

# *Histograms*

*By Kevin W. Gagel*

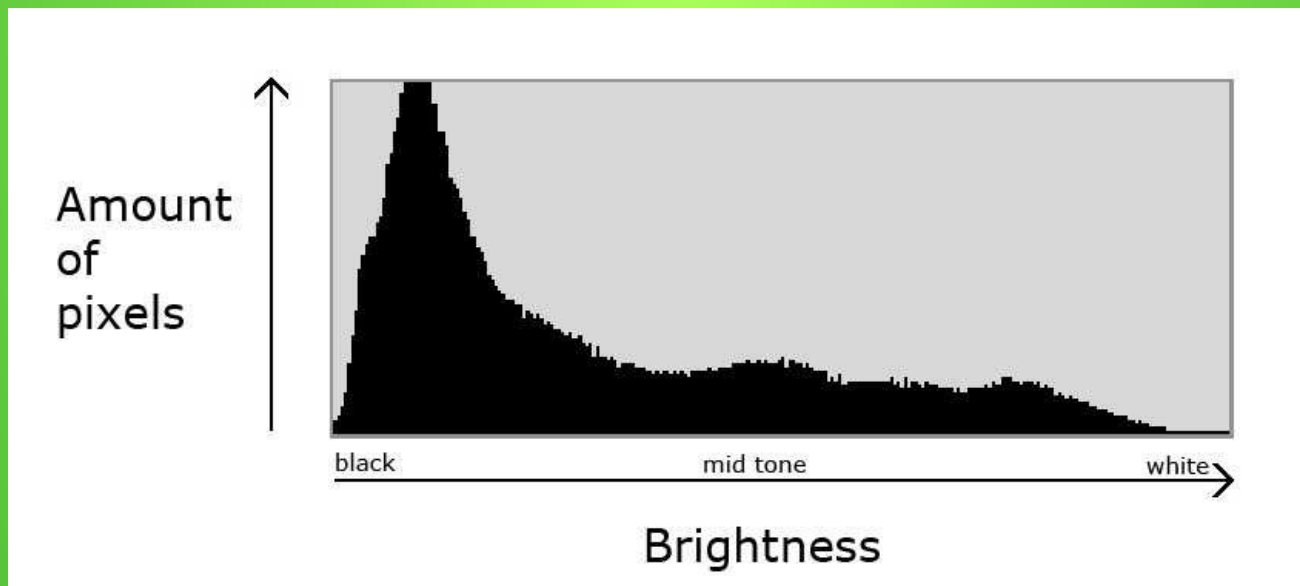
- What a histogram is
- How a histogram is made
  - How to read them
- Significance to Photography
  - Propaganda
  - Facts

# *What is a histogram?*

- A chart showing the relative frequencies with which a measurable quantity takes values in a set of contiguous intervals. The chart consists of rectangles whose areas are proportional to the relative frequencies and whose widths are proportional to the class intervals. It can be used to picture a frequency distribution.

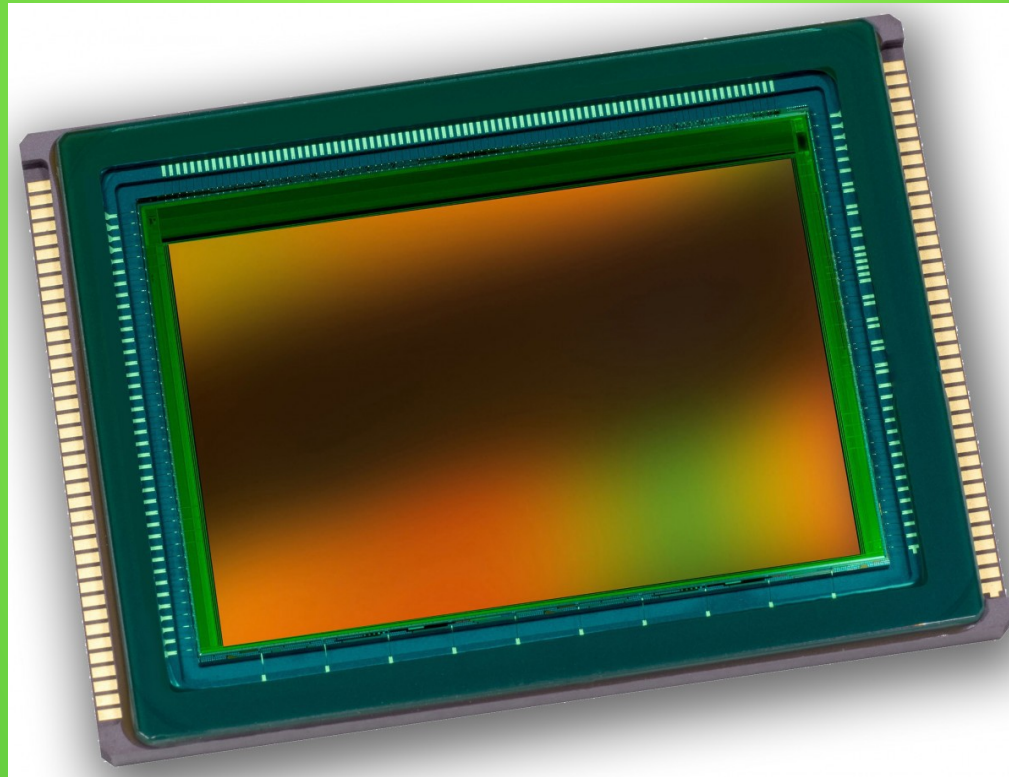
# *So, what is a histogram?*

- It's a chart that shows the frequency of the various brightness levels of the pixels in your image.
- More on this later...



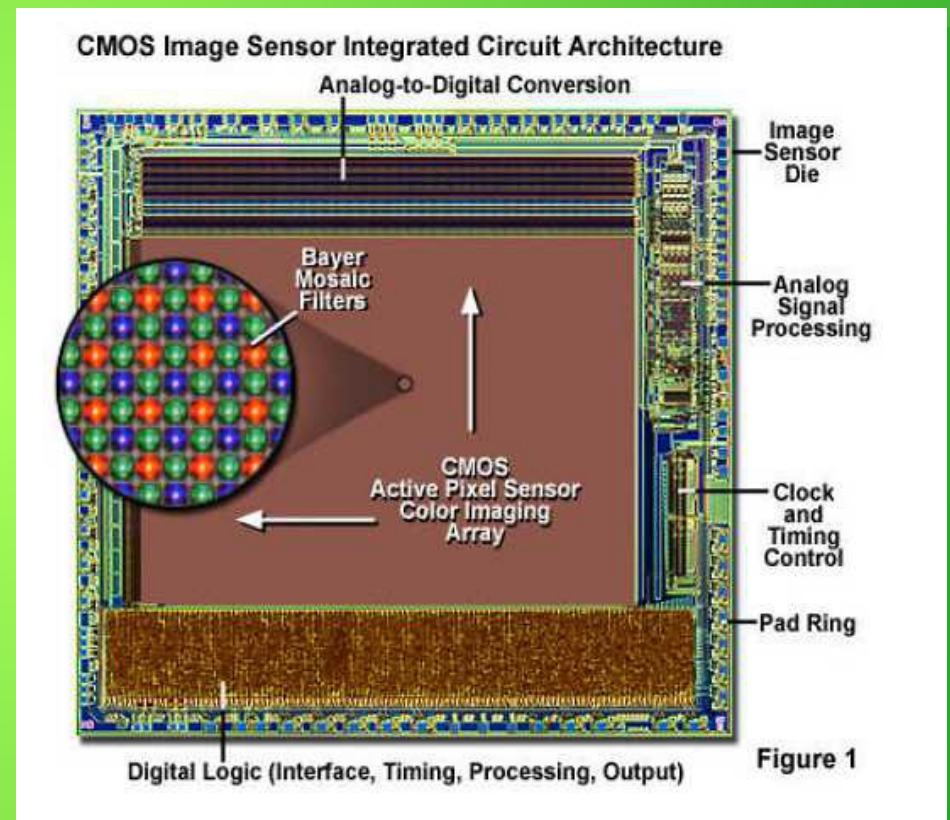
# Sensors

- How did we get a graph from a picture?



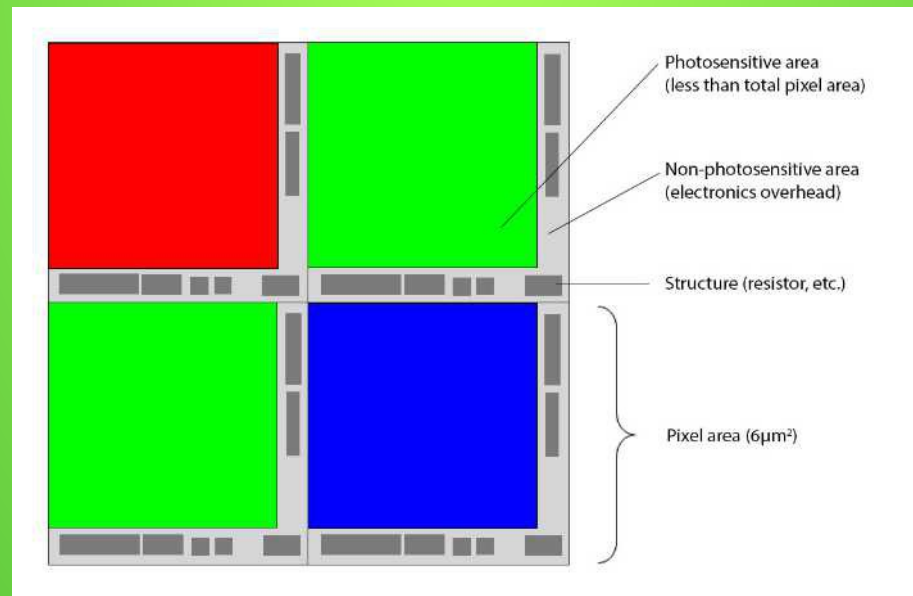
# Sensors

- Digital Sensors have photo sites.
- Each “site” is like a tiny solar panel cell.
- The greater the brightness the greater the voltage generated.



# Pixels

- Each photo site measures the brightness.
- 9 photo sites are combined to generate the Red Green Blue colors we see.
- Bayer filters measure Rx2, Gx5 & Bx2 levels per pixel.
- Color filters ensure a specific color's brightness is measured (RGB).





# *Pixel's to Data*

- Pixel information is so vast (plentiful) a microprocessor is needed to process it.
- Often referred to as “data” (because it is).
- Also often referred to a digital version of a negative.
- In it's naked “digital” format – it's just 1's and 0's.



# Digital

- 1's and 0's are called “bits”.
- Each bit is either a 1 or a 0 - that means each bit can represent one of two values.
- 12, 14 or 16 bit microprocessor (computer).
- 8 bits means  $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$  (or  $2^8$ ) for a total of 256 values.
- 12 bits means  $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$  (or  $2^{12}$ ) for a total of 4,096 values.
- 16 bits,  $2^{16}$  for a total of 65,536 values.

# *How a histogram is made*

- On board computer saves the row & column of where that brightness value comes from.
- A pixel represents the combined values of 9 photo sites from which the RGB values calculated.
- Brightness values are grouped together.
- The total values in a group are counted.
- The groups are ranked and displayed from left (lowest brightness) to right (the brightest).

# *How to read Histograms*

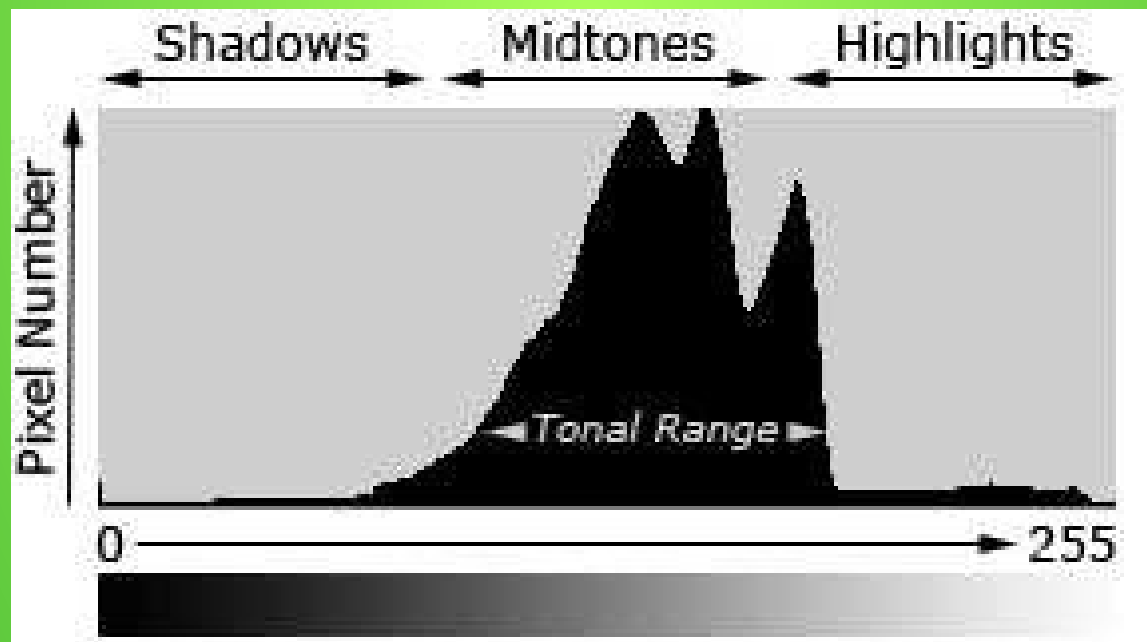
- With similar values grouped together and counted for a total, we can give the grouping a height.
- The higher the count, the higher the “bar” (or line) in the histogram.
- Obviously the higher the line the more values it represents for that particular grouping of brightness values.

# *How to read Histograms*

- The value 0 is the first one and the value 255 is the two hundred and fifty sixth one. 0 is a value too.
- These brightness values are often referred to as black (0) and white (255).

# How to read Histograms

- Here is a histogram, showing the darks (shadows), in-betweens and brights (highlights).



# How to read Histograms

- Here is an image under exposed, correctly exposed and over exposed. Each with their related histogram.



# *Significance to Photography*

- Ansel Adam's had his zone system - we have the histogram.
- Understanding the histogram allows you to make judgments on the brightness or tonality of your image.
- Knowing how the histogram represents the pixels in your image helps you to assess the exposure
- This knowledge allows you to decide if you need to make any corrections.

# *Things people say...*

- It should be as close to the right as possible – for better data.
- It should be to the left – for richer colors.
- It should be in the middle.
- You'll get “perfect” exposure by watching the histogram.
- It should look like a mountain.
- It should look like you're standing on your head.



# *Facts*

- A lot of bright areas within the image will cause a lot of high lines towards the right side.
- A lot of darker areas within the image will cause a lot of high lines towards the left side.
- More diffused brightness will result in more spread from left to right and more height throughout.
- Really bright and really dark areas make for “contrasty” situations – this is a really high dynamic range to deal with.
- The dynamic range of your camera will determine what corrective actions you'll need to take along with the adjustments to settings to capture the image you're envisioning.

# *Facts*

- Histograms are 8 bit representations of 16 bit data, that means values between 0 and 65,536 are converted into values between 0 and 255.
- 256 values means your apple blossom peach red doesn't exist!
- On some cameras the white (combined) graph is just the green graph.
- If you have colored graphs then use them instead of the white.
- Exposing to the right means more work on the computer.
- Exposing to the right has a purpose, just not for everyday use.

# *Facts*

- Histograms vary in the same way people do.
- Histograms change as you zoom into the image – this view shows you a graph of the data that you zoomed into.
- Histograms do not take into account your intention!
- The histogram is an approximation – it's not the expert, you are!
- Histograms are affected by the white balance (and possibly planetary alignment! See the point above)

# Questions?

- Thanks for your attention!
- Links to everything and more on the handout.
- View the fantastic video Canon did on how their CMOS sensor works.
- For easy linking the handout is also below.
- <https://kwegagel.wordpress.com/histogram-info/>