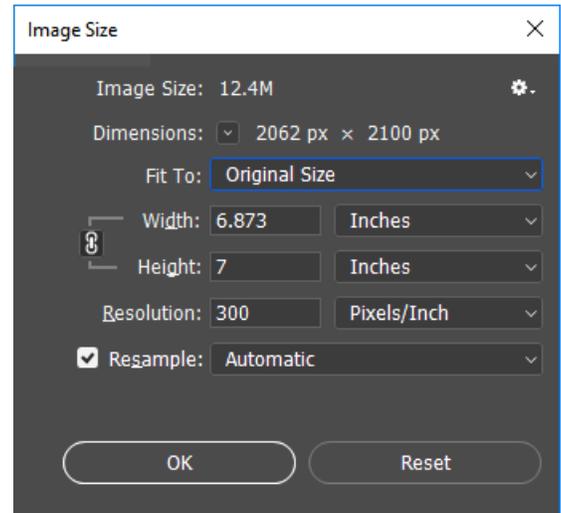


In the *Photoshop for Dummies* books (published in the early 2000s), author Deke McClelland referred to the IMAGE SIZE dialog box as perhaps the most confusing window in Photoshop. This observation is still true today.

The capability for creating artifacts by using this tool with a scientific image led to one of the most important “rules” for digital imaging. **Always perform image manipulations on a copy of the original image.** The original image is your raw data. If you make a mistake, you can always go back to the original image and start again. The original image can be used as a benchmark to verify that the image manipulations you performed have not significantly altered the data.

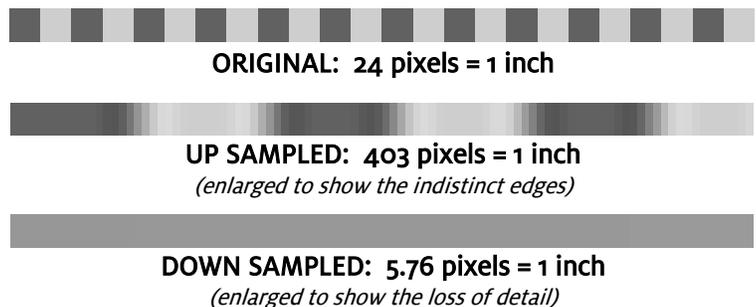


(from Adobe Photoshop CC 2017)

What makes this window so confusing is the use of the poorly defined term “resolution”. Forget for a moment that monitors & printers have dpi (*dots per inch*) and halftone screens are measured in LPI (*lines per inch*). What scientific users of Photoshop need to preserve is the magnification factor and the scientific detail in their image.

A common mistake can occur when users change the resolution value in this window from 72 to 300 so that they can build publication figures. Academic journals want bitmapped images to be at a resolution of 300 dpi so that the images reproduce well in print. Images often open in Photoshop with the resolution set at 72 dpi, which is typically the screen resolution.

By choosing to change the resolution setting from 72 to 300 pixels per inch, the user has instructed the software to automatically (usually using the bicubic algorithm) increase the number of pixels by a factor of 16.79 in X and Y. In the example at the right, the image was enlarged. This “upsampled” image has altered the direct relationship between pixels and inches. No additional detail is present. In fact, the edges of the dark blocks have been blurred because the interpolation was not a power of 2 (*the software has to “guess”*). “Downsampling” the resolution value from 300 to 72 causes a complete loss of the ability to distinguish between the dark and light colored blocks. In addition, the reduction by a factor 4.17 has resulted in a rounding error; the image’s new width of 5.76 pixels across has to be rounded up to 6 because the software cannot create fractional pixels. These sorts of artifacts can easily turn a crisp looking scientific image into a muddy mess.



To change the resolution value without changing the number of pixels in the image, uncheck the RESAMPLE IMAGE check box at the bottom of the dialog box. The DIMENSIONS downward arrow will change to gray, indicating that the pixel dimensions can’t, and won’t, be changed. Now when you change the value in the RESOLUTION box, the DOCUMENT SIZE width & height values will reflect the new conversion factor.

Other cautions/comments:

- The chain link icon connecting the width and height (constrain aspect ratio) is designed to ensure that these change proportionally. When these are linked it means that if you reduce/enlarge either the width, height, or the resolution of an image, the reduction/enlargement factor will be the same in both the X and Y dimensions.
- Reducing/enlarging an image should be one of the last things you do with your image data. If this needs to be done, it should only be done **once** to any image to reduce the possibility of compounding any rounding or interpolation errors inherent in the process.
- Including a scalebar on an image will ensure that, when the journal publisher reduces or enlarges an image to fit the page, the magnification will be scaled in the same manner as the image.

Mr. Cromey is grateful for the support he receives from the SWEHSC (P30-ES006694) and the UACC (P30-CA023074).

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