

# Computer Science E-7

## Exposing Digital Photography

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Lecture 6: The Histogram  
October 4, 2010

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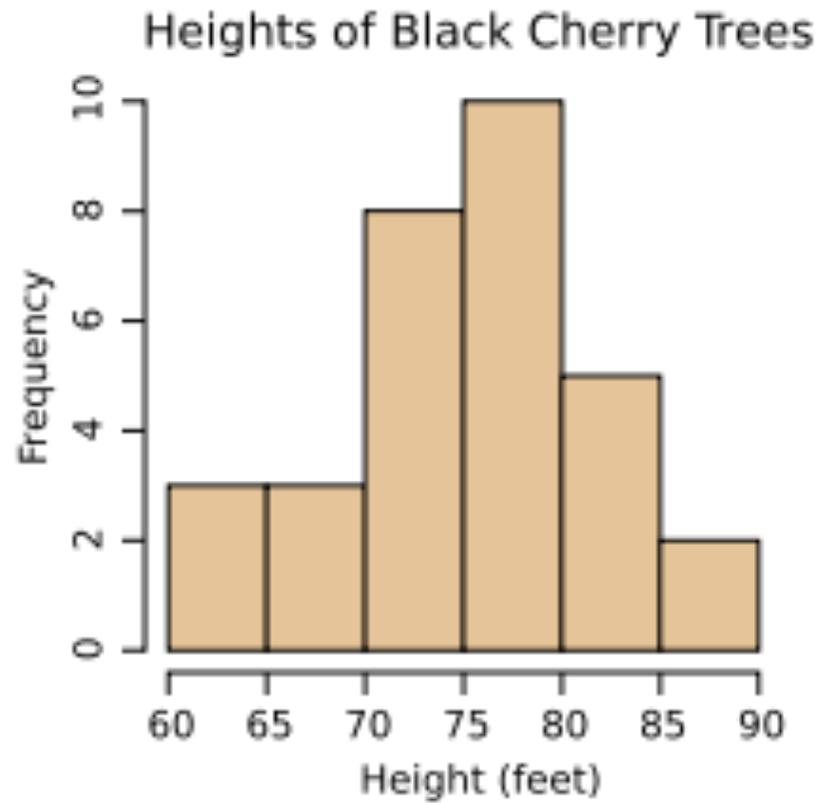
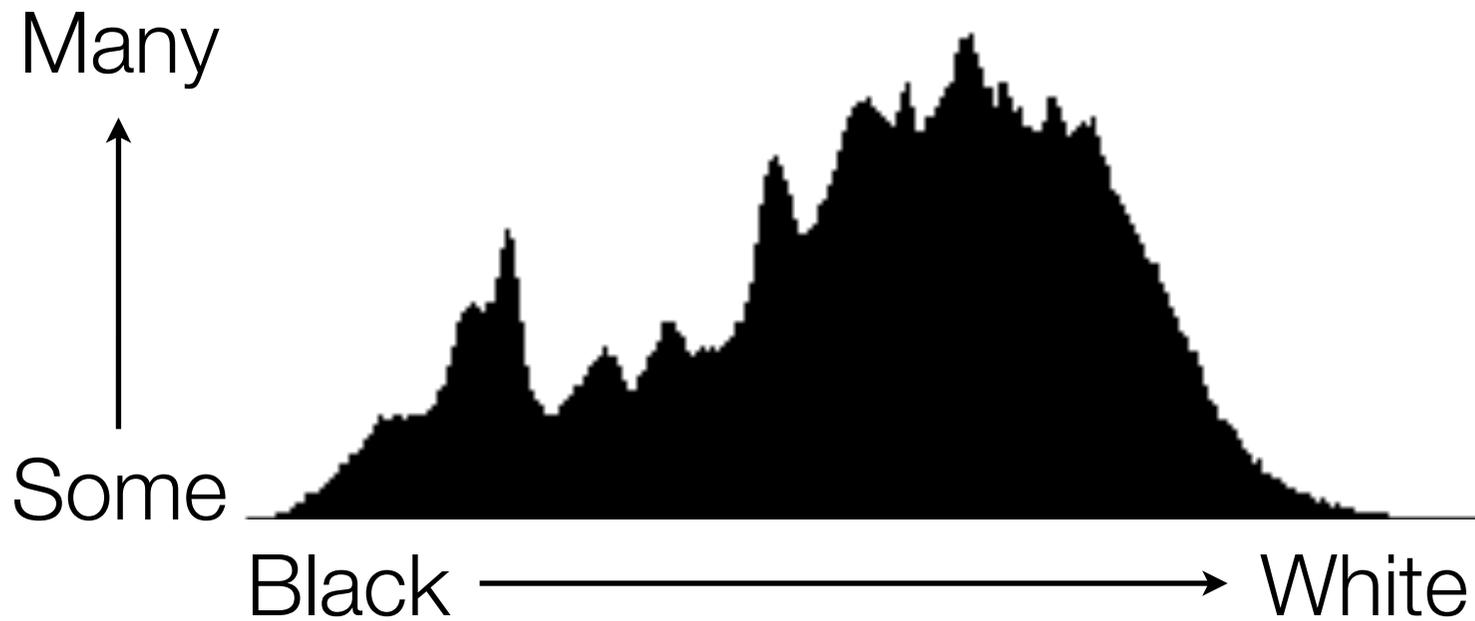


Image from <http://en.wikipedia.org/wiki/Histogram>

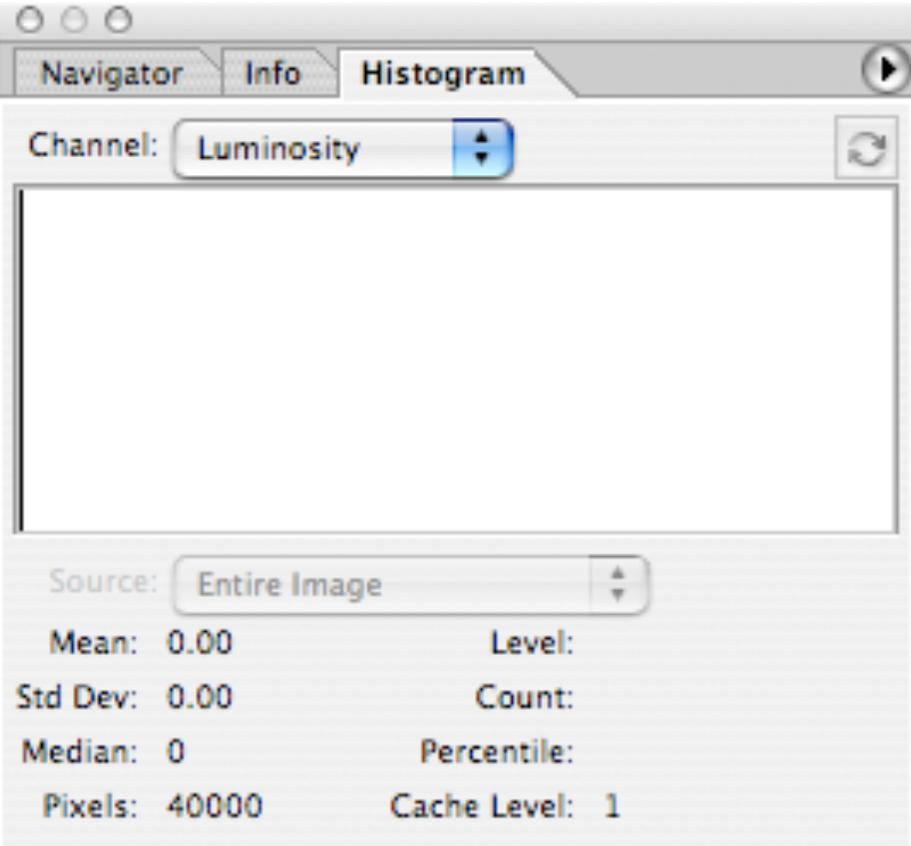
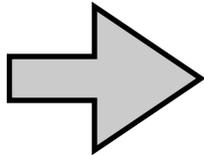
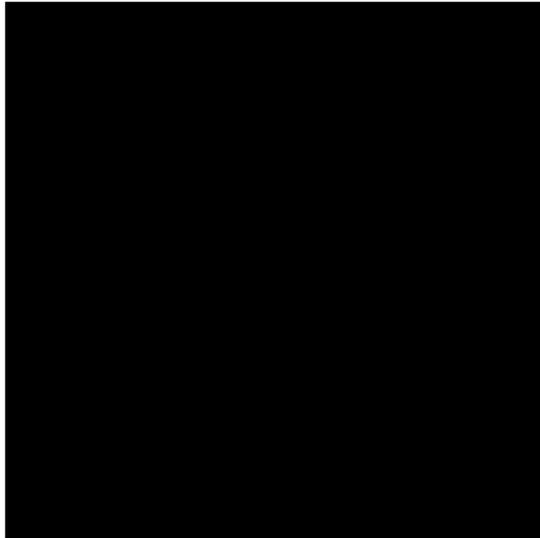
# Histograms

## General Histogram



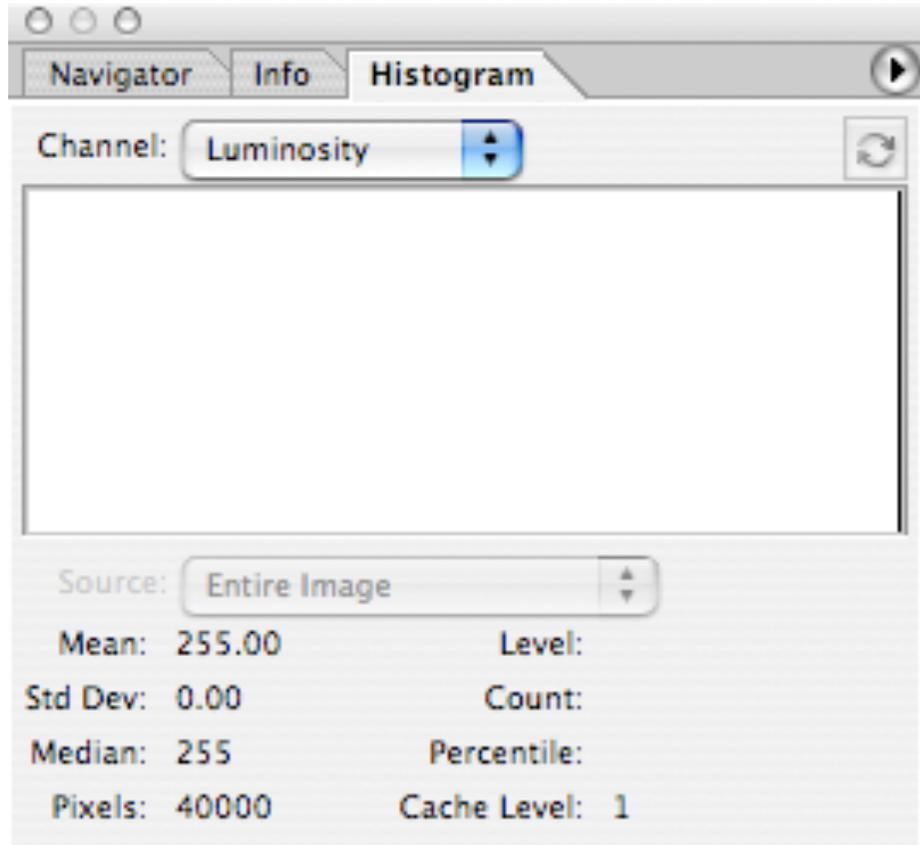
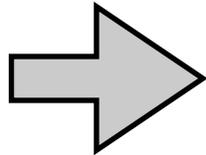
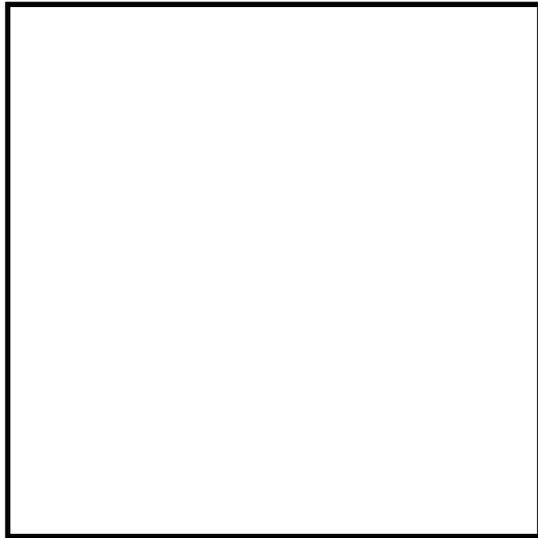
Histograms

Digital Photography



Histograms

Total Underexposure



Histograms

Total Overexposure



309s, ISO 100

Photo by Dan Armendariz, 2009

# Histograms

Well-exposed samples



1/1000s, ISO 400, f/5.6

Photo by Dan Armendariz, 2007

# Histograms

Well-exposed samples



Photo by Dan Armendariz, 2007

Histograms

Well-exposed samples



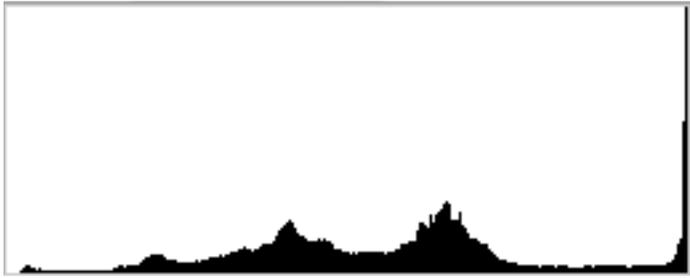
# Histograms

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Under-exposure



Photo by Dan Armendariz, 2005  
8.0s, ISO 100, f/8



# Histograms

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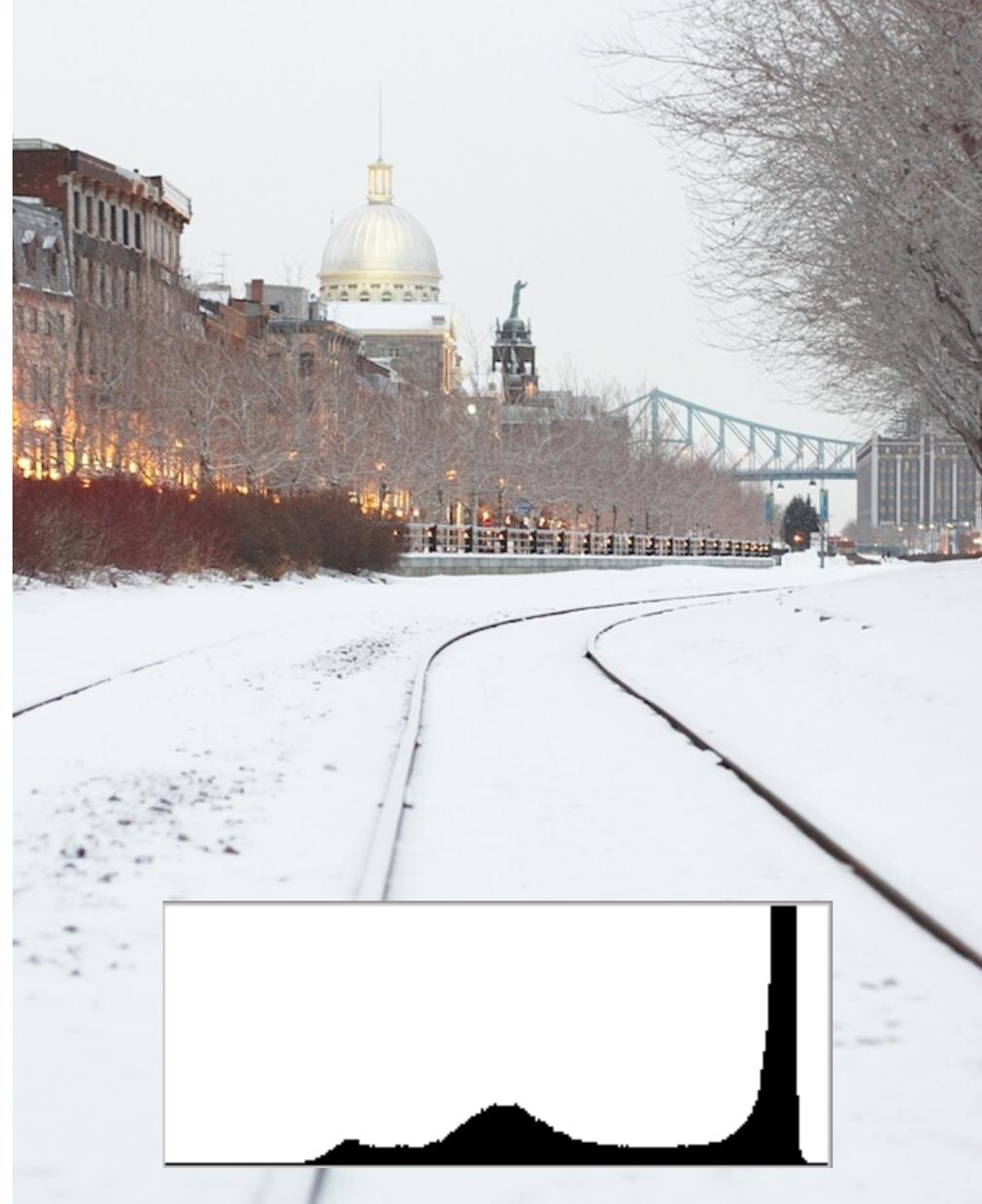
Over-exposure



Photo by Dan Armendariz, 2005  
15.0s, ISO 100, f/16



Left: 1/80s, ISO 400, f/2.8, 0ev. Right: 1/80s, ISO 800, f/2.5, +1.3ev



Photos by Dan Armendariz, 2005

# Histograms

# Exposure Compensation



1/80s, ISO 400, f/10

Photo by Dan Armendariz, 2006

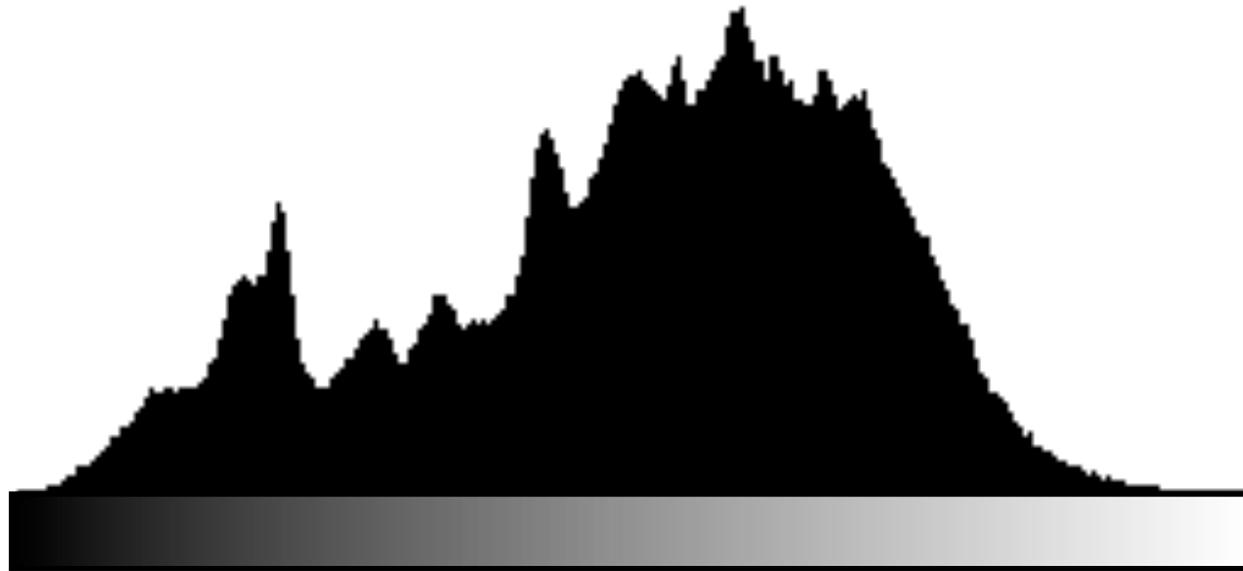
# Histograms

## Over- & Under-exposure

Bit	0 or 1
Byte	8 bits

Bits and Bytes

Refresher



Black —————> White  
0 —————> 255

Bits and Bytes

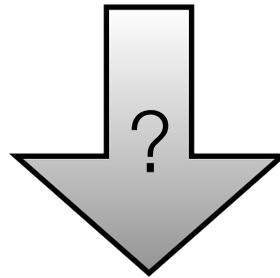
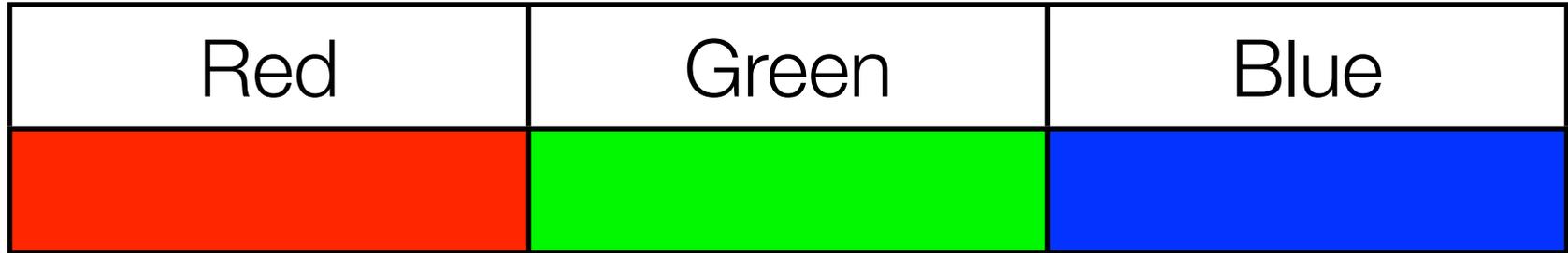
As related to histograms

# JPEG

Red	Green	Blue
8-bit	8-bit	8-bit
0 255	0 255	0 255

Bits and Bytes

Bit Depth



Histograms

What about color?

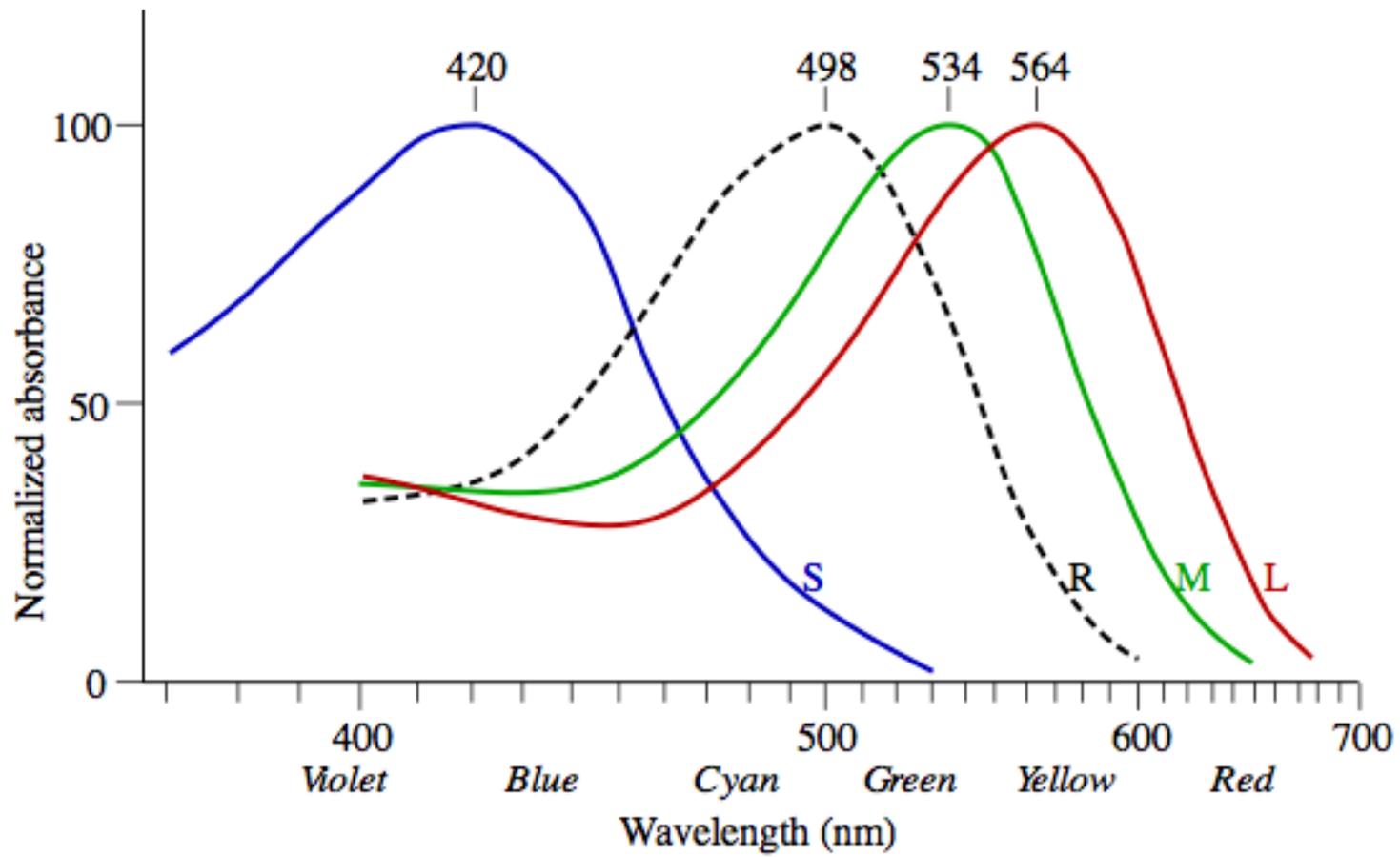


Image from <http://en.wikipedia.org/wiki/Trichromacy>

The Eye

Luminance Detection

Red	Green	Blue
Red	Green	Blue
Dark Gray	Light Gray	Black

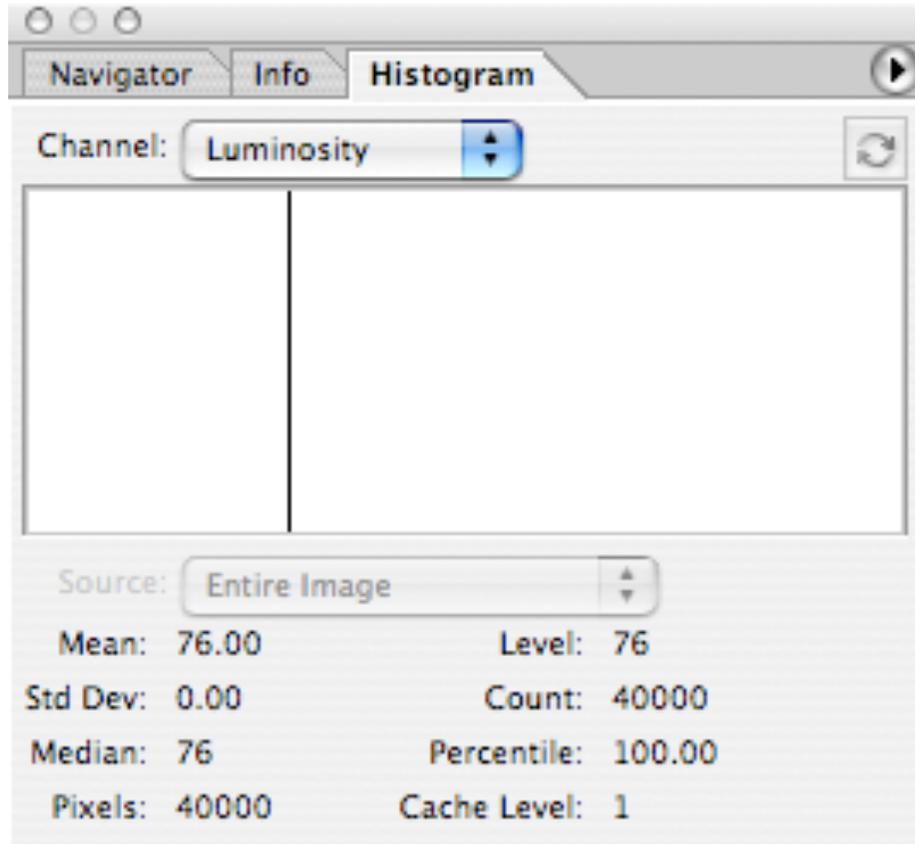
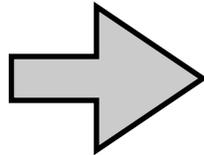
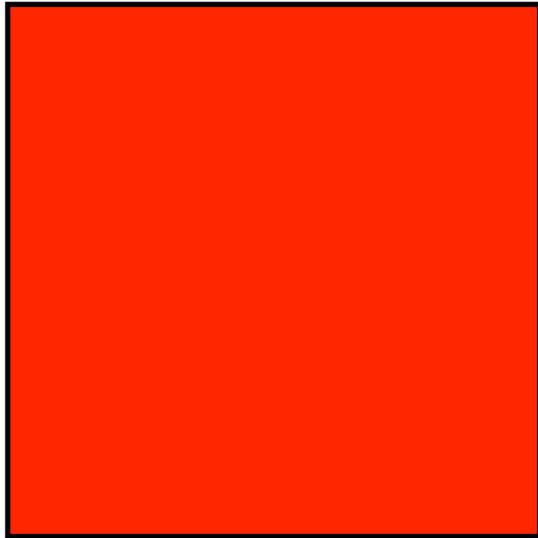
The Eye

Luminance Detection

$$\text{Luminance} \approx 0.3 \text{ R} + 0.59 \text{ G} + 0.11 \text{ B}$$

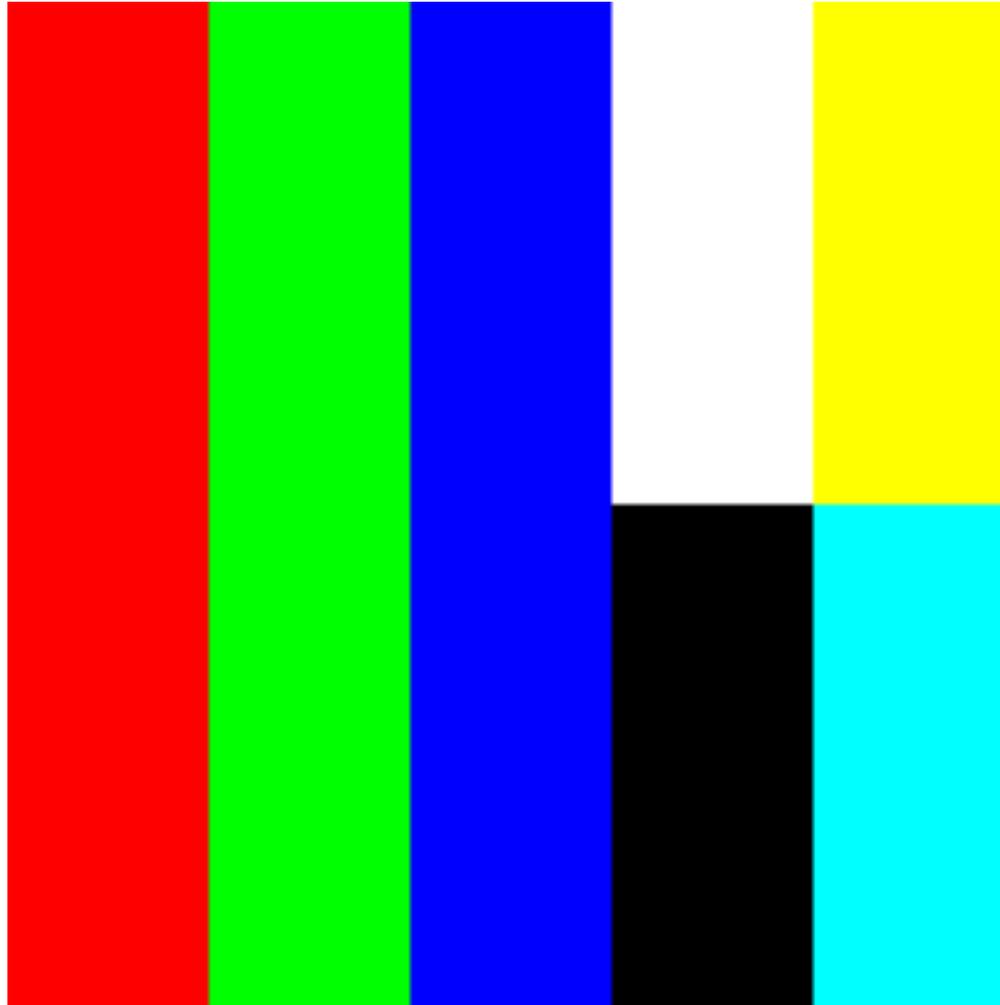
Luminance

Calculation



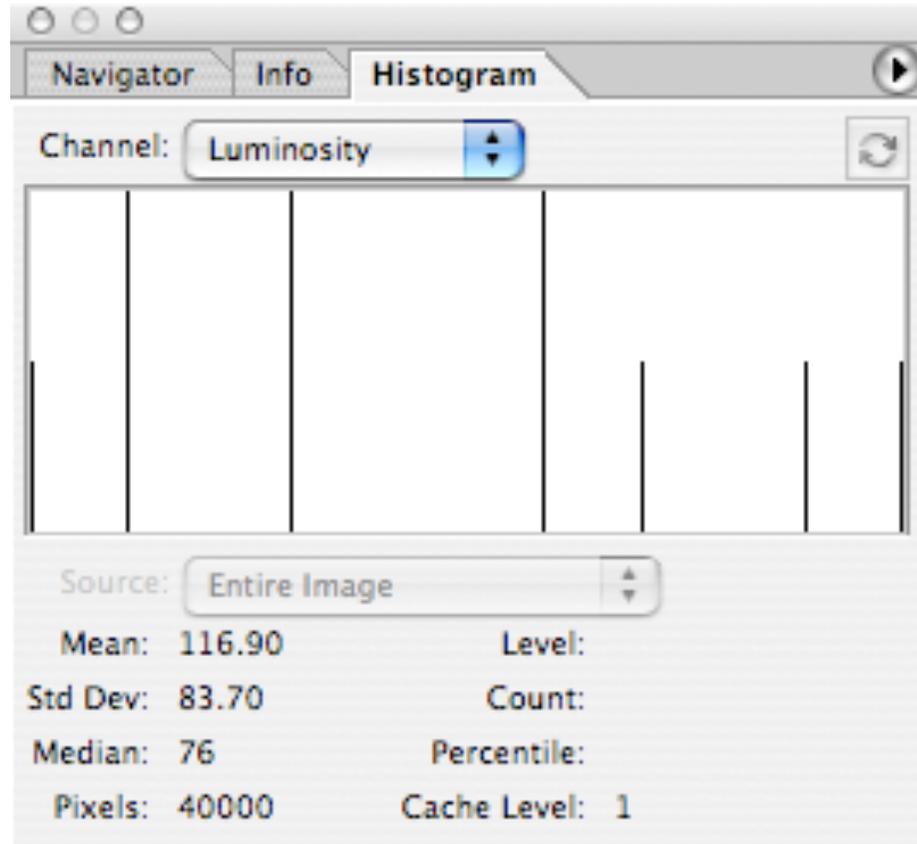
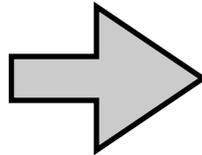
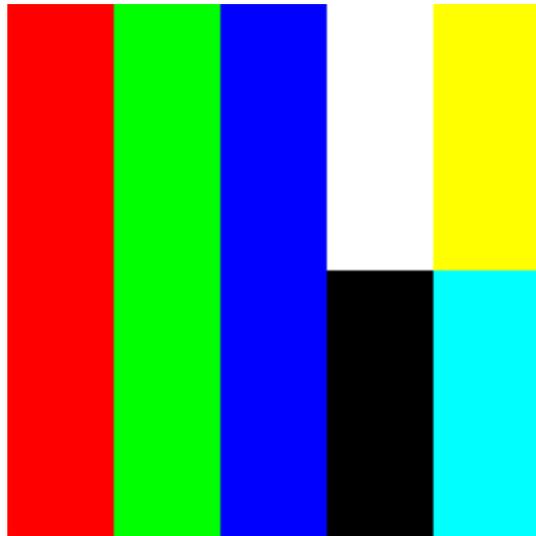
Luminosity Histograms

DIY!



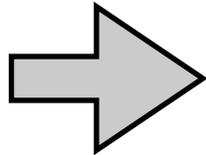
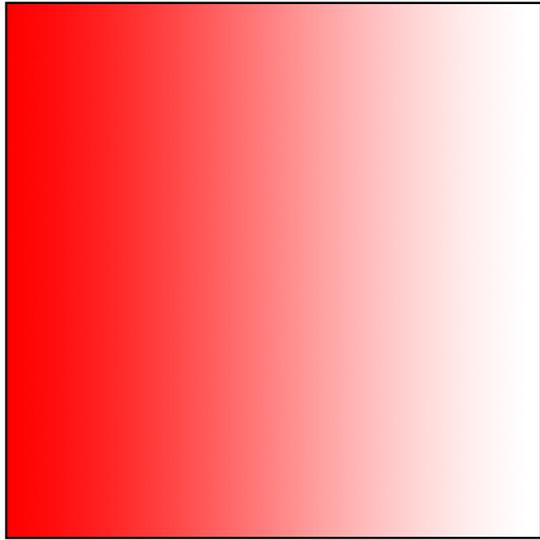
Luminosity Histograms

DIY!

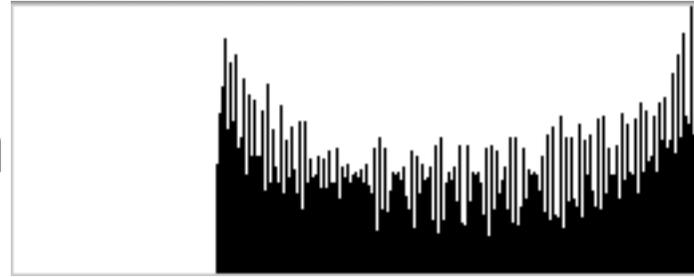


# Luminosity Histograms

DIY!



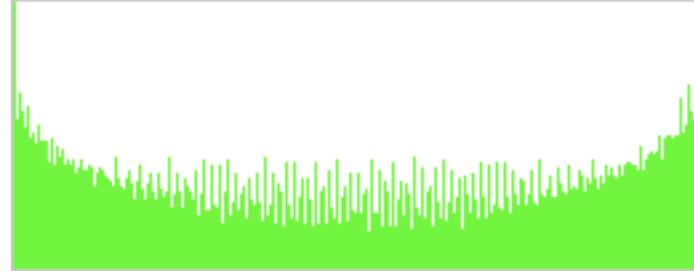
Lum



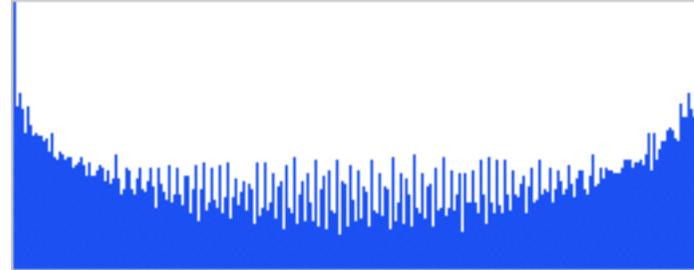
R



G

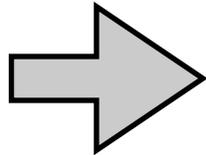
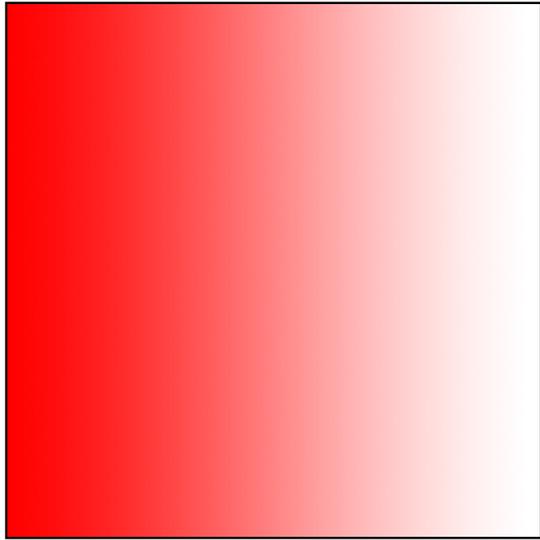


B



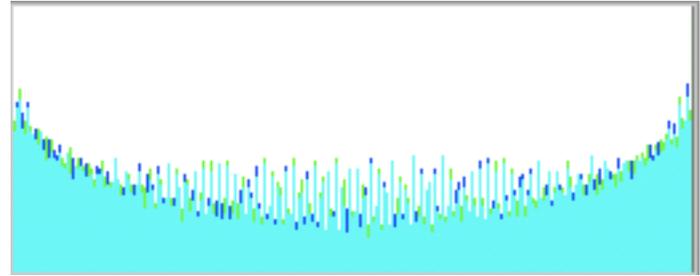
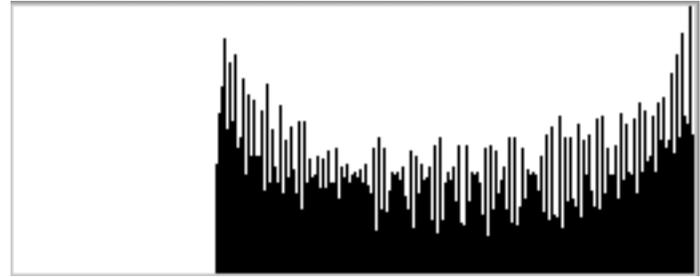
Histograms

More than just Luminosity...



Colors

Lum

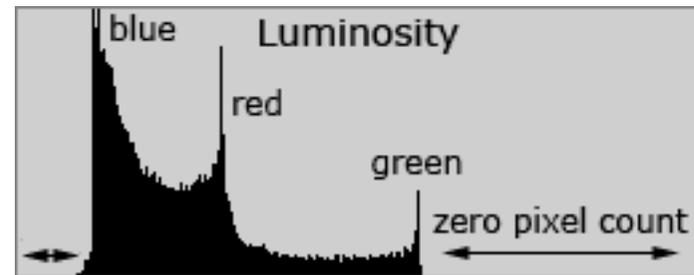
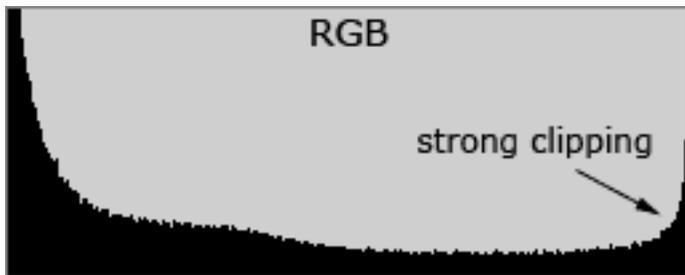
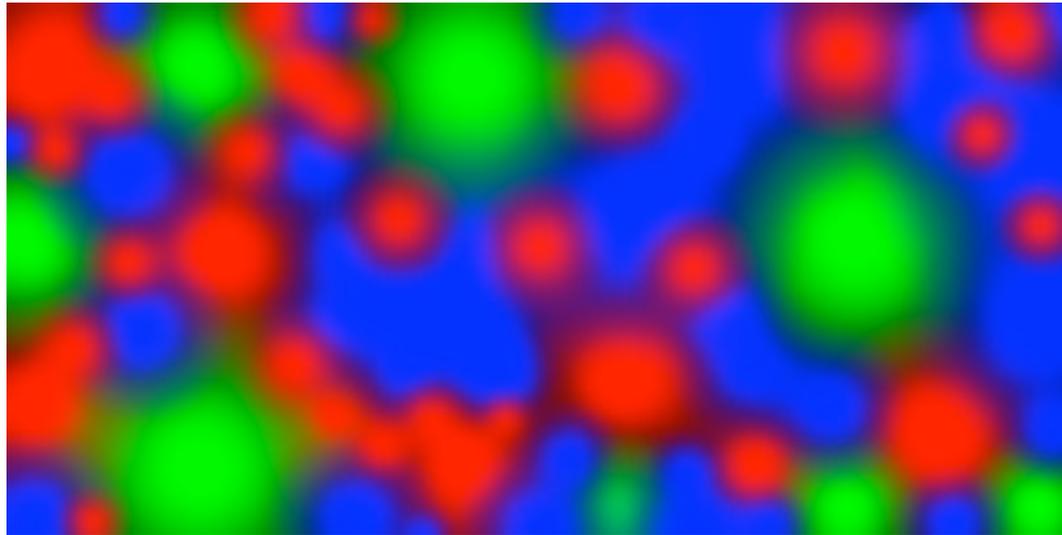


RGB



Histograms

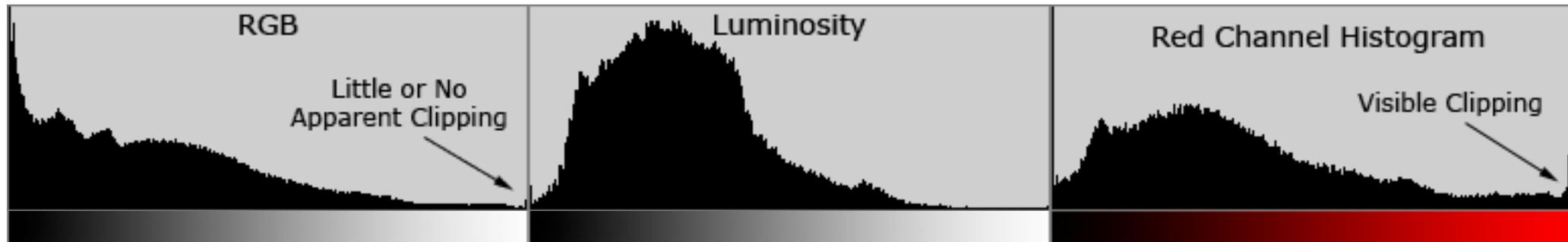
Luminosity, Colors, & RGB



Images from <http://www.cambridgeincolour.com/tutorials/histograms2.htm>

# Histograms

## Luminosity, Colors, & RGB



Images from <http://www.cambridgeincolour.com/tutorials/histograms2.htm>

# Histograms

Luminosity, Colors, & RGB



1/80s, ISO 400, f/10

Photo by Dan Armendariz, 2006

# Histograms

What is Black and White?

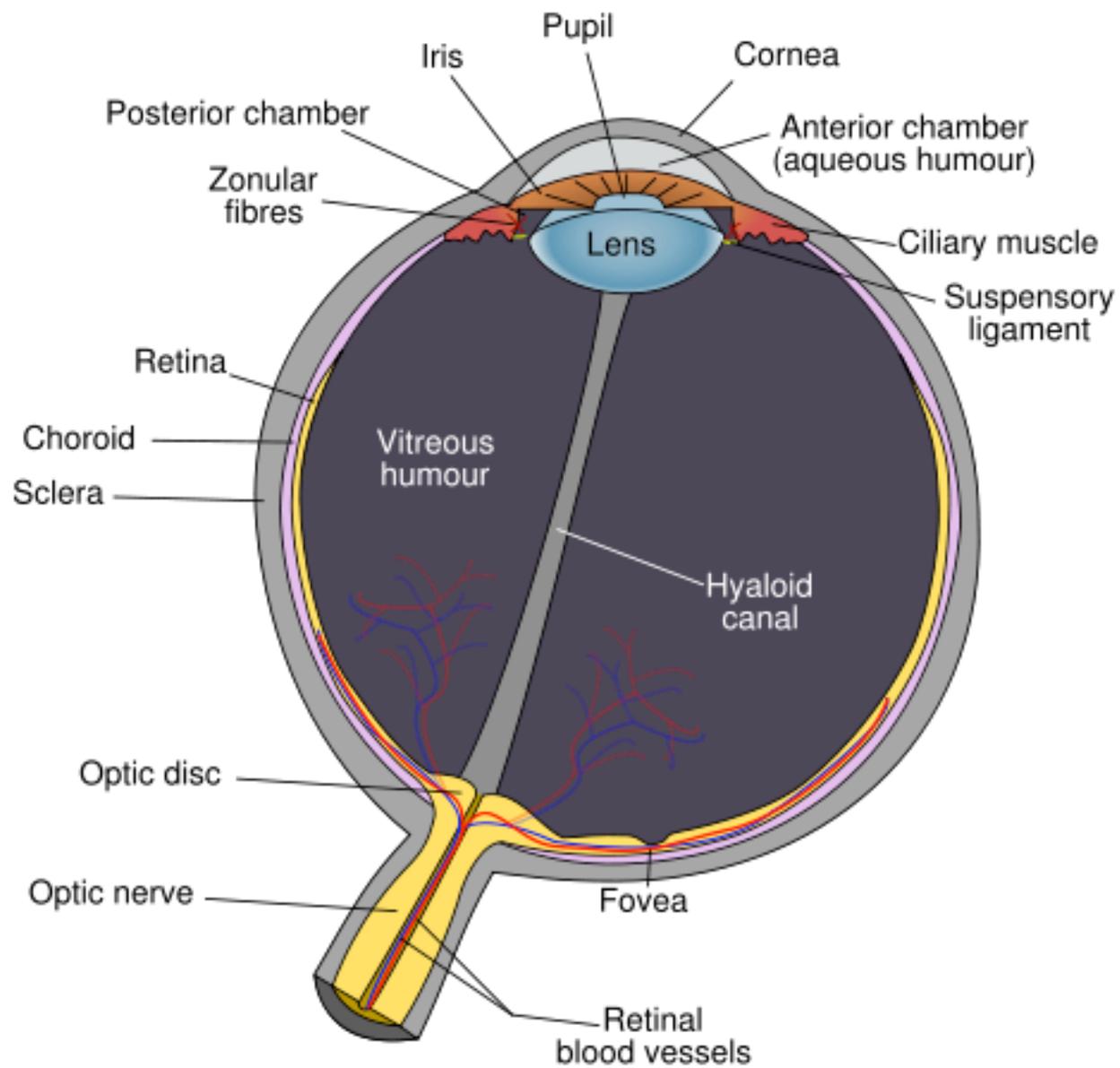
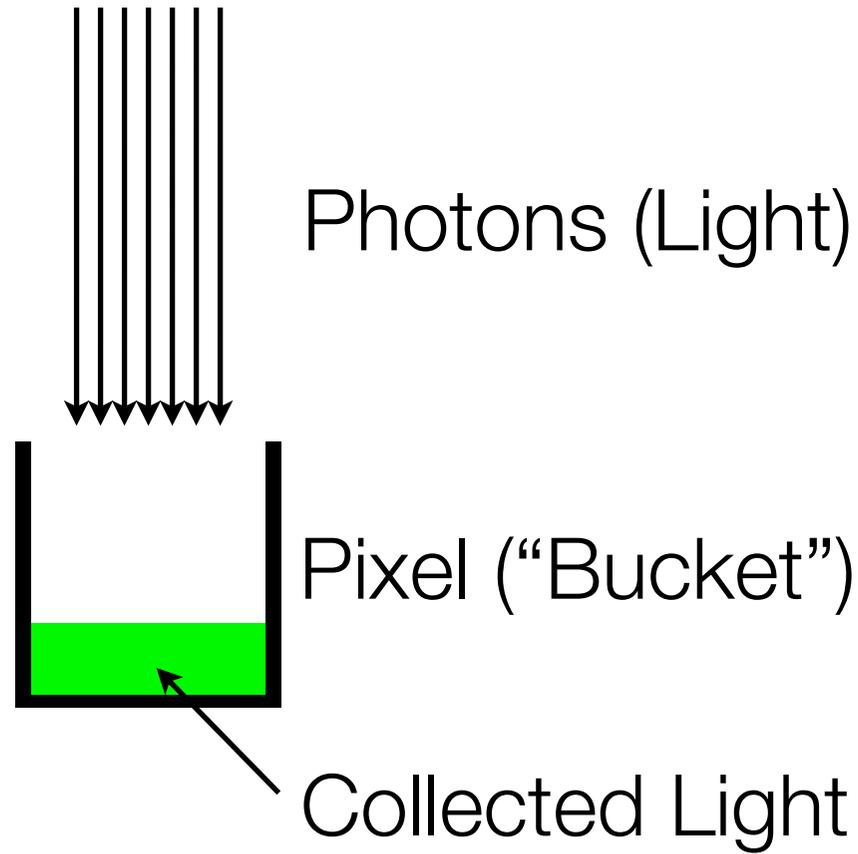


Image from <http://en.wikipedia.org/wiki/Fovea>

Dynamic Range

The Eye



Dynamic Range

Digital Cameras

$$\text{Dynamic Range} = \frac{\text{Biggest Signal (full "bucket")}}{\text{Smallest detectable signal}}$$

Dynamic Range

Simplified Calculation



1/80s, ISO 400, f/10

Photo by Dan Armendariz, 2006

# Dynamic Range

In Scenes

# Computer Science E-7

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