Determining factors of an image:

- Resolution
- Bits
- Channels

RESOLUTION

RESOLUTION

- There is **no actual size** of a pixel, just different *resolutions*, or ways that it can fit different dimensions. This is calculated by how many pixels are in a one by one inch square.

- The size of a pixel is determined by how much space it needs to take up in a square inch.

- Therefore, **RESOLUTION** is the **PIXELS PER INCH** or **PPI**.
  Commonly confused with DPI, which is dots-per-inch, reserved for output printing. PPI is pixels-per-inch, more accurate for digital imaging. But the same concept applies.

RESOLUTION

How does one determine what resolution and image should have?
By knowing your output...

•Web/Email	72 ppi (monitors) 100 ppi (flat screens, LCD)
•Projector	on average 72 ppi
•Billboards/Posters	200-250 ppi (depends on distance)
•Fine Art Photography	300 ppi

RESOLUTION

The above images are exactly the same dimensions at **2.7 x 1.6 inches.**
The only difference is their resolution, or Pixels Per Inch

The image on the left is a resolution of **300 ppi**
Total of **810 x 480 pixels.**

- To find out pixel dimension, just multiply the length by the ppi, and then the width by the ppi. For example, 2.7 inches x 300 ppi = 810 pixels
  1.6 inches x 300 ppi = 480 pixels

The image on the right is **72 ppi**
Total of **194 x 116 pixels**

- To find out pixel dimension, just multiply the length by the ppi, and then the width by the ppi. For example, 2.7 inches x 72 ppi = 194 pixels
  1.6 inches x 72 ppi = 116 pixels

RESOLUTION

The above images are exactly the same dimensions at **2.7 x 1.6 inches.**
The only difference is their resolution, or Pixels Per Inch

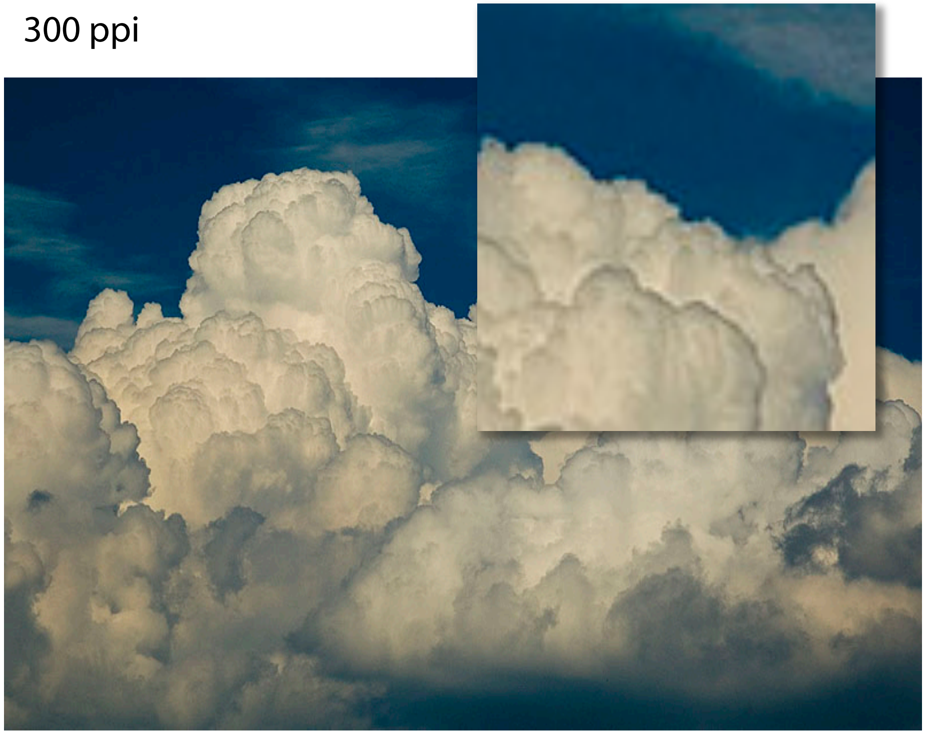
The image on the left is a resolution of **300 ppi**
Total of **810 x 480 pixels.**

- The left image has enough information for fine art printing, it has many pixels within each inch to enable accurate detail and detailed gradient quality.

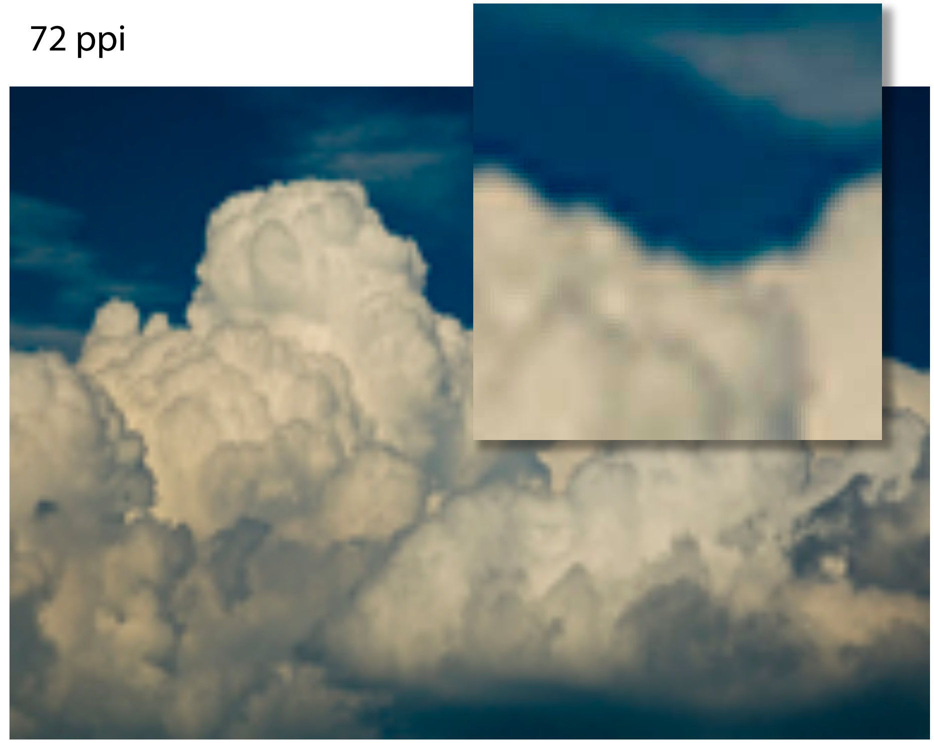
The image on the right is **72 ppi**
Total of **194 x 116 pixels**

- The right image has very few pixels per inch, this hurts the quality but makes it a smaller image with less information--perfect for a quick email.

300 ppi



72 ppi



R E S O L U T I O N

- If we take a closer look at a section of the image, you can tell that the 300 ppi image has more pixels in it, therefore the pixels take up less space and are smaller. This allows the image to have more information, more detail, a sharpness, precise gradients and an overall better quality.

- The 72 ppi image has fewer pixels, therefore they have to be larger to take up more space. This results in scaled edges, shallow gradient, and quite a bit of blur or lack of fine detail. It would **not** print well.

B I T S

BIT DEPTH

- A computer reads information in 0's and 1's.
- If each pixel were a 0 or 1, then images would either have pixels *on or off*, or *black or white*, this would be only **one bit** of information.
- This would not make a very good image, hardly any detail or gradation.

BIT DEPTH (a bit of math)

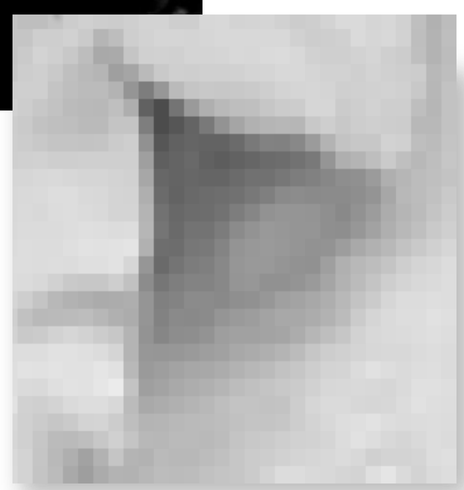
- So what bit-depth does is it gives a pixel more than just 2 variables (more than just being *on* or *off*, *0* or *1*, *black* or *white*).

- 8 bits equals a byte, a common measurement of information storage. 8 binary pieces of information to make a byte would look something like this:
  10011101

- **BIT DEPTH IS HOW MUCH INFORMATION IS INSIDE EACH PIXEL.**

- If we turned this image into an 8-bit image, then it would have 8 bits of information within each pixel.

- With 8 bits of information in each pixel then we have 8 sets of 2 variables. Resulting in…
  2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 = 256 variables!

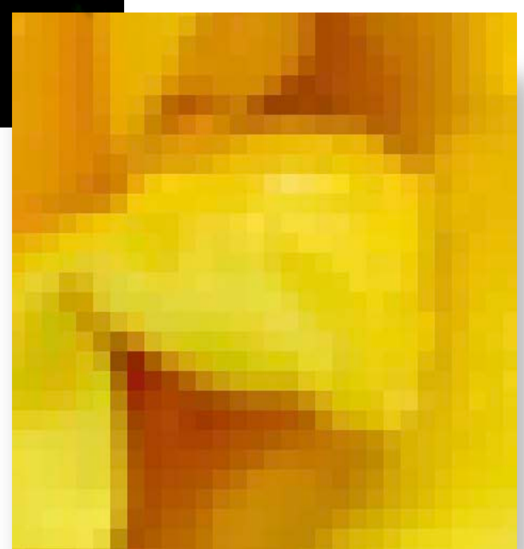


GRAYSCALE - 8 BITS

- A common grayscale image is 8 bits, which is 256 variations of gray. With black and white and 254 different grays in between.
- This gives images more detail and gradient to create that "photographic" look.
- Now, we have a grayscale image of 8 bits, but what if we added a Red, Green and Blue scale?

COLOUR - 24 BITS

- Well if an image had three scales. For example, one Red, one Green and one Blue, this would allow us to have COLOUR!
- 8 bits x 3 scales/bit = 24 bit image.
- 24 bits would be 2 x 2 x 2 x 2 x 2 …(24 times) which would result in 16+ million variables.
- This means that a 24 bit image has more than 16 million different variations of colour.



Note: *There are higher bit-depths that make billions of colours. We will be using 24-bit depth for colour because it is most common and most printers can only print at 24 bit colour at this point anyhow.*

C H A N N E L S

CHANNELS

- Did you know that a computer can't actually make colour? So what it does to compensate for this is it creates channels, (different grayscale gradient images) that stack on one another to organize colour information.

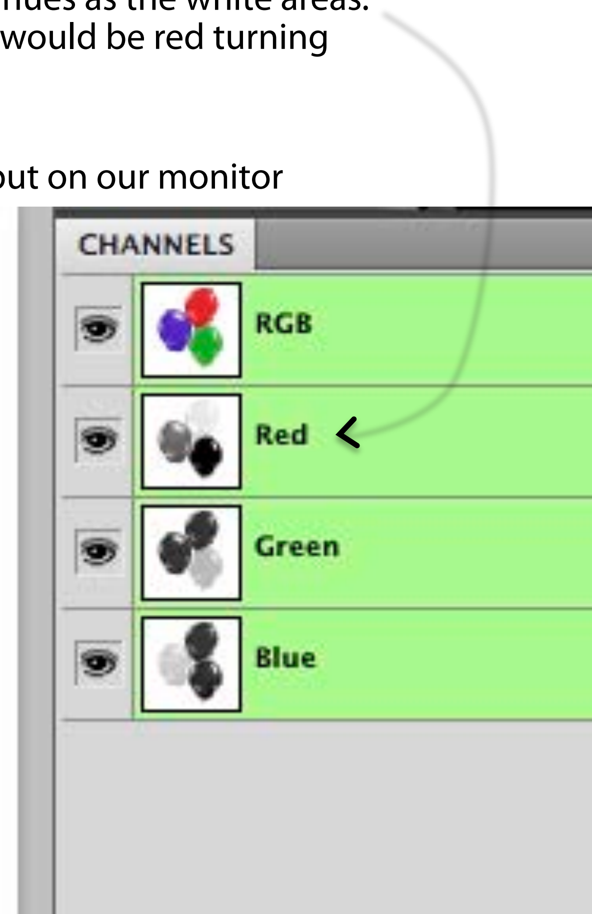
- The channel information translates to the output mechanism what light to put on or off and how intense the light should be in the case of monitors and televisions. For printers the channel information relays what inks should be dropped and how intense that ink should be.

- Each channel carries a gradient of either **Red, Green or Blue** (3 channels) in the case of **RGB** images. Or **Cyan, Magenta, Yellow and Black** (4 channels) in the case of **CMYK** images.

- For example, the grayscale composite of the RED channel would have pure red hues as the white areas. The opposite of red, no red, (which is cyan) would be in the blacks, in-between would be red turning into cyan.

- It would then translate to the monitor the different channels, and it would output on our monitor with colour. The same goes for printers, television screens, projectors, etc.

To the right are Photoshop RGB channels of the image of a red green and blue balloon. Notice the red balloon in the red channel, the green balloon in the green channel, and the blue balloon in the blue channel are all the lightest balloons. That is because these are tonal gradients of those colours scales.



CHANNELS

- **RGB** images have 3 channels that sandwich together to create colour in an image.
  A **red**, **green** and **blue** channel.

- **CMYK** image modes have 4 channels.
  A **cyan**, **magenta**, **yellow** and **black** channel.

- RGB and CMYK work together. You should be editing in RGB mode because your computer monitor works in RGB. Therefore colour correction should be done in the mode you view it in.

- When printing, you should convert your image to CMYK to get it ready for the ink. However, it is a good idea to let your printer convert to CMYK during the printing process because your printer software may be better at converting RGB to CMYK than Photoshop. So, if possible, leave it in RGB mode.

RGB & CMYK

- RGB is an additive colour model that light uses. So your computer monitor, digital camera, projector, television etc. all use RGB colour.

- CMYK is a subtractive colour model that pigment uses. Therefore your printer would use CMYK inks.

- RGB and CMYK are actually dependent on one another. For example, to make the colour cyan on RGB mode, you must take away red. So cyan is actually "no red". Since cyan is red's opposite it is determined by not having red, resulting in cyan colour.

- It is actually quite easy to memorize which colours are opposites, just line up the acronyms:

  Red — **C**yan
  Green — **M**agenta
  Blue — **Y**ellow
  blac**K**

- Also notice in the gradients to the left that the middle point of Red to Cyan is gray, same with the middle of green to magenta, blue to yellow and white to black. The middle points of the gradients of opposite colours is neutral gray.

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CONCLUSION

Determining factors of an image:

- **Resolution**
  The amount of pixels in an image. The dimension of an image determines resolution, for the pixels either have to expand to take up more room or contract to take up less room in a square inch depending on how many pixels per inch are required.

- **Bits**
  Bits and Bit-Depth determine how much information is in one single pixel.
  A one bit image has only black and white, leading to a rather abrupt image. (zero or one)
  A grayscale image has 8 bits of information per pixel, this leads to 256 different types of gray that any one pixel can be. (8 bits are called a byte, and look like this: 10111001)
  A 24 bit colour image contains 3 scales of 8 bit information pixels, so 3 scales of 256 variations of colour, which multiplies to over 16 million different colour variations that can be assigned to a pixel.

- **Channels**
  There are 2 channel modes, RGB and CMYK. CMYK is Cyan, Magenta, Yellow and Black. We will be working in RGB mode, therefore we will have 3 channels, a red, a green and a blue channel. A channel is important to how colour is determined in the 'black and white' world of the computer. Each channel consists of tonal grayscale composites that arrange colour information. These channels actually work with CMYK channels, in that the opposite of red is cyan and thus they depend on each other. The same goes with green and magenta, as well as blue and yellow.

Note: *You can relate Bit-Depth of colour to the channels.*
There are three scales of 256 variations of colour, each of those scales represents a channel!