The Pixel

A Digital Image is composed of an array of picture elements or \textit{pixels}. Each pixel represents a single color and value. The computer arranges the pixels to create the illusion of a continuous image, in a manner similar to that of a television screen or a Pointillist painting. Every image has an absolute width and height in pixels.

Image Resolution

The number of pixels packed into a unit of measure [e.g., inch] that determines the quality of the image. This value is the image \textit{resolution}. Image resolution most commonly refers to the number of pixels per inch. This is called “dots per inch,” or \textit{dpi}. In most cases, higher resolution [higher dpi] results in better image quality. Remember, however, that final image quality is limited by the quality of your image source. While image resolution can always be reduced, increasing resolution will not improve image quality.

Image Size

Image size refers to the real-world dimensions of an image, usually measured in inches. The dimensions of an image are independent of its file size: e.g., a 6” x 8” image at 100 dpi will print out at the same size as a 6” x 8” image at 300 dpi (although the 300 dpi pixel image will have a higher \textit{resolution}); conversely, a 3” x 4” 100 dpi image will print out at half the size of a 6” x 8” 100 dpi image, even though the images have the same resolution.

File Size

File size refers to the amount of memory needed to store a given image document. File size is directly proportional to the number of pixels in an image; the more pixels, the greater the file size.

Since resolution measures dots per square inch, file size is proportional to the \textit{square} of Image Resolution. For instance, the file size of a 300 dpi image is 9 times that of a 100 dpi image.

File size also depends on the \textit{kind} of pixels that comprise the image; e.g., since a full-color pixel needs more memory than a black & white pixel, a 100 dpi color image will consume more memory than a 100 dpi greyscale image. A good rule of thumb is that color images are approximately three times larger than greyscale images. The file format of an image document can also affect its file size.

Sampling Images

Any time the resolution of an image is changed while keeping the image size constant, the image is being \textit{samp}led. If the resolution is decreased, then the image has been down-sampled.

Scaling Images

In order to \textit{scale} an image without losing image quality, it is important to understand the relationship between image size and image resolution. When scaling in image, remember this basic formula: (Pixels) = (Image Size) x (Resolution).

When scanning a very small image, such as a color slide or film negative, it may be necessary to greatly increase the scale of an image after scanning. Accordingly, you will notice that a slide scanner will typically allow you to scan at resolutions as high as 2700 dpi (printers and flatbed scanners rarely go above 600 dpi). Such a high resolution may seem excessive, but is necessary to capture all the information contained in a 1” x 1.5” slide. Also, the small image size would make for a relatively manageable file size (see above formula). A 2700 dpi 1” x 1.5” image can be scaled into a 300 dpi 6” x 9” image without a change in file size or image quality.
There are many different file formats that can be used to store image data. Some of them are very high quality yet very large, while others may be small but compromise quality. Which format you use will be dependent on what your image looks like, how much quality you need and how much space you have to store it in. The matrix here delineates some of the strengths and weaknesses of a few of the more common formats.

<table>
<thead>
<tr>
<th>Format</th>
<th>Extension</th>
<th>Color Depth</th>
<th>Quality</th>
<th>Size</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiff</td>
<td>.TIF</td>
<td>24 bit</td>
<td>Excellent</td>
<td>Very Large</td>
<td>Good for line art and drawings</td>
</tr>
<tr>
<td>Jpeg</td>
<td>.JPG</td>
<td>24 bit</td>
<td>Very Good</td>
<td>Medium</td>
<td>Good for photographs</td>
</tr>
<tr>
<td>GIF</td>
<td>.GIF</td>
<td>8 bit</td>
<td>OK</td>
<td>Very Small</td>
<td>Good for small web graphics</td>
</tr>
<tr>
<td>Photoshop</td>
<td>.PSD</td>
<td>24 bit</td>
<td>Excellent</td>
<td>Varies</td>
<td>*</td>
</tr>
</tbody>
</table>

*Contains proprietary technologies like layers, actions, channels, transparency, but not compatible with most viewers.

Generally, the Tiff format is best for use with line art or drawings where image quality is key. Jpeg is best for working with photographs, where a little bit of loss in color quality, but not too much, is acceptable and not noticeable.

**Color Spaces & Gamut**

**Greyscale**

Greyscale images contain no color information. All shades vary from white to black.

**RGB**

RGB stands for Red Green and Blue. This model represents how your computer sees colors. According to the RGB model, each shade of each of the 3 colors (Red, Green and Blue) is represented by a number ranging from 0 to 255. For example, the black color is represented by the '0 0 0' RGB value (R=0, G=0 and B=0) while the white color is represented by the '255 255 255' RGB value (R=255 G=255 and B=255). So the RGB model can represent more than 16 millions of colors. RGB is an additive model, because Red Green and Blue are additive colors. In other words when red green and blue are combined, they create white. Red + Green + Blue = White.

**CMYK**

CMYK stands for Cyan Yellow Magenta and black. This model is used for printing. CMYK is a subtractive model. In theory, cyan, yellow and magenta should combine among themselves to absorb all colors and produce black. But because of the small impurities found in all inks, they actually combine to form a muddy brown. This is one of the reasons for the black ink.

**HSB**

HSB stands for Hue, Saturation and Brightness. According to this model, any color is represented by 3 numbers. The first number is the hue, and its value ranges from 0 to 360 degrees. First there is the red color (0 or 360 degrees) and then there are all other colors (for example yellow at 120 degrees, green at 180 degrees and blue at 240 degrees), up to the violet color. All colors are represented here. The second number is the saturation. It represents the amount of color or, more exactly, its percentage. Its value ranges from 0 to 100, where 0 represents no color, while 100 represents the full color. Finally, the third number is the brightness. 0 represents the white color and 100 represents the black color. The more this value tends to 0, the brighter the color is. The more this value tends to 100 the darker the color is.

**LAB**

LAB stands for Luminance (or lightness) and A and B (which are chromatic components). According to this model A ranges from green to red, and B ranges from blue to yellow. This model was designed to be device independent. In other words by means of this model you can handle colors regardless of specific devices (such as monitors, printers, or computers). The Luminance ranges from 0 to 100, the A component ranges from -120 to +120 (from green to red) and the B component ranges from -120 to +120 (from blue to yellow).

**Gamut**

The graph below-left represents the LAB color space - all colors perceivable by the human eye. Each color space (and in fact each device) has its own portion of the LAB space which it is capable of displaying. The graph below-right shows the RGB color space used by computer monitors as well as the CMYK color space used by printers superimposed on the outline of the LAB color space. As you can see the are colors that a monitor will show that cannot be printed, and there are colors that will print that a monitor cannot display.
Photoshop Program Layout

Menu Bar
- Contains menus for performing tasks; organized by topic

Options Bar
- Contains tool-specific options and modifiers

Toolbox
- Holds tools for creating and editing images

Palette Well
- Helps organize the palettes in your work area

Active Image Area

Layers Palette
- Allows you to control the visibility and arrangement of the layers in your image

History Palette
- Shows you the actions that have been performed on your image and allows you to undo them

Color Palette
- Allows you to choose and modify colors with a variety of color models

Navigation Palette
- Shows you where you are working relative to your entire image

Layers Palette
- Allows you to see and control the visibility and arrangement of the layers in your image
Getting to Know the Work Area

### Menu Bar

**File** is used for opening, closing, and saving; importing and exporting; and page setup and printing.

**Edit** contains a variety of commands including undo and redo; cut, copy, and paste; fill and stroke; and free transform.

**Image** contains area commands including color modes and adjustments; image and canvas sizing; rotating, cropping, and trimming.

**Layer** contains commands related to layers, only some of which are duplicated in the layers palette. Commands include creating, duplicating, and deleting layers; adjusting layers properties and styles; fill and adjustment layers; layer, vector, and clipping masks; layer arrangement and linking; and mergin and flattening.

**Select** contains a variety of commands including Preferences and Color Settings.

**Filter** contains a variety of commands including Preferences and Color Settings.

**View** contains some navigation tools: zooming, fit screen, actual size, and print size; as well as screen mode, and a number of commands related to image assistance tools: rulers, grid, snapping, and guides. The 'Show Extras' item will turn on, or off, all the items that can be individually turned on or off via the Show submenu. Turning an item off in the Show menu does not affect its performance, it simply makes it not visible. Note that items in the show menu are only available if they already exist in your document.

**Window** is where you can hide or show any palette, the status bar, the options bar, and the type tool's paragraph and character palettes. Palettes which are on the screen but hidden behind another palette in a group can be brought to the front from this menu. Clicking on the palette’s name toggles it to show or hide. Palettes that are showing have a check mark next to their name. Clicking the name of a checked palette will either close it to the palette well, or remove it entirely from the window.

The Arrange submenu contains command that will organize how your open images are arranged. Tile will arrange multiple images within the window without overlapping them. Cascade overlaps pictures but allows a fair amount of each underlying picture to remain showing.

A list of all open images is at the bottom of the menu; clicking the name of the one you want will bring it to the front.

**Help** Choose Help > Photoshop Help to use Adobe's online help. The index and contents are a little bit confusing, but the Search feature works quite well. There is a wealth of step by step information there.
### Toolbox

The toolbox contains all the Photoshop tools. Some are not visible, but are hidden under another tool. To choose a hidden tool, click and hold on the visible tool icon and pick the sub-tool from the pop-up menu that appears.

#### Selection Tools
- **Marquee Tool** - Select a rectangular region (click and hold mouse on tool for other shapes)
- **Lasso Tool** - Select by drawing a free-form shape
- **Magic Wand** - Click on a pixel to select a contiguous area of the same color. Use the Shift Key to add additional areas to the selection.
- **Quick Mask** - convert a selection into a mask which can be edited with any of the painting tools. Edges can be distorted, and filters, or effects applied. You can convert the mask back into a selection.

#### Painting Tools
- **Brush** - Dragging in the image creates colored strokes similar to what might be created by a paintbrush. The way the paint is applied varies according to the options you have selected.
- **History Brushes** - Paints from an earlier ‘state’ of an image onto the current ‘state’ of the image.
- **Paint Bucket** - Fill a selected region with the foreground color.
- **Gradients** - Applies a color fade from foreground to background in the selected area.
- **Pencil** - Drawing tool that provides a harder edge than what you get with the brush.

#### Retouching Tools
- **Healing Brush** - Lets you correct imperfections, blending them into the surrounding image.
- **Patch** - Lets you repair a selected area with pixels from another area or pattern.
- **Clone Stamp** - Takes a sample of an image which you can then apply over another area of an image.
- **Eraser** - Makes pixels the background color or transparent (if on a layer).
- **Dodge** - Lightens an area of the image.
- **Burn** - Darkens an area of the image.
- **Sponge** - Subtly changes the color saturation of an area.
- **Blur** - Softens hard edges or areas in an image to reduce detail.
- **Sharpen** - Focuses soft edges to increase clarity or focus.
- **Smudge** - Simulates the actions of dragging a finger through wet paint.

#### Vector Tools
- **Path Select** - Used to select a path
- **Pen** - Create straight lines and flowing curves
- **Shape** - Create vector shapes in shape layers and as paths. Also can create raster shapes editable with the painting tools.
- **Line** - Create linear vector elements.

#### Navigation
- **Hand Tool** - Pan around the image - just click and drag
- **Zoom** - Get closer or further away. Percentage Zoom is shown at top of image window. 100% means one pixel on the screen shows one pixel of the image. Hold down the Option key (Mac) or Ctrl key (Windows) to zoom out.

#### Miscellaneous Tools
- **Type** - Allows you to insert a text layer into an image.
- **Crop** - Allows you to remove portions of the image outside the selected area.
- **Move Tool** - Move a selected region (or an entire layer). Hold down Option key (mac) or Ctrl key (Windows) to copy.
- **Notes** - Allows you to attach a text annotation to a particular location on an image. Appears as an icon.
- **Eyedropper** - Choose a color by matching a pixel on screen
- **Color Picker** - Set foreground and background color for all manipulations.
Getting to Know the Work Area

The **Options Bar** is context sensitive and changes as different tools are selected. Some settings are common to several tools, such as painting modes and opacity, and selection boolean logic. When you select a tool in the toolbar, it's very important to remember that you need to set the proper options before using the tool.

**Selection tools** - used for creating closed boundaries. Once a selection has been made, editing can only occur within the selection outline.

**Painting tools** - used for adding color by using the mouse like a brush, or by simply filling areas with a selected color. These include the brush, history brushes, paint bucket, gradients, and pencil tool.

**Retouching tools** - used for editing existing colors and image details. These include the new healing brush and patch tool, the clone stamp (formerly known as the rubber stamp), eraser, dodge burn, sponge, blur, sharpen, and smudge tools.

**Vector tools** - used for creating, and editing vector shapes. These include the path select, pen, shape, and line tools.

**Change view tools** - used for moving and magnifying the view of an image, without affecting the image, itself. The hand, and zoom tools are workhorses you'll be using constantly.

And, then there's the powerful type tool, the crop tool for chopping images down to size, the move tool for moving selection contents or layers, the notes tool for adding little sticky notes to an image, the eyedropper for collecting color data, and the big foreground/background color squares you see near the bottom of the toolbox that are where you can make your color choices.
Getting to Know the Work Area

**Status Bar**

The status bar (the area in the lower left corner of the image window on a mac, or in the lower left corner of the photoshop program window on a pc) shows the image’s current magnification. You can change the magnification by typing in a value and pressing Enter. ‘Doc’ followed by two numbers (e.g. 547k/1.2M) tells you the file size of the active image, flattened (all layers, and channels merged), versus saved with all layers and channels intact.

**Palettes**

To display a palette which is not currently on the screen, choose Window > [palette name], or to remove a palette from view, choose Window > [palette name]. You can just as easily click the X in the upper right hand corner (pc) or the red lozenge in the upper left hand corner (mac) of any palette to close it.

To hide all palettes and the toolbar, press the Tab key. To hide the palettes, but leave the toolbar in view, hold down the Shift key while pressing the Tab key. Pressing the Tab key again will bring them all back. This can be a big help if the palettes are overlapping an image you are trying to work on.

An individual palette can be moved out of its group by dragging on its name tab. Palette size can be adjusted by dragging on the lower right corner of the palette.

To bring a palette out of the well, click on its name tab and drag it out. To return it to the palette well (if it doesn’t do so automatically) click on the little arrow in the upper right corner of the palette and choose Dock to Palette Well.

A palette’s options menu is accessed by pressing on the arrow in the top right hand corner of the palette. As with all things Photoshop, palettes also contain a ton of context menus. Try right-clicking on just about anything and you’ll get a menu of relevant commands.

The **Navigator** palette is for changing the view of an image.

The **Info** palette displays information about the color values beneath the point and, depending on the tool in use, other useful measurements.

The **Histogram** palette offers many options for viewing tonal and color information about an image.

The **History** palette keeps track of almost every change made to an image, and allows multiple undo by clicking on whichever step a user would like to return to.

The **Actions** palette allows you to record, play, edit, and delete individual actions. This palette also lets you save and load action files.

The **Character** palette provides options for formatting characters. Some formatting options are also provided in the options bar.

The **Paragraph** palette allows you to set formatting options for a single paragraph, multiple paragraphs, or all paragraphs in a type layer.

The **Color** palette displays the color values for the current foreground and background colors. Using the sliders in the color palette, you can edit the foreground and background colors according to several different color models. You can choose a foreground or background color from the **Swatches** palette, or you can add or delete colors to create a custom swatch library.

The **Layers** palette lists all layers, layer sets, and layer effects in an image. You can create, hide, display, copy, and delete layers.

The **Channels** palette allows you to view any combination of individual channels.

The **Paths** palette lists the name and a thumbnail image of each saved path, the current work path, and the current vector mask.

The **Brushes** palette allows you to select preset brushes and design custom brushes.