

Pixels and Megapixels, Oh My!

Digital cameras, graphic editing applications, and multimedia applications are natural partners. They empower you to make vivid, creative, and professional looking activities and other classroom materials. But with so many choices for graphics formats, resolutions, display size, and print out size, it can be very confusing! These tips will hopefully make it a little easier to get the graphics into a project in Classroom Suite®, Clicker 5®, My Own Bookshelf®, and other applications. The following pages will demystify these topics:

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Want more free activities, tips, and graphics? Look in the Attic!

Pixels and Bit Depth

A pixel is one of the little teeny dots that make up a digital picture, whether it's part of a photo or a graphic drawn on a computer. Each one has some code attached to it, telling where it is to be displayed on the screen and what color it is. The amount of code per pixel goes up if the number of possible colors is higher, needed for subtle color gradations. This is the **bit depth**, and typically digital cameras now are 32 bit depth, that is, 32 bits per pixel.

Combine that with the large number of pixels in a single photo (megapixels!) and you can see why the file sizes of digital photos are getting larger all the time. When you put a set of these photos into an activity, that quickly adds up to an enormous activity file size. So one goal in these tips is to find ways to use those pixels without overloading the applications.

Pixel Dimensions

One way to imagine a digital picture is that it's a certain quantity of pixels. You can calculate the actual number of pixels in any digital photo or graphic by multiplying the number of pixels wide by the number of pixels high. You often see graphics described by their resolution or **pixel dimensions**, the width in pixels times the height in pixels. That total number is much larger than you'd guess! For example, a typical photo might be 2048 pixels wide by 1024 pixels high (2048 X 1024). Multiply those together, and the result is 2,097,152 total pixels, just for that one photo!

What's a Megapixel?

The total pixels in a digital picture is often a big, unwieldy number, so we need a larger unit than the pixel to conveniently compare various photos and graphics. We define a **megapixel** as one million pixels, so that example photo has a total of a little over 2 megapixels. The **megapixel rating** for your camera is the largest total pixels you can have in a single photo taken with that camera. However, often you can

set the camera for fewer megapixels per photo than this maximum, by choosing a lower resolution or quality setting. And of course small graphics like clip art might have a very small total pixel count, not large enough to designate in megapixels.

Fewer Pixels = Less Detail = Less Total Information

Why would a setting with fewer total pixels be designated as lower resolution or quality? Essentially, fewer total pixels means less detail. Displayed at a fairly small size, a picture with 3 megapixels total might look much like one with 11 megapixels. But if you enlarge those two photos, very soon the 3 megapixel photo will begin to look grainy. You're beginning to see space between the dots (pixels). At the same display size, there are so many dots in the 11 megapixel picture that they cannot all be displayed, so it still looks smooth. You'd have to enlarge the 11 megapixel photo much more before it looks grainy.

Another way to look at a digital picture is to think of each pixel as a tiny container of information. The more pixels, the more information. Photo editing programs can change the values of the information, adjusting a dark picture to look lighter, for example. But no editing tricks can actually put in more information, so a picture with fewer pixels cannot be displayed as large as one with more pixels and still look good.

More Pixels Than Can Be Displayed Is Wasteful!

However, bigger is not better if you are using the photos in Classroom Suite or some other application. After all, usually you are not enlarging a photo or background graphic when you use it in a computer activity. Indeed, it is well worth investigating how many pixels will actually be displayed in an activity. If only part of the total is displayed, you have a hidden bunch of code that is going to inflate the file size without adding content or visual quality to the activity.

Displayed Pixels vs. Pixels in the File

The typical monitor displays 72 dots (pixels) per inch. On my monitor, which is about 14 inches across, that means that only 1024 pixels will fit across it. But not all activities would fill the entire screen. I notice that the default Classroom Suite v. 3 page is only 11 inches across (not counting the border) on that monitor. This means only 800 pixels could be displayed across it, and when I check the default page size, it is indeed 800 wide. For My Own Bookshelf, a picture 600 pixels wide would fill the activity window. That means a graphic 800X600 is plenty big enough to use as an ICS background, and one 600 wide for My Own Bookshelf. I've found that 800 X 600 is plenty of pixels for an activity background.

Monitor Resolution Compared to Pixel Dimensions

I could change the settings and have my monitor set at a higher resolution, maybe 96 pixels per inch. In that case, 1344 pixels might fit across it. What happens if I change my resolution to 96 pixels per inch? Do I need more pixels in a graphic I want to use as a background, since now more pixels will fit on that same screen? It turns out that the number of pixels displayed across a default page for an activity remains the same, whatever the screen's resolution setting. Everything on the screen looks smaller at 96 per inch, though, because now the pixels are closer together. For example, a Classroom Suite page looks smaller, only a little over 8 inches across, on that same computer monitor when the screen resolution is changed from 72 to 96 per inch. It's still 800 pixels across the activity page, but they are closer together.

More Pixels Than Can Be Displayed = Bigger File But Worse Image

What happens if you load in a picture that is much bigger in terms of pixel width than the size of an activity window? Again let's consider an application that has 800 X 600 as its default page size. If you put in a background picture that had the pixel dimensions of 1600 X 1200, it would still just fill the page. The application uses some plan to show

only half of those pixels, perhaps every other one. However, you will be charged the full price in terms of file size.

Also, the picture loses quality because of the need for showing only some of the pixels. If you resize that 1600 X 1200 picture in an editing program such as PhotoShop Elements® which resamples the image and save a version reduced to 800X 600, it will look better on the page than the full size version of that picture.

Using Your Megapixels Wisely: Editing and Resizing

Usually, you want to crop or resize you background pictures so that their pixel dimension matches the width of the page, in pixels. You might even get away with loading in a picture with pixel dimensions a little less than the page, and stretching it to fit, if total file size is an issue. How much difference does it make? If you resize a 1600 X 1200 image to half size (800 X 600), it has only 25% as many pixels, so the file size is a little over one fourth as big.

If you were using it in an animation where part of the effect was to enlarge the picture, to give the illusion of moving into it, then having the pixel width somewhat wider than can be displayed might make sense. Otherwise, when you enlarge the picture it might look grainy. Still, you do not need much more than 1024 pixels across even if you are enlarging the photo dynamically within the activity.

For clip art and other graphics that do not fill the page, try to estimate how much you need to shrink the art to use in the activity. If it's quite a bit, then consider resizing it in an editing program, and saving a smaller version.

Print Resolution

There is one more resolution to know about if you intend to use digital images to make printed materials such as handouts and flash cards, or just print out your photos. That is the print resolution. Just as the

monitor resolution determines the size of the image you see, the dots per inch (dpi) of the printer resolution determine what size your printed picture will be. Usually you can set the printer for various resolutions, or set the print resolution in the application from which you are printing.

Suppose you have an image that is 1600 pixels across. If you print it at 300 dpi, it will be 5.3 inches wide. It will look very smooth and rich, too, because you certainly won't see between the dots! If you decided to set the photo to print at 150 dpi, then it would be twice as wide, 10.6 inches. Probably it still would look pretty good. But if you had an image only 600 pixels wide, it wouldn't be a good one to print. At 300 dpi, it would be only 2 inches wide! That might be perfect for a small clip art image, but too small for a photo of a group of people. You would be better off starting with a photo of higher resolution, that is, larger pixel dimensions.

Why Did I Get An 11 Megapixel Camera, Then?

The bottom line is that you really don't need to buy the camera with the largest megapixel rating you can afford, if you intend to use the photos as part of computer activities, handouts, tutorials, or for a web page. Remember that we found that a 2048 wide photo needed to be resized or cropped down to at most 800 pixels wide to use as an activity background. And a 2048 X 1024 photo is only 2 megapixels! Probably 3 to 5 megapixel rating cameras are all you ever need.

Be sure to look up the ratings of the lenses as well as checking the megapixels. If the lens doesn't focus sharply, or if it has aberrations to that you get a fish-eye effect, lots of pixels will only show up these flaws more clearly!

So what do you do with all those extra megapixels, if you already have a camera? There are several ways to take advantage of a camera that takes pictures with wider pixel dimensions than what you need to fill an

activity page. You could simply set the camera for a lower resolution, knowing approximately what size you need for an activity. Then you can take many more pictures before filling up your camera card.

Using Part of a Photo

You also can take high resolution pictures at a distance, knowing you will be able to crop out the subject area and display that subject close up in the activity. That is, you could crop out an area of only, say, an eighth of the total area of a high megapixel picture, and that would still have enough pixels for a full screen wide image in an activity. If you have a high megapixel camera, this allows you to get some good detail on distant or small subjects, such as a bird in a tree.

You also can turn parts of a photo into high quality clip art. Crop out that bird, and carefully erase the background around it. Select the background to check for stray pixels, and make sure you get the background completely erased. you may want to fill the background with white. Some applications, like Classroom Suite, make the background color (as determined by the color in the left upper corner pixel) transparent. If your clip art needs solid white areas, fill the background with another color, not used in the clip art. You may need to select the clip art and use stroke or outline to put a solid dark line around it, if you find that it looks shaggy on the edges when you try to use it in your activity.

It's a good idea to do this cropping and editing in PhotoShop® or the editing software that came with your camera, and then save a cropped **COPY** to use in activities. Be sure to save the original, though, in case you need it later. Remember that resizing the image within an activity does not reduce the file size, because it is not really discarding any of those pixels. Resizing in an editing program reduces the file size, and usually results in a better-looking reduced image than resizing it within the activity.

When Many Megapixels Do Pay Off

I feel that a higher megapixel camera takes better short video clips, probably because these are memory-intensive and the memory used for a high megapixel photo can also be used for taking a short video. More megapixels are **definitely** necessary if you intend to make photo enlargements for posters, to frame, or for printing on tee shirts.

Graphic Formats and Their File Extensions

There are many different ways to encode the information for a digital picture, be it a photo or the work of a digital artist. You can determine which one a certain image is by looking at the **file extension**, a dot followed by three or four letter suffix after the image name. If you don't see a file extension on your image file, and you are on a Windows computer, look under the **Advanced** section of **Folder Options**. The default setting often is to not show file extensions of known file types, but you can change the setting so that they all show. You can also set this in the **Advanced** section of **Finder Preferences** on a Mac.

I like to see all the file extensions, because it's a necessary bit of information in determining if a particular digital image will work with a given application. Check the application documentation to see what graphic formats it will load. One thing to look out for: Image files without a file extension. Macs often create these, at least on older systems. I have also seen images downloaded from the web that arrived without the extension. Many applications will not load such an image, and the error message may say it's corrupt or that it's an unknown file type. If you are having this problem and know what the extension should be, change the name of the file by adding the dot and three letter suffix. Often the image will load after the change.

Trade Off: Image Appearance vs. File Size

Some graphic formats encode detailed color information, printing information, and the position of each pixel. Some even can include information for path or vector based art that can be easily resized

with no loss of quality. Other formats emphasize small file size. They do this in several ways. One option is a compression scheme, which may discard some of the information in order to make the file size smaller. Another tactic is to limit the number of colors, thus cutting down on the amount of color information that must be stored in the file. Some use a little of both.

In general, as you might guess, if you include more information, you get a better quality image that can be enlarged and printed beautifully, but the file size is very large. If you can compromise a bit on image quality, don't need high quality printing, and do not intend to edit an image, you can go with a compressed image format for a smaller file size.

Recycle Your Images

A very good strategy is to keep your original, save an edited copy if needed in a format that preserves image quality, and also save a JPEG or GIF image to use where small file size is the main criterion, such as in an activity. That's a lot of versions of the same file, but it will pay off if you need to go back to the original and crop out a different part, further edit for appearance, or add information such as labels. You can recycle all or part of your images in this way. Keeping an organized library of images you can choose from really saves time in building activities! I keep mine on an external hard drive so that my main computer drive doesn't get filled up. You could also burn a bunch to a CD when you have a good collection, or keep copies on flash drives.

Formats that do not erode upon repeated saves include .psd (PhotoShop), .bmp (Bit-mapped, common on Windows), .pct (Pict, a Mac format) and .tif (TIFF, a good format for something to be printed). These are good choices for your edited or cropped image, and could be further edited and resaved without loss of quality. But still keep that original!

Formats that you probably would not edit further but create small files good for the web or for activities, handouts, and lesson sheets include .jpg (JPEG) and .gif (GIF). GIF format files use a maximum of 256 colors, but for digital art and photos with limited colors, this may be a good option.

A Final Note About File Size

Be sure to check the file size of activities made with JPEG images. In some cases, JPEG will really save you on file size. For example, I made a PDF file using small .psd clip art, and it was about 10X the file size of the same PDF made using JPEG images.

However, some applications seem to decompress the JPEG as it's added, so that you lose the advantage of the small file size. I have seen this with My Own Bookshelf® and ICS v. 3, but have not tested Clicker 5®. One way to check is to make a test activity of 10 pages, loading an image into a blank page and then duplicating it. As a control, make a second activity with just 10 blank pages.

Calculate how big the file size of the JPEGs alone would be (10 X the image file size). See if the difference between the control activity and the one with the same image on each page is fairly close to the size of 10 images. If so, then you know JPEGs are a good choice for building activities in that application. But if it's double or more, then that application may be decompressing the files. If you suspect that is happening, try using GIF images if the limited color palette is acceptable, or .bmp images saved with 16 bit color depth and see if that gives you a smaller file size.

What's This About JPEG Being "Lossy"?

You may have heard that JPEG compression is a "lossy" compression. This does not mean JPEGs are bad. It means that you do NOT want to repeatedly open, change, and resave in JPEG format. That's because each time it is saved, a JPEG image is re-compressed, and a bit more

information is lost. If you do this repeatedly, the image begins to be blurry, especially if it's enlarged.

However, JPEG is a very compact format, and is particularly good for putting pictures onto the web. In fact, GIF and JPEG are the only image formats to use for the web. Just be sure to save a version of the image in a non-lossy format, and a second one in JPEG. If you find that you need to do further editing, return to the non-lossy version, make the changes, save in the non-lossy format, and then replace the JPEG with the changed version.

Why Do Some Downloaded Web Images Look Lousy?

Images on the web are either in JPEG or GIF format. They are often in the most compressed/lowest quality format, especially if the image is part of a page's design rather than a download. They look fine on a web page, and usually are quite small in both file size and pixel dimensions, so that they will load in quickly. But since they are pared down to the minimum of pixels, you will see a very grainy low quality image if you use these in an activity. Use your own photos and artwork if at all possible, or go to one of the websites that have copyright-free images specifically to download.

What About Copyright?

Keep copyright in mind when you use images from the web in your activities and other class materials, particularly if you plan to distribute or share these with others. Look for **terms of use** before you use these images. You may have to do some detective work to find the home page of a site with an image you found through a search engine like Google Images®. These go directly to the page an image is on, sometimes even bypassing a place to sign in to a private area! But somewhere on each site will be copyright information and any restrictions on use.

Some sites ask that you include attribution information if you use images. Some clearly state that images on the site should not be used without permission. There are also sites with copyright-free or public domain images you can download. Look for links to several of these on the [Annie's Resource Attic](#) site under the **Free Stuff** links in the sidebar.

Did you know that you can add copyright information to your own photos and other digital images? You can do this under **File Info** in PhotoShop or PhotoShop Elements. The information will be embedded in your image file, and if you post such an image on the web, it will register as copyrighted. I don't know if this option is available in other photo editing applications.

You can mark the image as copyrighted, put in your name as the author, record the name of the photo or other graphic and a description of it, and list your own terms of use. You also can embed contact information, such as a web site or email address, where someone could contact you asking permission to use the image. This is helpful to both you and others. I once was contacted by a publisher to use one of my copyrighted photos, of a dinosaur footprint, in a textbook. The embedded copyright information had led the publisher to write to me. So who knows? Your photos might become famous :)

Quick Notes On Pixels and Megapixels

Definitions

Pixel - One of the little teeny dots that make up a digital picture, whether it's part of a photo or a graphic drawn on a computer

Megapixel - 1 million pixels

Megapixel rating - The maximum number of pixels per photo that a particular camera can produce

Bit depth - A measure of the information in each pixel. A bit depth of 32 requires 32 binary digits per pixel.

Pixel dimensions - The dimensions of a digital graphic image expressed as the width in pixel times the height in pixels, also called the image resolution. Example: A 2048 X 1024 image

Monitor resolution - The number of dots or pixels per inch displayed on the computer screen, typically 72 or 96. An image 600 pixels wide displayed at 72 dpi would appear 8.3 inches wide on the screen.

Print resolution - The number of dots per inch (dpi) in a printed image. An image 600 pixels wide printed at 150 dpi prints out at 4 inches wide on paper.

Graphic format - The particular type of information encoding scheme used for a digital image.

Lossy compression format - A graphic format that re-compresses and thus loses information and image quality each time it is saved.

Tips on Digital Images

✳ Fewer pixels or megapixels = Less detail = Lower quality = Smaller file size in a digital image.

✳ Using an image with pixel width larger than page width = Bigger file size = Worse appearance than using an image the same pixel width as the page.

✳ Pixel dimensions of 800 X 600 are a good default size for a page background in most applications.

- ✿ High resolution images may be needed for printing large finished sizes. Here is where high megapixel cameras are needed.
- ✿ If an image is too big, crop or resize in an editing program, not in the activity, for smaller file size and better appearance.
- ✿ For web or computer activities, a 3 to 5 megapixel camera is just fine.
- ✿ Check lens quality along with the megapixel number in buying a camera.
- ✿ Be sure you have your operating system set to show file extensions, so that you know for sure the graphic format of your image.
- ✿ Be sure the image has a file extension. Many applications won't load without one!
- ✿ Keep the original image, an edited version in a non-lossy format, and a JPEG or GIF version to use in the activity.
- ✿ Keep all images so that you can recycle all or part of each in other activities. Your digital library is a wonderful time-saver!
- ✿ Be sure you know and comply with terms of use for images from the web. Most are copyrighted and have restrictions on use.
- ✿ Look for sites with public domain or copyright free (NOT royalty free!) images to download rather than grabbing images off a site.
- ✿ You can add copyright information to your own photos and digital art in PhotoShop® or PhotoShop Elements®. Look under **File Menu-->File Info**.



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