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# Resolution and Image Resizing:

This tutorial is going to cover the often misunderstood subjects of resolution and image resizing. Don't worry if you don't understand it all straight away – remember you can watch the tutorials as many times as you like.

The first thing to define is a pixel. Digital pictures, whether scanned or taken with a digital camera, are made up of a grid of tiny squares – each square is a pixel and contains information about the colour and brightness of that part of the image. If you zoom into an image far enough you can see the individual pixels. This type of image, made up of pixels, is called a raster image. We will look at the other type of image, a vector image, in a later tutorial.

Next, let's get some definitions out of the way. Resolution is one of those words that means different things in different contexts. It's a bit like the word print – this could be a photographic print created in a dark room, a collagraph print made with a press, a screen printed image, or something printed on an inkjet printer. They are all called prints but the word needs qualifying before you know precisely what it is.

We'll start with **Monitor resolution.** This refers to the number of pixels that are displayed by the monitor for example 1024 x 768 (pronounced ten twenty four by seven sixty eight). The first number refers to the width in pixels and the second to the height in pixels.

Each monitor will have a maximum resolution and it can't physically display any more pixels than this. You can, however, choose to set your screen to a lower resolution. If you do this, everything on your screen looks bigger. A higher resolution means that everything is displayed smaller. I find, as I get older, that I am more comfortable with my monitor at a slightly lower resolution than I had when I was younger …

Now we have **Printer resolution.** This refers to the maximum number of dots of ink or toner the printer can print per inch of paper. Be careful when looking at the resolution given in the specifications of inkjet printers. For instance, a printer could have four different colour cartridges - cyan, magenta, yellow and black. Each dot of printed colour could be made up of overlapping drops of all these colours. So it makes some sense to divide the resolution figure given in the spec, in dots per inch (dpi), by the number of ink cartridges present. That will give a more realistic number to work with later when you come to print.

Next we have **Image resolution.** This refers to the number of pixels in an image. Lots of pixels means a high resolution image, a small number means a low resolution image. Of course, the definition of 'lots of pixels' is changing over time. When I got my first digital cameral it took the, then, huge amount of 3 megapixels. Now even my phone takes 5 megapixels and reasonably priced cameras can take 20 megapixels!

By the way, the megapixel number in a camera's specification is derived by multiplying the maximum width of the image that the camera can take in pixels by the maximum height of the image in pixels. At its highest resolution my somewhat elderly digital camera produces an image 3456 pixels x 2304 pixels or just under 8 megapixels.

**Image resolution has nothing to do with 'pixels per inch' – this only comes in when you want to print an image.**

The last definition is of **Print resolution.** When you want to print an image, the first step is to look at the size of the image to make sure it will fit on the substrate you want to print on. So, you either use the menus - Image | Resize | Image size or use the keyboard shortcut Ctrl-Alt-I (letter i). Here you will see two sets of dimensions - the top box refers to the image size in pixels. The bottom box refers to the Document Size ie the size the document will be when it's printed. This is made up of the width, the height and the print resolution.

I created a new blank image that is 1000 pixels by 500 pixels, keeping the numbers simple so it's easy to see what's happening as we change settings. The print resolution was set to 100. Elements calculated that the image will print at 10 inches by 5 inches. In other words it's divided the 1000 pixels by 100 to give a printed width of 10", and divided 500 pixels by 100 to give a printed height of 5".

I made sure the Resample option, down at the bottom, isn't ticked, then changed the resolution and observed how the dimensions changed. Taking our image of 1000 pixels by 500 pixels if the print resolution is set to 200 ppi (pixels per inch) then the image will print at 5" x 2.5".

If the print resolution is set to 300 ppi then the image will print at 3.3" x 1.6". THE NUMBER OF PIXELS HASN'T CHANGED BUT THE SIZE OF EACH PIXEL HAS. The higher the print resolution the smaller each pixel is squashed because it has to fit into a smaller space. If the print resolution is low the image will spread out over a greater area and each pixel will be bigger.

It follows therefore that if you have a low resolution image (one with a small number of pixels) and you want to print a big version of it then each pixel will be big and the image may look blocky or to use the technical term, pixellated.

Next I went back to a print resolution of 100 ppi and clicked on the Resample option at the bottom of the box. This time when I changed the resolution to 200, the print size didn't change but the number of pixels, shown in the top box, did. What is happening is that the software is inserting extra pixels. Elements is guessing what pixels to insert - this is called interpolation. Elements makes a pretty good guess at what to insert, especially if you are not changing the size a lot. However, if you increase the size considerably then the image can become fuzzy. Interpolation is never going to be as good as getting original pixels by taking a high resolution image in the first place.

It's logical therefore to do as much resizing as possible with Resample switched off so you are only working with the original pixels taken by the camera or scanner. Then, if you want to expand or reduce the image even further, switch Resample on – Elements will then help you by inserting or taking out pixels to give you the printed size and print resolution you want.

There are two other settings to have a look at in this dialogue box. The first is Constrain Proportions, down at the bottom. If this is ticked then when you change the print size of an image, Elements will keep the aspect ratio the same for you. So, if you change the width then the height will be changed automatically in the same proportion so as not to distort the image. On the other hand, if you want to deliberately distort the image, perhaps to make a long, thin shape to print on a banner, then you would have to deselect this setting. Now you could set whatever print size you want and Elements will not try and keep the aspect ratio constant. Just be aware that if you want to have Constrain Proportions off then you need to have Resample Image on, or it won't work.

The remaining item is the drop down list right at the bottom. This holds a list of settings that you can choose from, depending on how you are re-sizing the image and, to some extent, the type of image. Luckily they have an explanation next to each one describing what each one is best for.

*If you remember from the explanation of Printer Resolution, I talked about the maximum print resolution to use, calculated by dividing the inkjet specification by the number of ink cartridges? Well if your printer has a maximum resolution of, say, 360 dpi (dots per inch) then setting your print resolution in Elements to a higher number will result in a much bigger file and may well result in a less sharp image rather than a better one.*

To finish this tutorial I thought I would go back to image resolution to show you how the number of pixels affects the quality of an image when you want to expand it. To illustrate this I scanned a fern at different resolutions (150, 300, 600 and 1200 ppi) to give increasingly high numbers of pixels. I zoomed in to each version by the same amount (using Ctrl-+) so you could see how the varying amounts of pixels affects the quality of the expanded image.

Starting with the lowest resolution version, I zoomed in eight steps. You could see the pixellated result. Moving on to the next size up and zooming in by the same amount, pixellation is still visible but is less. The third version shows virtually no pixellation at all at this level of zoom and the fourth one could be expanded still further without pixellation.

You can see below a table showing the numbers of pixels for each version and the corresponding file size. As you can see from this, increasing the numbers of pixels also increases the size of the image file. Although hard disks, memory sticks and so on are pretty cheap these days, you wouldn't have to have too many images at 252 megabytes each to fill a gigabyte of disk, so it is a consideration.

| Pixels | File size |
|---|---|
| 1014 x 1361 | 3.95 M |
| 2027 x 2721 | 15.8 M |
| 4056 x 5444 | 63.2 M |
| 8112 x 10889 | 252.7 M |