

Graphics Basics for Scientific Figures

This is a brief guide to explain the basics about computer graphics, to help you when you are creating and modifying scientific figures.

I am the web editor and graphics specialist for the Department of Biochemistry and Molecular Biology. I am available for troubleshooting and questions on a case-by-case basis. My contact information is below.

Concepts: file types, color, resolution

Vector and photographic files

Vector files are created with drawn lines and shapes. Examples include tables, graphs and flow chart illustrations. You can create vector files in Illustrator or PowerPoint. Possibly, you might have Freehand, Canvas or CorelDraw. Vector files are resolution-independent. You can increase the size as much as you want, and the edges stay sharp. The preferred file format for vector files is *eps*.

Photographic images are made of pixels. They are images from cameras and microscopes. If you increase the size too much, they become fuzzy and jagged. You must pay attention to resolution for photographic files. The preferred file formats for photographic files are *tif* and *jpg*.

Color

There are two color systems to consider. RGB (**R**ed **G**reen **B**lue) is color by light – computer screens and PowerPoint presentations. CMYK (**C**yan **M**agenta **Y**ellow **blacK**) is color by pigment – ink on paper. One color system does not always convert easily to the other. There is a wider range of colors in RGB. Your digital camera, your scanner, and your imaging equipment attached to your microscope will give you an RGB image; these instruments are using light. You should make all image adjustments in RGB, and convert to CMYK only at the end when you're preparing figures for print publication. If you convert to CMYK and back to RGB, you will lose color information.

Fluorescent colors are a problem, especially green. Converting fluorescent colors to CMYK often results in a muddy image. I have not found a foolproof solution for this yet. You can often improve the image by desaturating the color somewhat before converting to CMYK. But you must be careful to document such image manipulation and apply it uniformly.

Leisa McCord
 Web Editor/Graphics Specialist
 Department of Biochemistry & Molecular Biology
 Office: S9.8316 Hours: 11:00 am-5:00 pm daily
 Phone: 713-834-6280
 Email: lmccord@mdanderson.org (*email is best contact method*)

Resolution (photographic images)

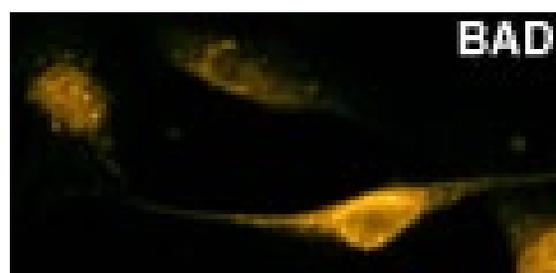
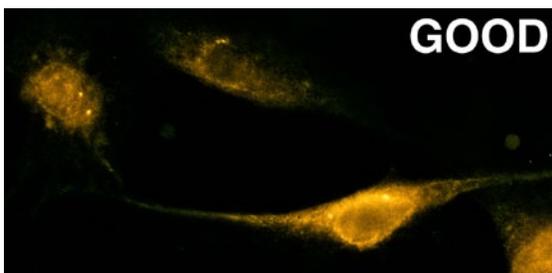
Resolution is expressed as dots per inch (dpi), sometimes referred to as pixels per inch (ppi). Anything that's going to be printed requires a higher resolution than other end uses. Generally, publications want images to be at least 300 dpi. PowerPoint presentations are at 150 dpi. Resolution for computer screens is typically 72 dpi.

Open any image in Photoshop and pull up the image size. (**Menu → Image → Image Size.**) The **Pixel Dimensions** represent the amount of information in your image. The **Document Size** gives you options for expressing size representation and resolution. The check boxes at the bottom give you constraint options. You can ignore **Scale Styles**; you will not be applying styles to scientific images. Checking **Constrain Proportions** will lock your width and height together. Checking **Resample Image** will allow you to change the resolution without affecting the current width and height. Unchecking **Resample Image** will lock the resolution to the width and height. See the example to the right.

Best practice is to keep an original of your image at full resolution in either Photoshop's native *psd* format or as an uncompressed *tif*. You can make copies to size down as needed for different purposes – presentation, emailing, electronic submission – but always keep that high-resolution image as a backup. Once you resample down and then save the image, you have REDUCED the amount of information in the image. Your pixel dimensions are smaller than they used to be. If you attempt to increase your pixel dimensions, you are NOT adding new information, and you are potentially misrepresenting your data. So keep that original full-resolution image!

The image shows three sequential screenshots of the Photoshop 'Image Size' dialog box, illustrating the effects of the 'Resample Image' checkbox.

- Top Screenshot:** Shows the initial state. Pixel Dimensions: 4.83M (Width: 1500 pixels, Height: 1125 pixels). Document Size: Width: 10 inches, Height: 7.5 inches, Resolution: 150 pixels/inch. 'Constrain Proportions' and 'Resample Image' are checked. 'Resample Image' is set to 'Bicubic'.
- Middle Screenshot:** Shows the result of resampling. Pixel Dimensions: 1.21M (was 4.83M) (Width: 750 pixels, Height: 563 pixels). Document Size: Width: 5 inches, Height: 3.75 inches, Resolution: 150 pixels/inch. 'Resample Image' is checked. A red box highlights the Pixel Dimensions and Document Size fields. A red note on the right says: "Image resampled. If document width and height is decreased, then Pixel Dimensions are decreased."
- Bottom Screenshot:** Shows the result of not resampling. Pixel Dimensions: 4.83M (Width: 1500 pixels, Height: 1125 pixels). Document Size: Width: 5 inches, Height: 3.75 inches, Resolution: 300 pixels/inch. 'Resample Image' is unchecked. A red box highlights the Pixel Dimensions and Document Size fields. A red note on the right says: "Image NOT resampled. If document width and height is decreased, then resolution is increased, and Pixel Dimensions do not change."



Software tips

Apart from any specialized scientific or graphing software, you're most likely going to be using Adobe and Microsoft products. MD Anderson maintains an institutional license for Adobe software. If you don't have it and you need it, contact 4INFO.

<http://inside.mdanderson.org/departments/its/prefsoft.html>

All these applications are meant for a wide audience of end users, not just the scientific community, and they can be intimidating, especially the Adobe software. You don't need to know how to use every single tool and option. Take advantage of the Help menus and tutorials. Following are a few basic tips.

Adobe Illustrator tips

Adobe Illustrator is a vector illustration program. It's very useful for drawing figures and for graphing. The file format you will use for submitting figures is *eps* or possibly *pdf*. The native format is *ai*.

- The black arrow selects the entire object; the white arrow selects part of the object.
- Guides and grids are very helpful in lining things up.
- To place a photographic image, choose the **Place** command under the **File** menu.
- Labeling such as letters and arrows for a photographic image can be done in either Illustrator or Photoshop. I often find it easier to do this in Illustrator. It's helpful, though not necessary, to put the labeling on a separate layer. (However, you **MUST** put labels on a different layer in Photoshop.)
- Clipping masks can be very useful for showing selected parts of images. Draw a box over the part of your image you want to show. Select both the image and the box, and choose **Object → Clipping Mask → Make**. Now only the part you want shown is visible; the rest is hidden. You can adjust the mask, changing how much of the image you want shown, even rotating it. Keep in mind that the file still contains the entire image, not just the part shown, and could make the file size quite large. If you want to show a small part of a large image, you should crop the image in Photoshop before placing it into Illustrator.
- To see the outlines of everything in your file, choose **View → Outline** (Command-Y for Mac or Control-Y for PC). This is very useful for identifying and eliminating pesky invisible points and boxes. Use the same command to go back to Preview mode.
- If you use fonts other than the basics (Times, Arial, Helvetica, Symbol, etc.) and you want to submit a figure with those fonts, you should convert the fonts to outline so that they'll print correctly. By doing this, you are turning text into pictures of text, and you can no longer edit the text. So this is one of those things you'll do specifically for the copy of the file you're sending for publication, leaving your original intact. Select the text and choose **Type → Create Outlines**.
- Illustrator has pretty robust graphing capabilities, but it's not terribly intuitive. You have to specify dimensions before you even enter any data, but you can change them later. I highly recommend consulting the Help menu for graphing.

Adobe Photoshop tips

Adobe Photoshop is a very extensive, powerful program. I definitely recommend making use of the Help menu. Use common sense when working in Photoshop. You have worked hard for your data; don't compromise it by getting too ambitious with image enhancement. The native format is *psd*, and the format for submission will most likely be *tif*, or possibly *jpg*. Always keep your original file, in *psd* or uncompressed *tif* format.

- Layers are extremely helpful, and sometimes quite necessary. If you're trying different methods of enhancing your image, do so on duplicate layers of your original image. This makes it easier to compare your new figure to the original.
- You can add labeling such as letters and arrows in Photoshop. Unlike Illustrator, layers are absolutely necessary here. Use layers so that you don't permanently remove bits of data from your image in the shapes of letters and arrows. Remember, keep your original.
- Don't keep lots of blank white space around your image. It will make your file size unnecessarily large.
- In general, keep images in RGB mode. Make a CMYK copy when you need to for publications.
- Also in general, keep images as *psd* or uncompressed *tif* files. Only make a *jpg* when you need to. Pay attention to the quality and the level of compression you use for *jpg*.
- Keep your original image! Keep your original image! Keep your original image!

Adobe InDesign tips

InDesign is a page layout program, available from 4INFO, just like other Adobe software. InDesign is extremely useful for putting together graphics and text, especially for multipage documents. Even for collecting and labeling a set of figures, it's a viable option to PowerPoint. InDesign has a lot of options for import and export/output, and it doesn't mess up your resolution like PowerPoint does.

Adobe Acrobat tips and pdf files

Pdf files can be created in just about any application. They preserve all formatting and can be opened by anyone; *pdf* stands for **P**ortable **D**ocument **F**ormat. Different applications have different options for creating *pdf* files, and while the default settings are usually fine for most purposes, they may not be suitable for publication. The full Acrobat application (as opposed to the free Reader) can make changes in *pdf* files, but as with any other file, it's best to start with the largest, most complete file possible.

Microsoft PowerPoint tips

PowerPoint is good for drawing vector figures and for assembling presentations to be shown on a computer screen or projector. PowerPoint is very bad as a place to store your photographic images. The main problem is that the default output for PowerPoint is 150 dpi, and there's no way to determine the original pixel dimensions. It's very difficult to get nice figures out of PowerPoint once you stick them in there. **IF AT ALL POSSIBLE, YOU NEED TO GO BACK TO THE ORIGINAL FILE THAT WAS INSERTED INTO POWERPOINT.** If you must resort

to rescuing images from PowerPoint, you can follow these tips for extracting images out of PowerPoint into formats you can actually submit. These are Mac tips; PC options may differ.

- For a photographic image, the safest method is to copy in PowerPoint, create a **New** file in Photoshop (keep the default settings), and paste. The default settings that Photoshop will offer is based on the information in the image. Sometimes this copy/paste works easily, sometimes not. It may depend on your particular version of PowerPoint or Photoshop, or the file format history of the image. If what you paste looks like a total mess, try a three-application process. Copy in PowerPoint (you may need to add a white box behind your image) and paste in the Mac application called Preview. Then in Preview, save as *psd* or *tif*. Open that file in Photoshop, and crop and adjust resolution/dimensions as needed. Save as *psd* or *tif*.
- If the first method just isn't working, you can try this one. In PowerPoint, go to the **Save As** menu. For **Format**, choose **JPEG** and click the **Options** button. In that menu, bump up the resolution to 300, 600 or 1200 dpi – it depends on your image. Save it and open it up in Photoshop. You can often recover the original pixel dimensions this way, but it can be hard to tell. If you save it as a higher resolution than the original image, you run the risk of misrepresenting your data. This really should be done only as a last resort. Finally, save as *psd* or *tif* in Photoshop.
- For a vector image that's been created and drawn in PowerPoint, go to the **Print** menu. Under the PDF button, choose **Save as PDF**. Open the *pdf* file in Illustrator and clean it up. It will have some unnecessary boxes that can be deleted, but you probably won't have to redraw it from scratch. Save as *eps* in Illustrator.
- For a vector file that's been placed into PowerPoint, you're going to be disappointed. If you can't go back to the original vector file, you're stuck with trying to save it as a photographic image. You cannot turn it back into a vector file, and you won't have all those nice sharp edges. You can try to save it according to the methods above for photographic images, or you can redraw it from scratch.

Microsoft Excel tips

As a graphics tool for scientific figures, Excel is primarily used for graphing. It's very robust and easy to use for that. The harder part is getting your graph into a good format for submitting.

- To create an *eps* file, go to the **Print** menu and save as *pdf*. Open the *pdf* file in Illustrator and remove the data block and other non-graph items, then save as *eps*.
- If you have the data in Excel but you want to create the graph in Illustrator, you don't have to reenter it. You can copy the data in Excel and paste it in Illustrator's Graph Data window.

Microsoft Word tips

I rarely work on entire grant applications or journal submissions. As such, I am unwilling to offer specific tips for Word. But I am always available for case-by-case troubleshooting.

General graphics tips

These are some basic common-sense tips to help you make your work look its best.

Planning ahead — It is important to have an idea of what you want at the end before you begin. Something that will be submitted for a print publication will not be formatted the same as something for a PowerPoint presentation. Keep your options open as long as you need to, regarding resolution and color system.

Consistency — Make fonts, colors, sizes and shapes consistent within a figure, and among a set of figures. For text, it's helpful to know how to set tabs correctly and how to use style sheets. Style sheets help with text consistency, and can help minimize the risk of making global changes to a document.

Printing — Always check your page setup and print settings. You will get best results, especially if you are using specialty paper, if your application and your printer are in agreement on settings for quality and media. Inkjet and laser use different chemistry and processes; use the correct paper for your printer for best results. Regular copy paper can be used in either kind of printer for basic printing.

Journal or grant submission specs — Each journal or grant will have its own instructions or specifications for text and graphics. If you have difficulty deciphering them, please don't hesitate to ask. I am here as your resource to help you succeed.

Previous figures — If I have worked on a file or printed it, I have it archived. If you're looking for a previous version or an original vector file, contact me. If I have an approximate date and an idea of what it looks like, I should be able to find it, or find a file that can be altered for your needs.

Posters

For posters consisting of PowerPoint slides, I can print them on heavy glossy paper. No appointment is required, though advance notice is appreciated. Please keep in mind that for big events such as the G&D Retreat, there may be many requests for printing, so the earlier you get your files to me, the better.

I can also print long title banners, also on heavy glossy paper. An Illustrator file with an image of the BSRB is available on the BMB intranet site here:

<http://inside.mdanderson.org/departments/biochemistry-molecular-biology/graphics.html>

Medical Graphics can print large-format posters for a fee. This department offers templates in both Illustrator and PowerPoint, along with other helpful links. This information can be found on their intranet site here:

<http://inside.mdanderson.org/departments/medical-graphics/scientific-posters-slide-presentations.html>

Leisa McCord
Web Editor/ Graphics Specialist
Department of Biochemistry & Molecular Biology
Office: S9.8316 Hours: 11:00 am-5:00 pm daily
Phone: 713-834-6280
Email: lmccord@mdanderson.org (*email is best contact method*)