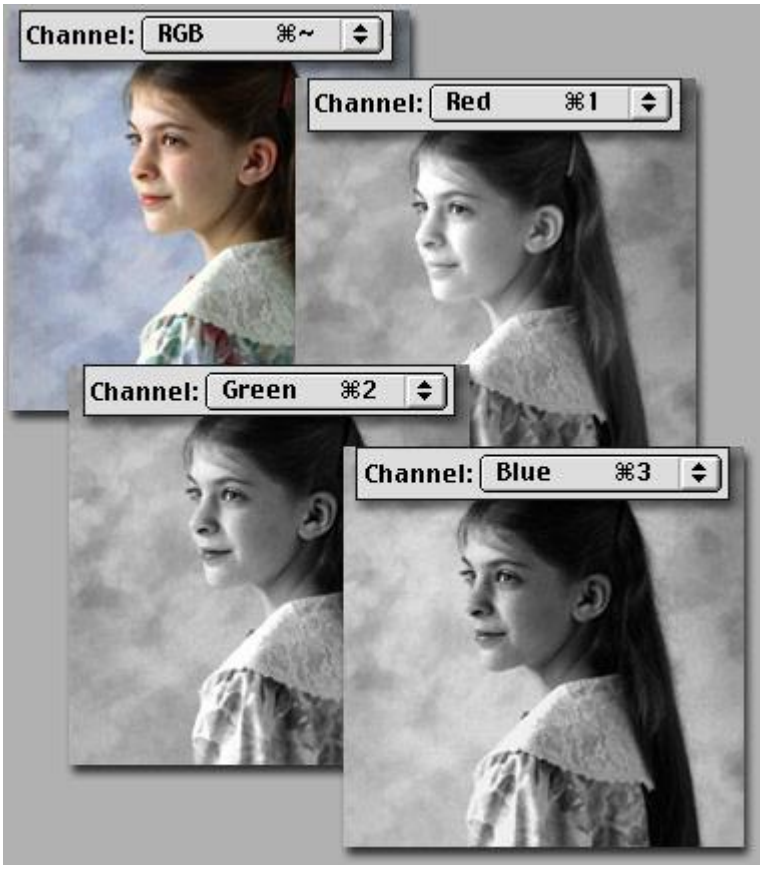
Introduction to the Curves Command, Page 3

Applying the concepts to improving RGB color photos.

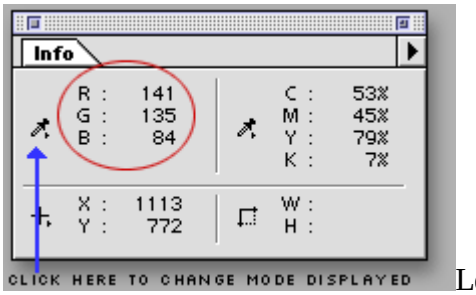
 By now you may thinking I have spent a disproportionate amount of time and words on grayscale images. Since you probably think you work in color how could this apply to you? First, as I stated at the beginning of page 2, the concepts are simpler to present without the issue of color. And second - RGB color images can (and should be) thought of as being comprised of a **composite channel** and three essentially **grayscale channels** containing the brightness values of the three colors. If you have never thought of it this way, study this illustration:



Are you getting an inkling of where this is headed? You can edit each channel with a curve just as we did a grayscale channel, but now in addition to affecting contrast we are affecting the amount of Red, Green and Blue, effectively manipulating color channel by channel. This is the most powerful and precise color correction tool in Photoshop. From this moment on in your career, skip the Color Balance command all together, and save Hue/Saturation and Variations for special effects work. We have something better!

When you invoke the Curves command in an RGB image, the channel displayed at the top of the dialog box defaults to the composite channel: RGB. If your image is okay for color but just needs to be lighter or darker or contrastier, a quick pull of the composite curve will do it, just as with grayscale images. Things get a little more complicated if the color itself needs to be modified. How do you start? Where do you begin? You begin by evaluating the image for a color cast and eliminating it. One of the first big mistakes many people make is to start haphazardly attacking what they percieve to be a color cast in a part of an image with selection tools; in

reality, if you can see a color cast in a part of an image, chances are good it has infected the entire image, and should be addressed globally before local tools are brought out. How do you determine if there is a color cast, and what color it is?



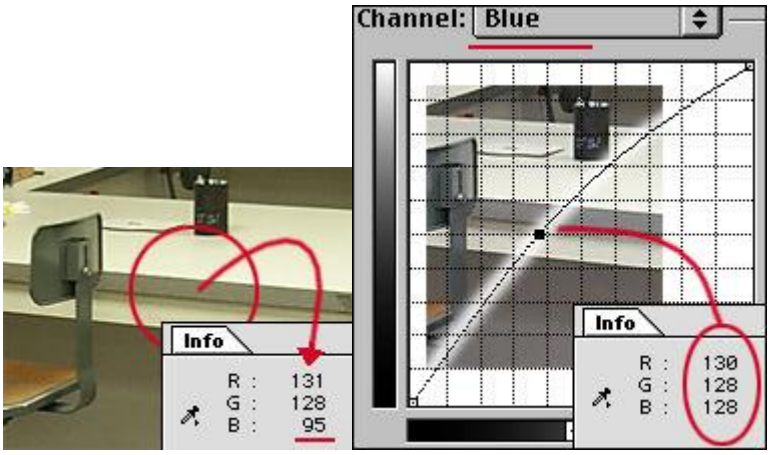
Let me introduce you to our second most helpful tool, the Info Palette. Windows>Info brings this little puppy up, and it should be given a permanent place of honor on your desktop. Run the cursor around your image (doesn't matter which tool you have selected) and notice that the info palette displays the RGB values for whatever pixel lies under the cursor! Color correction "by the numbers" is the ultimate hallmark of the master color technician, and is **way** beyond the scope of this introductory piece. But just knowing one fact will make an enormous difference in how you approach color correcting: for a pixel to be **neutral**, just remember that **the values for Red, Green and Blue should be the same**. It doesn't matter what they are, just that they are the same. A light gray will have different values from a dark gray, but if R=G=B you know they will be neutral. (As a sidebar: our eyes and brain are tremendously adaptable; they work together to pull things almost neutral, or almost black, or almost white to what the brain thinks they should be. Colors are okay to evaluate from the monitor, but black, white and especially neutrals should be confirmed with the info palette.)

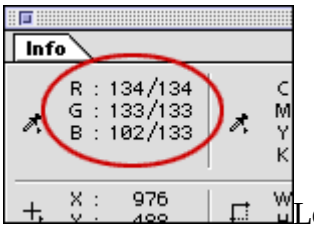
I can't tell you what color skin should be, or what values to use for green grass or a navy blue suit. But neutrals are your point of reference. Of course not every image has a neutral in it, but if you start looking, it's amazing how many photos have something in them that can be used as a neutral reference point. A white shirt; a car tire; a paper on a desk; asphalt paving; a white fence; granite foundations… you get my point. If you need a neutral, chances are better than 50/50 you'll find something. Now, what can you gather about the color of the pixel being described by the info palette in the previous paragraph? It sure isn't a neutral! The value of Blue is much lower than Red or Green. What's the opposite of Blue? That's one pretty yellow pixel. If that was **supposed** to be neutral, we've got to bring blue into line with the others.


In fact, that reading came from this image, shot with a digital camera in a flourescent lit room. You might look at it and have the distinct impression of "something's wrong", but what? We tend to think of flourescent lighting as being deficient in red, leading to green images, but in this case the combination of light and camera is less green than it is yellow. How do we know that? Well, I've done you a favor by picking an image with loads of potential neutral reference points. (You can grab a larger version of this image here if you wish to work with it on your own.) We run the cursor around any one of

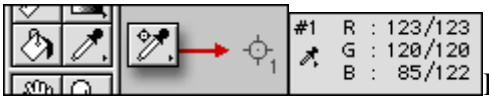
the things that our eyes say probably ought to be neutral, and over and over again the Info Palette announces that blue is seriously low.

Here's the reference point I chose, and the Info display, followed by the correction applied, followed by the net result:





Locate the source of the problem with the Info Palette. Go straight to the problem channel in the Curves dialog. Make the problem go away. As you move the curser out of the image window into the Curves dialog, the Info paletted display goes away; but if you have made a change to one or more curves, when the cursor goes back into the image window the read–out now displays a "before and after" reading. Wow! And, as we saw in grayscale, a command/control click in the image window plants a point on the curve. In color it gets better: if you have, for instance, the blue channel displayed, that's where the point gets planted. Wow **Wow**! Simple! Of course not all images are this simple, and even this one could have used other help too, but the point is just look at what a difference pulling **one point** in **one channel** made! I could have spent ages having at it area by area, but pulling a global curve based on a known neutral worked wonders. Are you shocked? Are you stunned? Are you ready to go?



Here's a super helpful tip Adobe introduced with Photoshop 5. It's annoying to have to keep making trips back into the image window to check on whether you've brought the color value to where you want it. And it's hard to get the curser back to the exact same place each time. Hiding under the Eyedropper tool is a locking eyedropper. Click in the image on the point you want as a reference; the little cross hair icon stays there and a new level appears in the Info Palette. Adjusting curves is simple now: the before and after readout is always there to refer to until you dismiss or accept the changes.

The eyedroppers still work, just as they did in grayscale, and now the middle, "neutral" dropper has some meaning. As we discussed before, double clicking on each of the eyedropper icons will open the color picker. This allows you to set exactly how that dropper will function. If you have some specific parameters, this can be very useful. If you need to keep whites no lighter than 250 – 250 – 250 and blacks no darker than 5 – 5 – 5, set up the droppers and that's what you will get. I still prefer direct manipulation of the curves most times, but the droppers can be handy. I still have same guarded opinion of the Auto button however. A click on this will set the darkest point in each channel to 0 and the lightest to 255. Sometimes it's great, but often it does violence to both color and contrast. However, if you are stumped by an image, give it a try. The preview will tell you the story pretty quickly; if you hate it, try this trick: hold down the option/alt key and notice that the button which had been "Cancel" changes to "Reset". Now wasn't that thoughtful?

Two final points before concluding with some Power User tips. **Point One**: We have looked so far at doing everything globally (to the whole image at once). But you might see that there are times when it is in fact warranted to use curves on a local selection. There are times when the foreground doesn't match the background, or the background is too dark but the subject is okay… any number of cases can come to mind. After having done everything possible to the image overall, it's certainly legal to have at it with selection tools and work locally with Curves! They are just as powerful and capable inside a selection boundary.

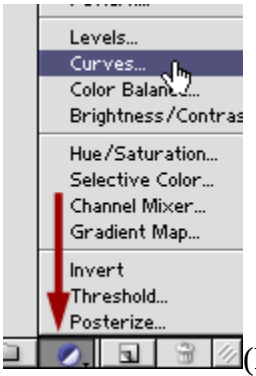
Point Two: I have invested many many words describing how to discern and remove a color cast from an image, bringing it to neutral. But **not all images want or need to be neutral**! There will be times when you will want to enhance a tan, exaggerate a sunset or brighten up a lawn. There will be times when an image needs to be warmed or cooled to work better with other images in a montage. You should have no fear now! Your eyes will have to be your guide since this is interpretation and there are no numerical reference points, but if you had to put a little more red into a face or take some yellow out of moody twilight shot, you know how to approach it now. If at the same time you need to make it darker and less contrasty - one trip to Curves and you can take care of it all!

Power User Tips

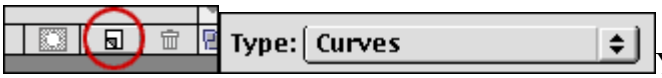
Four tips to make your life easier.

1. **Fade Curves**; sometimes you have done the right thing, just a little too heavy handed. Your best friend could be found in, of all the unlikely places, the Edit menu: Edit>Fade Curves. (Just to avoid confusion, version 5.x of Photoshop located this command in the "Filter" menu.) Immediately after clicking "OK" in the Curves dialog, this option becomes available. You can adjust the amount of the effect of the Curve you just applied! Very handy for fine tuning, but like Undo in that it is not available after you do anything else — use immediately in other words!

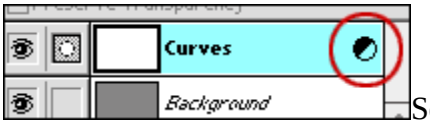
2. **Undo and Reapply**; Let's say you just spent 5 minutes tweeking your curves and you were on the right track, but now that you see it you're not perfectly satisfied. Undo Curves (command/control + z). You know the keyboard shortcut for Curves is command/control + m. If you press command/control + **option/alt** + m the curves dialog opens **with the last settings**!!! Now you have the opportunity to rework them a bit without throwing out all the effort you have invested already. As with tip 1, the Undo step of this tip is only available immediately. But the open with previous settings can be invoked any time during a Photoshop session. It remembers the last Curves settings (works with Levels too if you substitute "L"). Let's say you have 6 images from a shoot all needing the same Curve. Write the Curve for the first one and reapply it effortlessly with the other 5.
3. **Batch Process**; This is an extension of number 2. Frequently you will be shooting a number of shots in a similar location or with similar lighting. Try to get into the habit of shooting the first shot with a neutral reference in it. Since not everybody travels with a gray card, a down–and–dirty trick that can work equally well is to use a sheet of newspaper. No, not US Today's color front page; something with mostly type, like the Wall Street Journal. Back at your office, color correct to this neutral reference and, before clicking "OK", click "Save". Now if you know how to make Actions in Photoshop it's a cinch to batch process dozens or hundreds of images with this same curve!
4. **Adjustment Layers**; I've saved my very favorite till last. Hope you're still alert and with me! Every new version of Photoshop includes new features, and it seems like every new version makes it easier and easier to use the program in real life. What do I mean? Real life involves clients. It involves vaguaries. It involves interpretation and opinion. Any feature that allows you to change your mind at a later date non–destructively is a feature aimed at real life for professionals. (Every application of Curves or levels or whatever involves some shuffling of data, and this is not lossless; once or twice and you'll never see it, but do it too many times and the image will start to show the wear and tear.) Adjustment layers permit unlimited lossless fiddling!



(Please note that the above method for creating an adjustment layer refers to the version 5.x interface. Versions of Photoshop since Six have made it far easier to create adjustment layers, and have added even more options. They are most conveniently accessed from a pop–up menu at the bottom of the Layers Palette. Press the Adjustment Layer icon and select the type you wish from the menu that appears.)



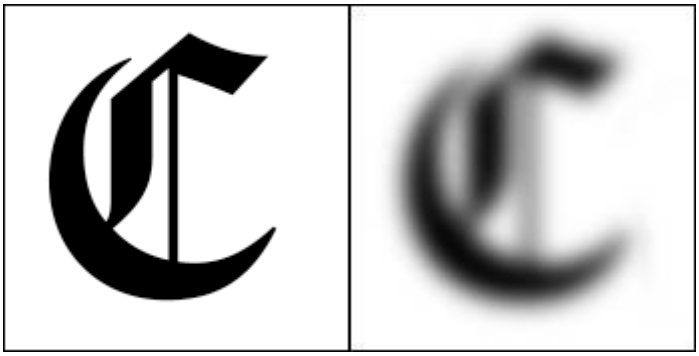
You know how to create a new layer, by clicking the New Layer icon at the bottom of the Layers palette. Try this: hold down command/control while clicking. It's a special type of layer, called an Adjustment Layer. You can select from the pop up menu whether to have it be a Curves layer or Levels, or Hue/Saturation or several others. Select Curves, and the Curves dialog immediately appears. What's different now is that, instead of directly acting on the pixels in a layer, this adjustment layer sort of "describes" the curve to any layer below it. Nothing actually happens to a pixel until or unless you flatten the image; up until that point Photoshop knows to display the effect of the curve but not actually do it for real.

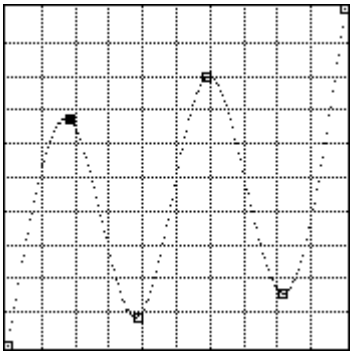


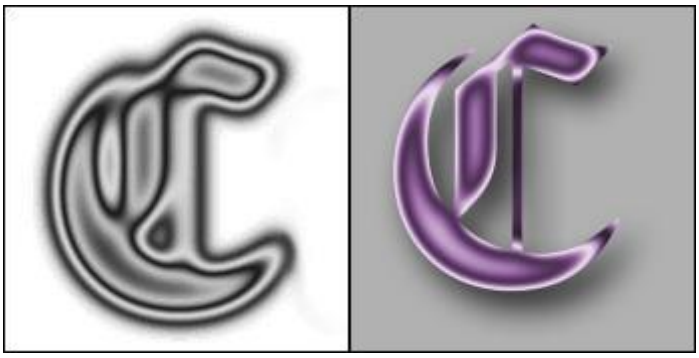
So there it sits in the layer stack - pure magic. Not happy with the curve? Double click the little black/white icon and the Curves dialog opens with the previous settings, ready to be tweeked. This is similar to tip 2, Undo and Reapply, but you can come back and do it any time, hours, days, weeks later, so long as you save the layered Photoshop file (naturally you lose this tool when you save in any format other than PSD). **Don't forget this tip**! The more you work with Curves, the more likely it is to save your butt, especially with demanding clients. I tell you from personal experience, you only have to pull out this trick once on an 18 layer, 40 megabyte magazine cover image to want to kiss some programmer at Adobe!

Special Effects

You have seen the power of the Curves command; you have seen how a pixel's tonal values can be mapped to a different tone. You have seen what an impact a relatively mild curve can produce. You have seen Curves used for boring, utilitarian, everyday pay the bills purposes. I said at the beginning of this piece that Special Effects were beyond the scope of what I would cover, and it is. But just to give you a taste of how dramatic Curves can be used to produce remarkable synthetic effects, take a look at this sequence, starting with a plain black–on–white graphic. The graphic is blurred, to give some gray tones for curves to remap. After the tonal distortion, the original graphic is used to trim the new one, and a fairly conventional color effect is provided by Hue/Saturation. Do you sense the possibilities?







Recommended Reading

I have only touched on RGB images; CMYK is beyond the scope of this essay. The grand Guru for all things CMYK is Dan Margulis. His landmark book **Professional Photoshop** (check Amazon or your local book store for the current edition) should be on the required reading list of anyone preparing files for 4–color printing. His coverage of curves and printing issues is exhaustive, innovative and fun to read too! Other outstanding resources on my bookshelf include **Real World Photoshop** by Bruce Fraser and David Blatner, **Photoshop 5 Artistry** by Haynes and Crumpler and the **Photoshop Bible** series by the fabulous Deke McClelland. (Oh yeah - you might consider reading the manual too - the Adobe folks really do an excellent job with documentation on a program this massive!).

There is still so much to say, but now you have the framework to be able to master Curves, the most powerful tool for professional image editing. Time to jump in and make your own photos better!

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Thanks for