

# Computer Science E-7

## Exposing Digital Photography

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Lecture 10: Digital Cameras (continued)  
November 14, 2011

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**Home**

**Final Project**

**Lectures**

**Problem Sets**

**Resources**

**Syllabus**

Welcome to Computer Science E-7: Exposing Digital Photography! This is a course offered in Spring, 2008 at **Harvard University's Extension School**.

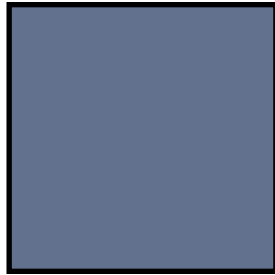
The course strives to offer students a more thorough understanding of digital photography through an exploration of technical, rather than strictly artistic, details. With a better understanding of the limitations and compromises behind digital photography, students will be better prepared for unexpected and dynamic photographic situations.

Find the **syllabus** and much more on the menu at the left!

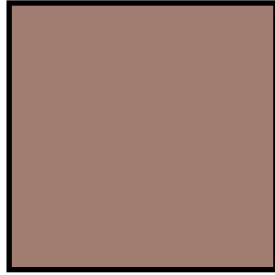
(cc)2008 Dan Armendariz, some rights reserved: Creative Commons BY-NC-SA.

## Project 4

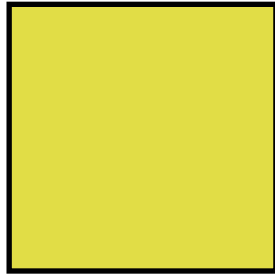
## Website Theme



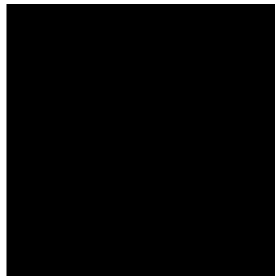
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content: A17D71

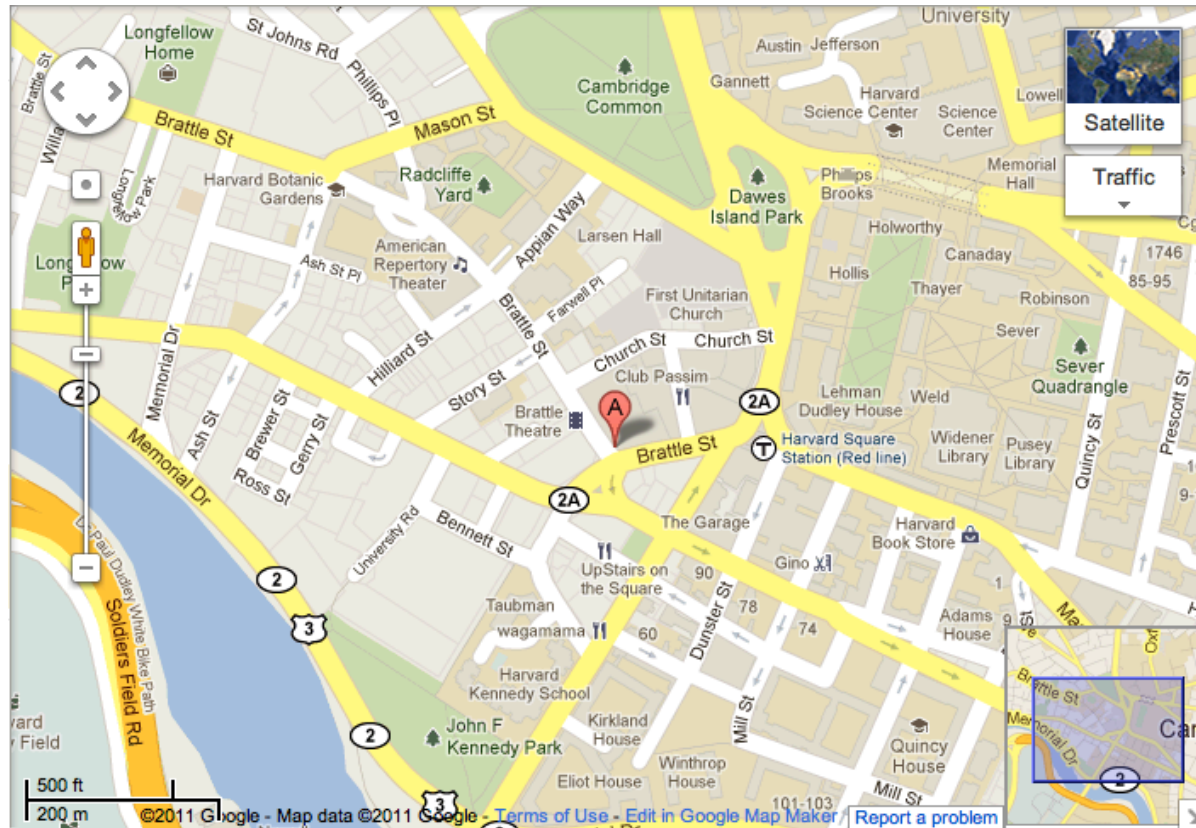


highlight: FFDD46



text: 000000

# Crema Cafe



Final Project

Exhibition

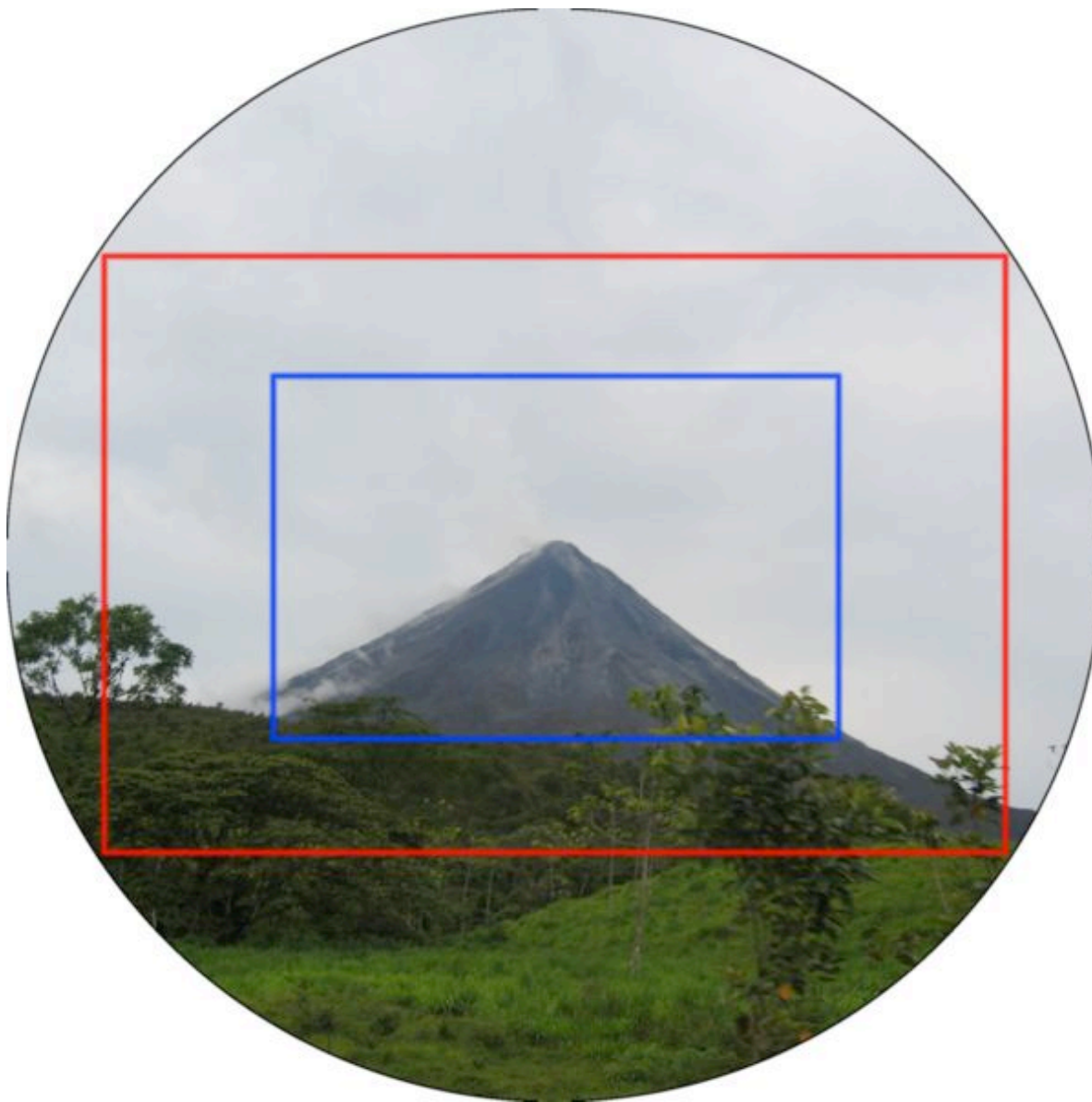
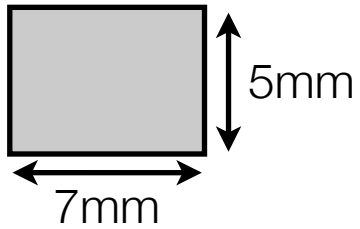


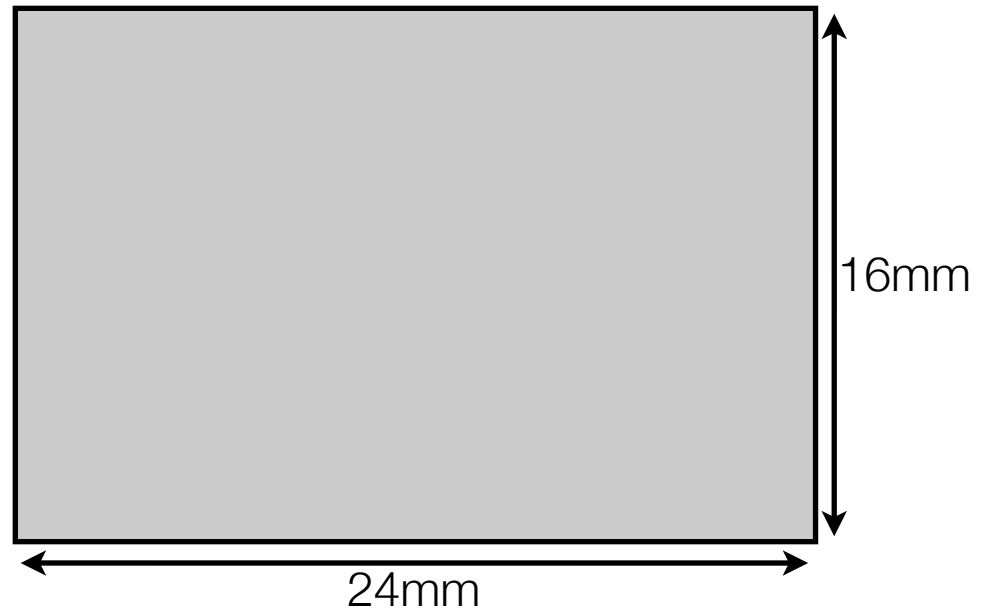
Image from [http://en.wikipedia.org/wiki/Crop\\_factor](http://en.wikipedia.org/wiki/Crop_factor)

# Review

## Focal Length and Perspective



1/2.5"  
6 MP



APS-C (SLR-sized)  
6 MP

Review

Sensor & Pixel Sizes





Canon 1D Mark II, 28mm f/13 1/8 sec, ISO 640



Canon S70, 8mm f/3.5 1/8 sec, ISO 50



Canon 1D Mark II, 28 mm f/3.5 1/100 sec, ISO 640

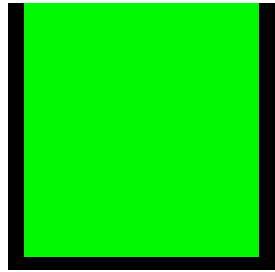
© Roger N. Clark

[www.clarkvision.com](http://www.clarkvision.com)

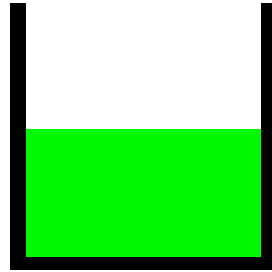
Image from [http://www.clarkvision.com/photoinfo/dof\\_myth/](http://www.clarkvision.com/photoinfo/dof_myth/)

# Review

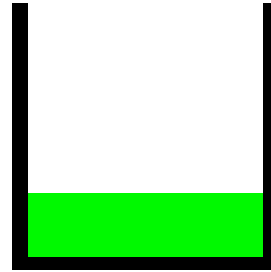
## Depth of Field



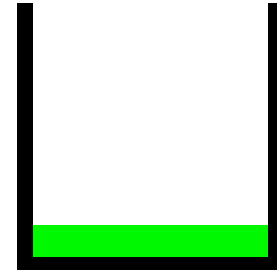
100



200



400



800

Review

Full capacity of pixels at ISOs



Passive Pixel Sensors

CCD

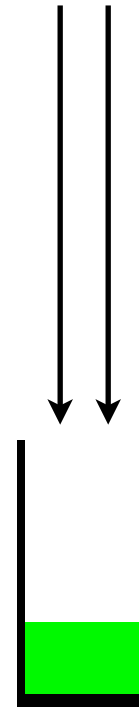
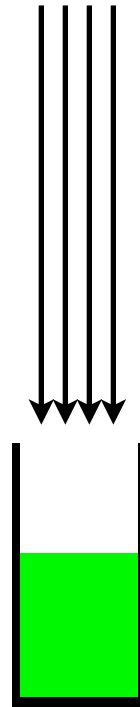
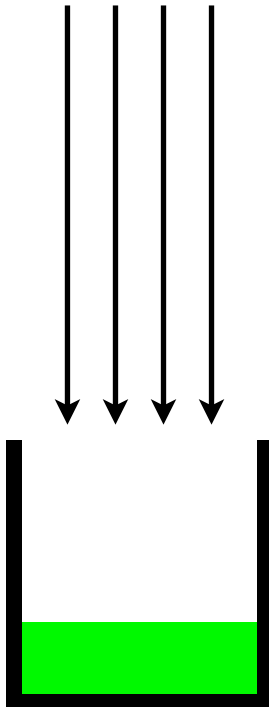
Active Pixel Sensors

CMOS

JFET LBCAST

Digital Cameras

Sensors



Sensors

Pixel Size

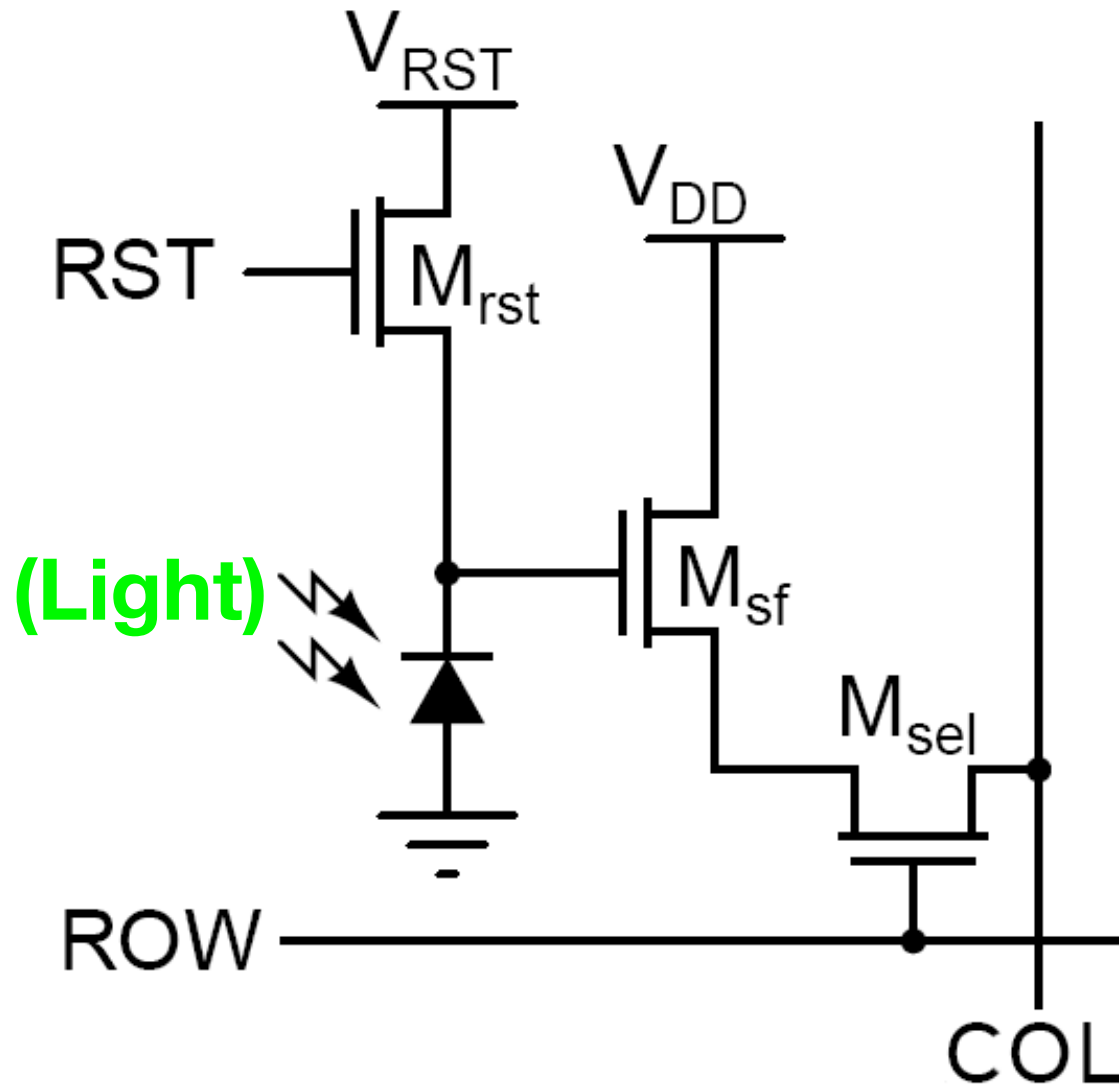


Image from [http://en.wikipedia.org/wiki/Active\\_pixel\\_sensor](http://en.wikipedia.org/wiki/Active_pixel_sensor)

Sensors

Pixels

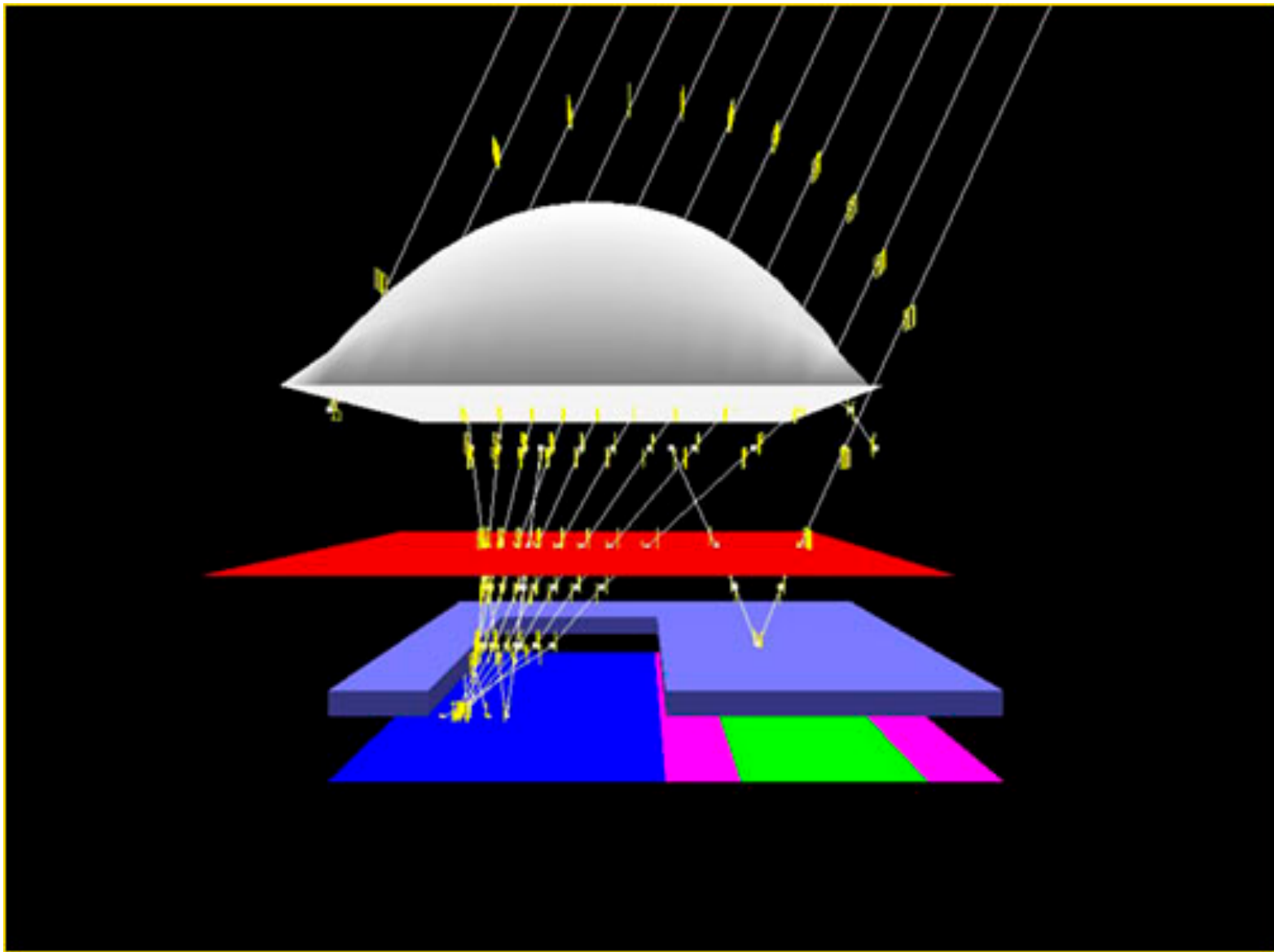


Image from Eastman Kodak, from <http://www.luminous-landscape.com/essays/kodak-iss.shtml>

Sensors

Microlens

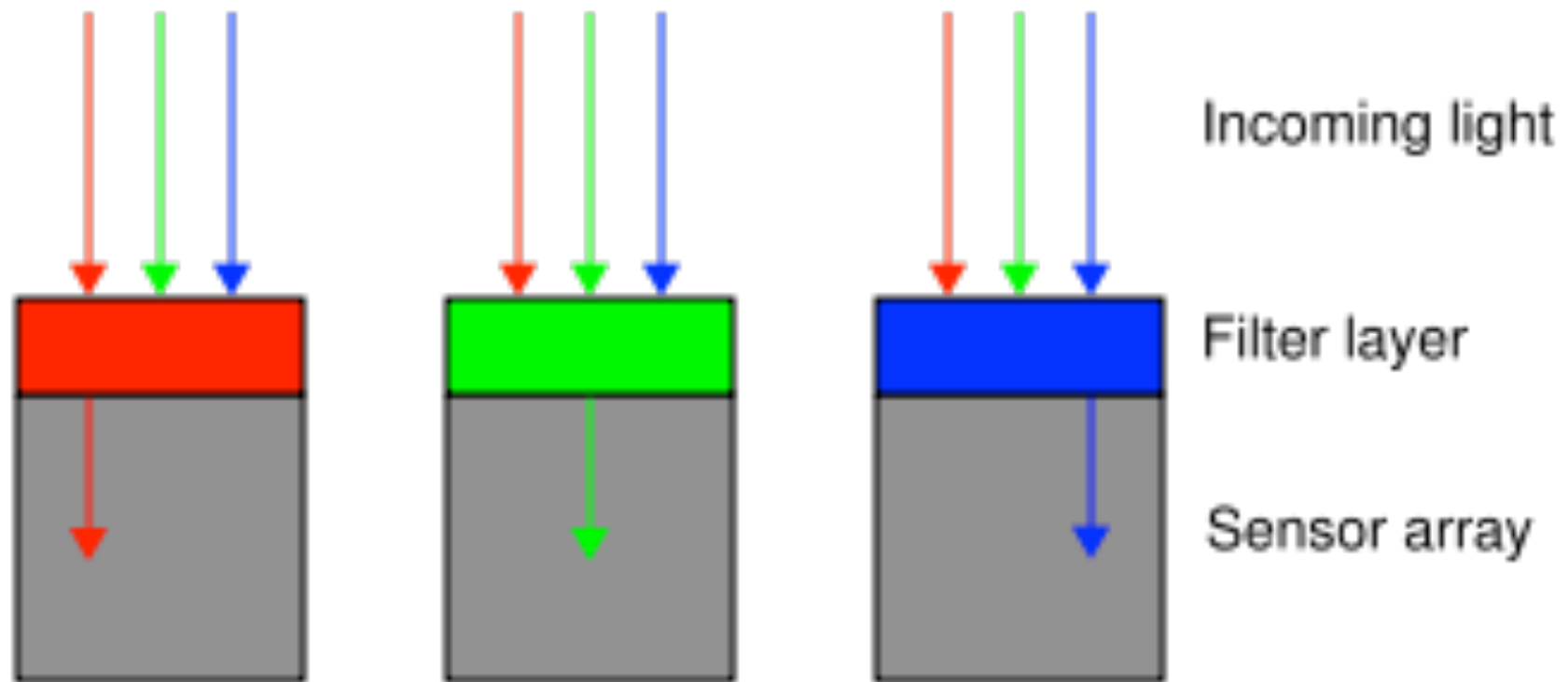


Image from [http://en.wikipedia.org/wiki/Bayer\\_filter](http://en.wikipedia.org/wiki/Bayer_filter)

Sensors

Color Filter Arrays



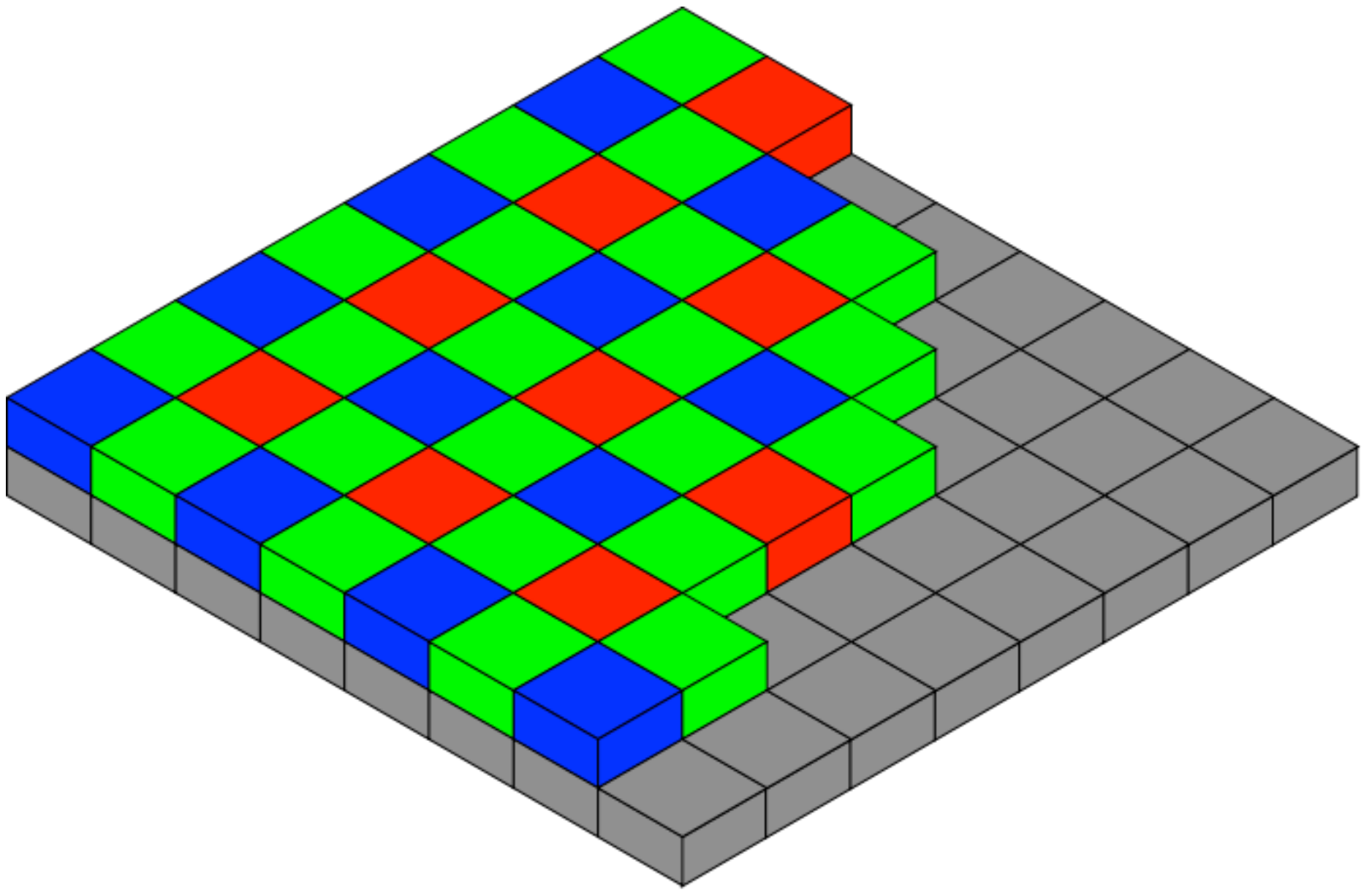
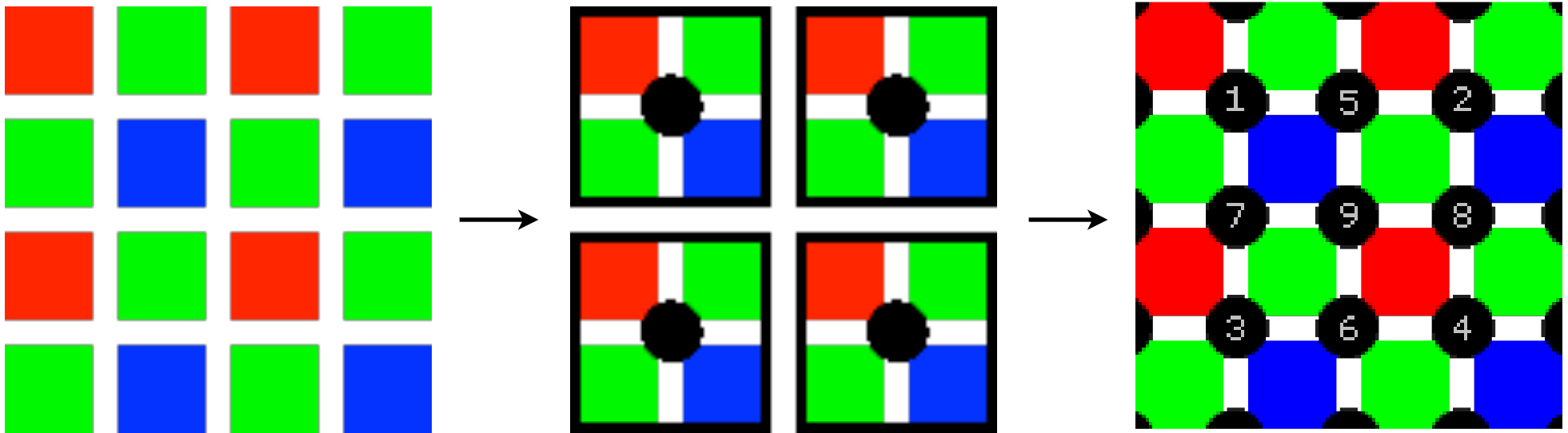


Image from [http://en.wikipedia.org/wiki/Bayer\\_filter](http://en.wikipedia.org/wiki/Bayer_filter)

# Color Filter Arrays

## Bayer Filter



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

# Color Filter Arrays

## Demosaicing

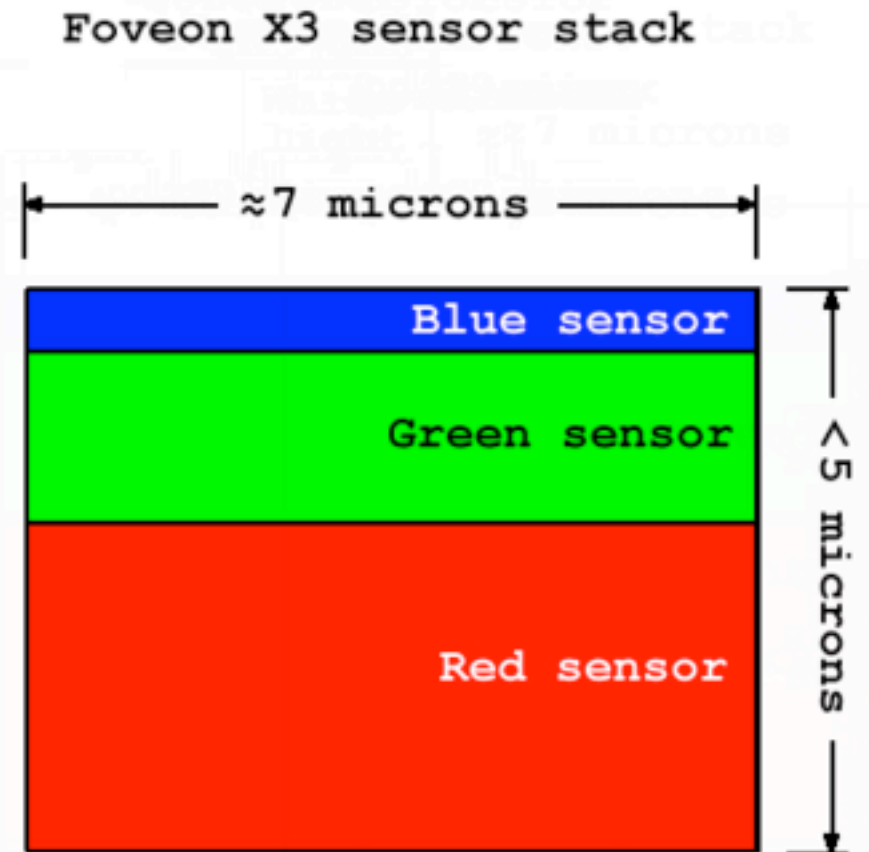
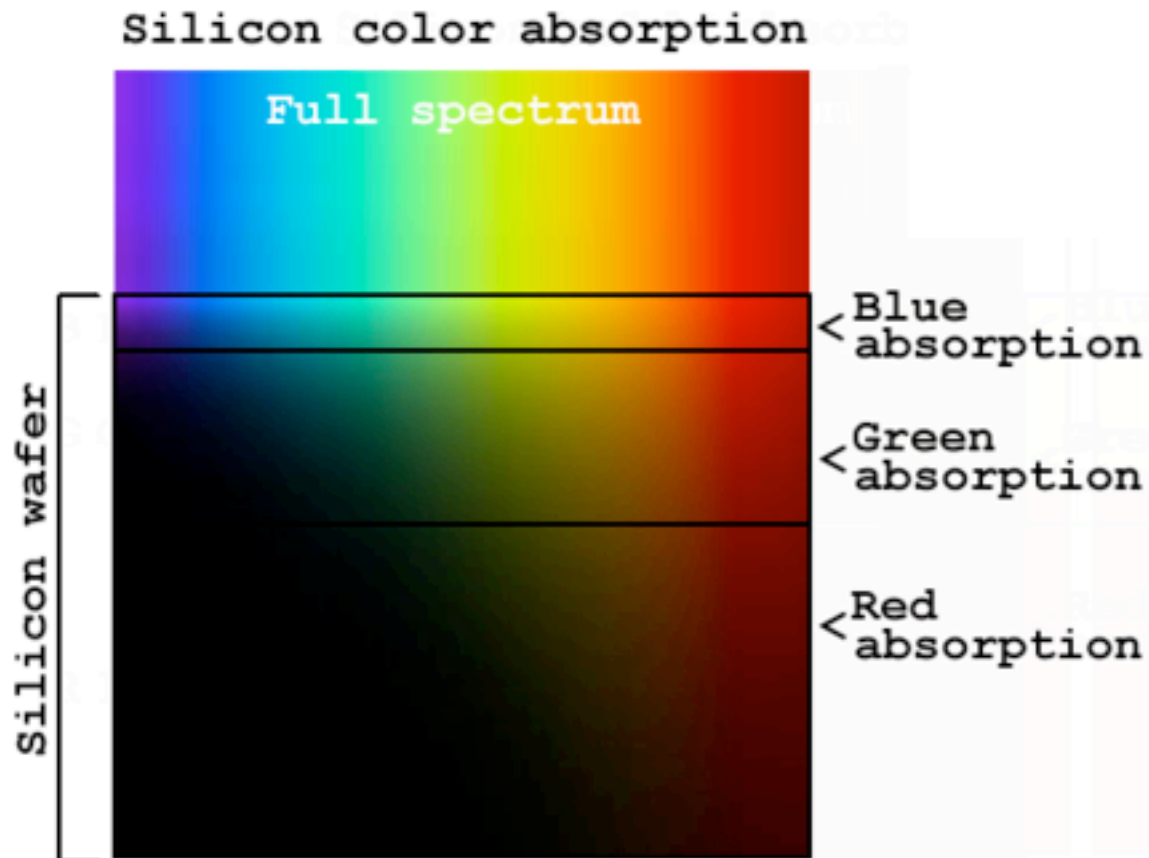
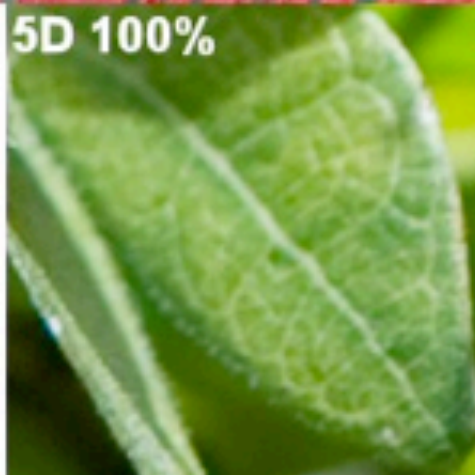
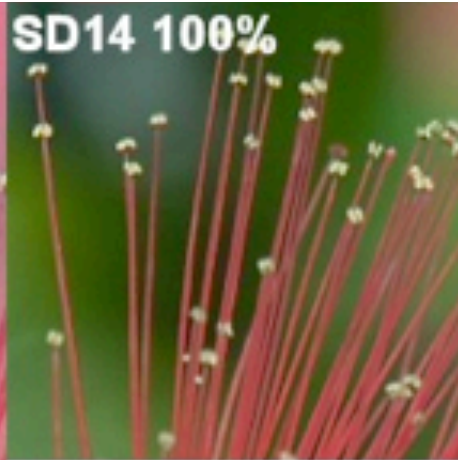
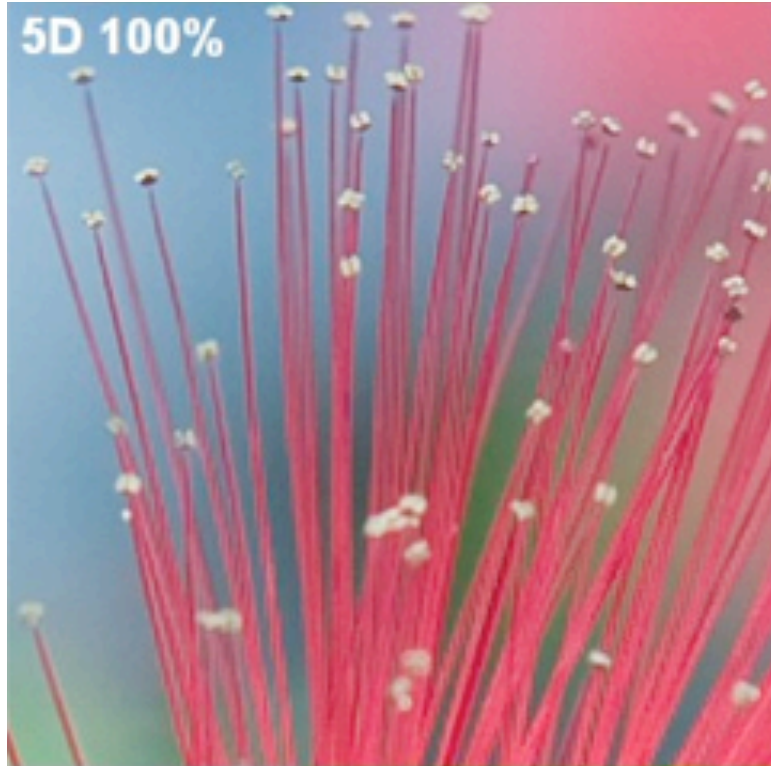


Image from [http://en.wikipedia.org/wiki/Foveon\\_X3\\_sensor](http://en.wikipedia.org/wiki/Foveon_X3_sensor)

Sensors

Foveon X3



Images from <http://www.ddisoftware.com/sd14-5d/>

Sensors

Foveon X3



Foveon



Bayer



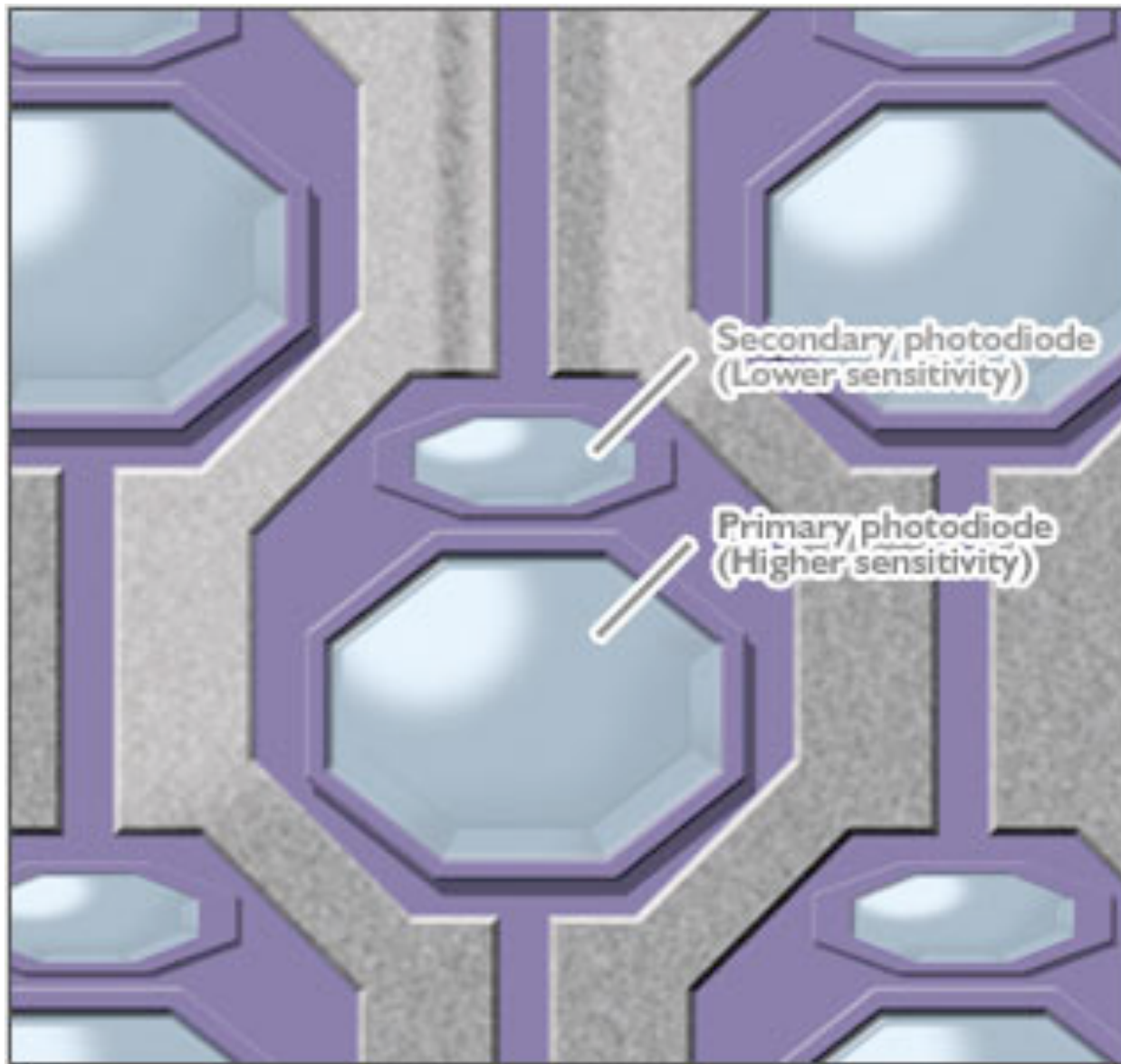
Bayer+LP (AA)

Images from <http://www.ddisoftware.com/reviews/sd9-v-bayer/>

Sensors

Low-Pass (Anti-Aliasing) Filter





Images from <http://www.dpreview.com/news/0301/03012202fujisuperccdsr.asp>

# Sensors

## Fujifilm SuperCCD SR



309s, ISO 100

Photo by Dan Armendariz, 2009

# Digital Cameras

## Histograms



Images from [http://www.dpreview.com/learn/?/Glossary/Digital\\_Imaging/dynamic\\_range\\_01.htm](http://www.dpreview.com/learn/?/Glossary/Digital_Imaging/dynamic_range_01.htm)

# Digital Cameras

## Dynamic Range





Images from [http://www.dpreview.com/learn/?/Glossary/Digital\\_Imaging/dynamic\\_range\\_01.htm](http://www.dpreview.com/learn/?/Glossary/Digital_Imaging/dynamic_range_01.htm)

# Digital Cameras

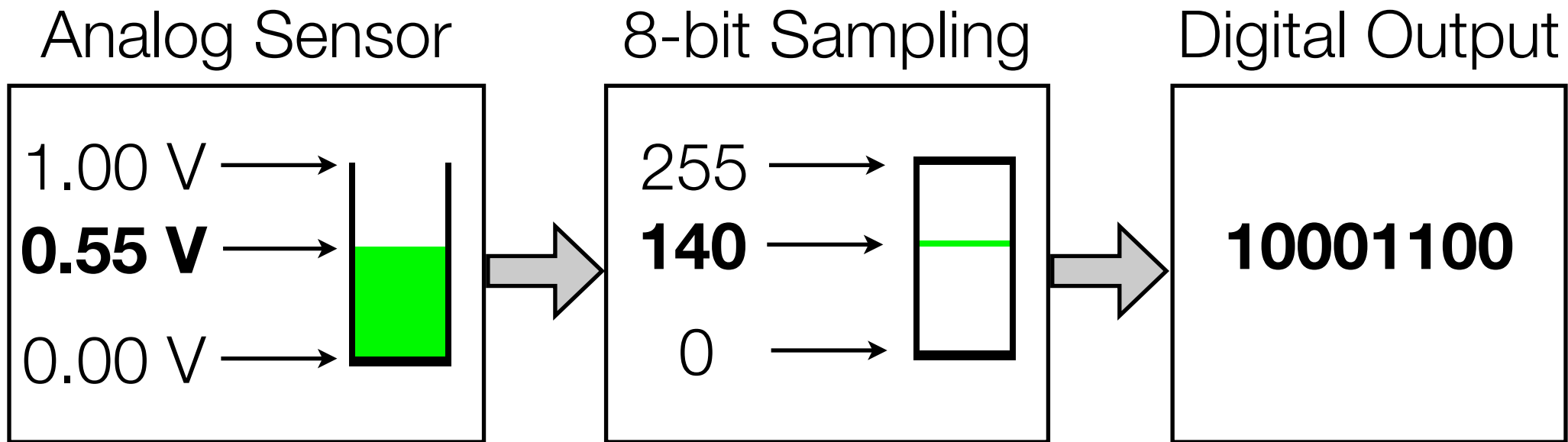
## Dynamic Range

Bit	0 or 1
Byte	8 bits

Bits and Bytes

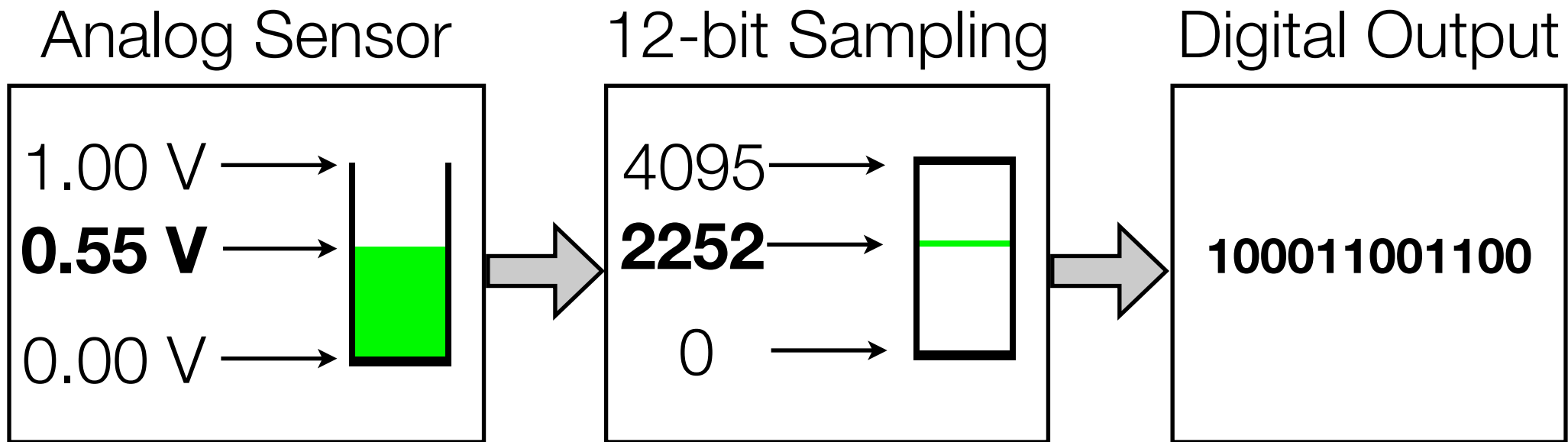
Refresher





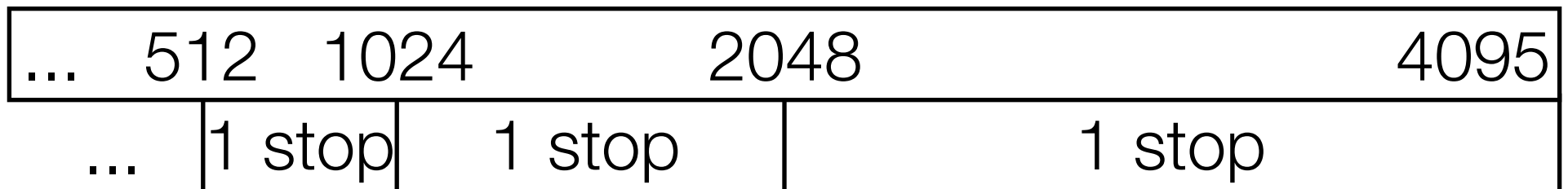
Digital Cameras

Analog to Digital Converter (ADC)



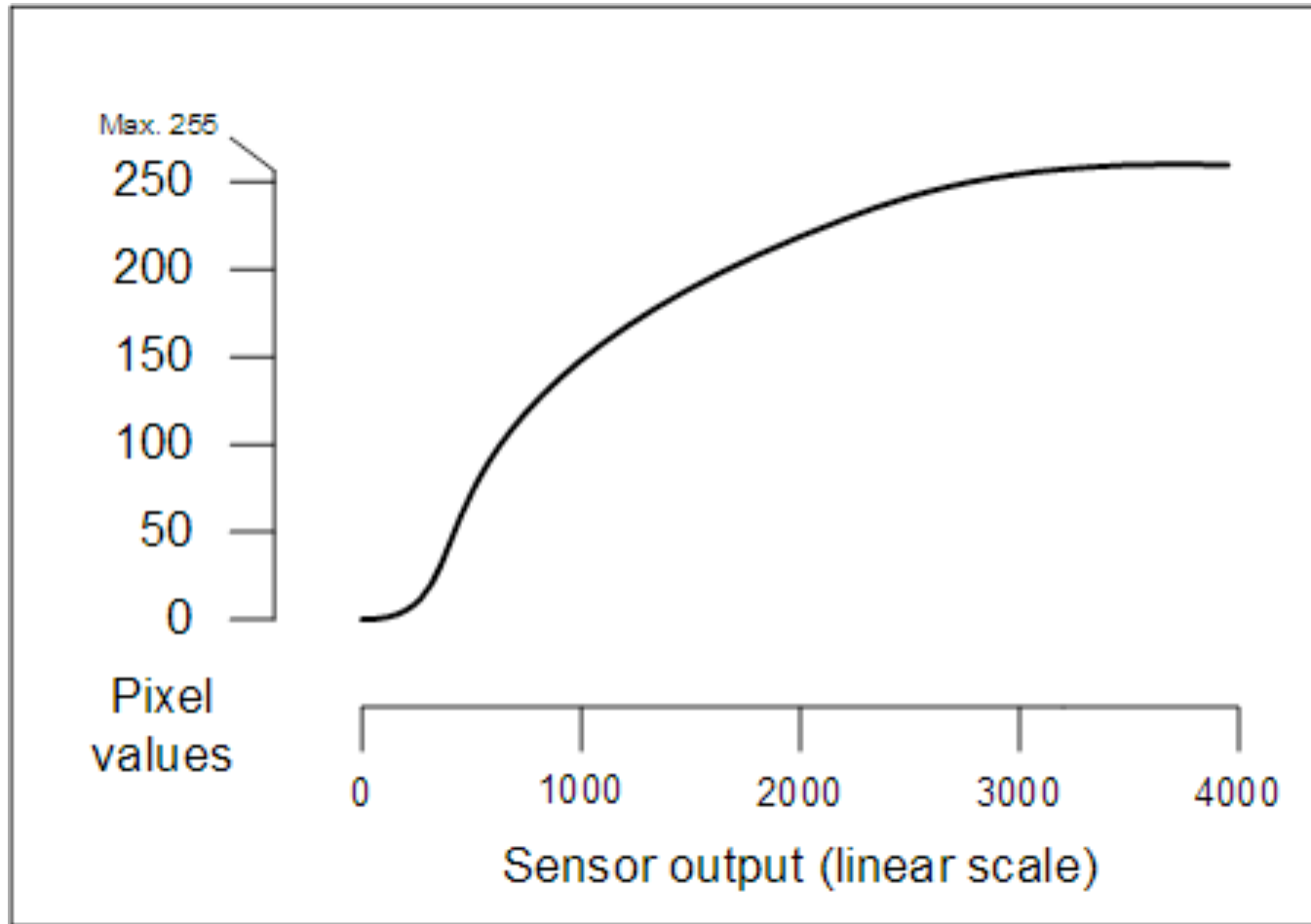
Digital Cameras

Analog to Digital Converter (ADC)



Digital Cameras

Sensor Linearity



Images from <http://www.covingtoninnovations.com/dslr/Curves.html>

# Digital Cameras

## Tonal Curve

	<b>RAW</b>	<b>JPEG</b>
<b>Bit depth</b>	10-, 12-, 14-bit	8-bit
<b>Tonal Curve</b>	Not applied	Applied
<b>White Balance</b>	Not set	Set
<b>Compression</b>	Lossless	Lossy
<b>Portability</b>	Nonstandard	Standard
<b>Post-Processing</b>	Required	Optional

Digital Cameras

RAW vs JPEG!



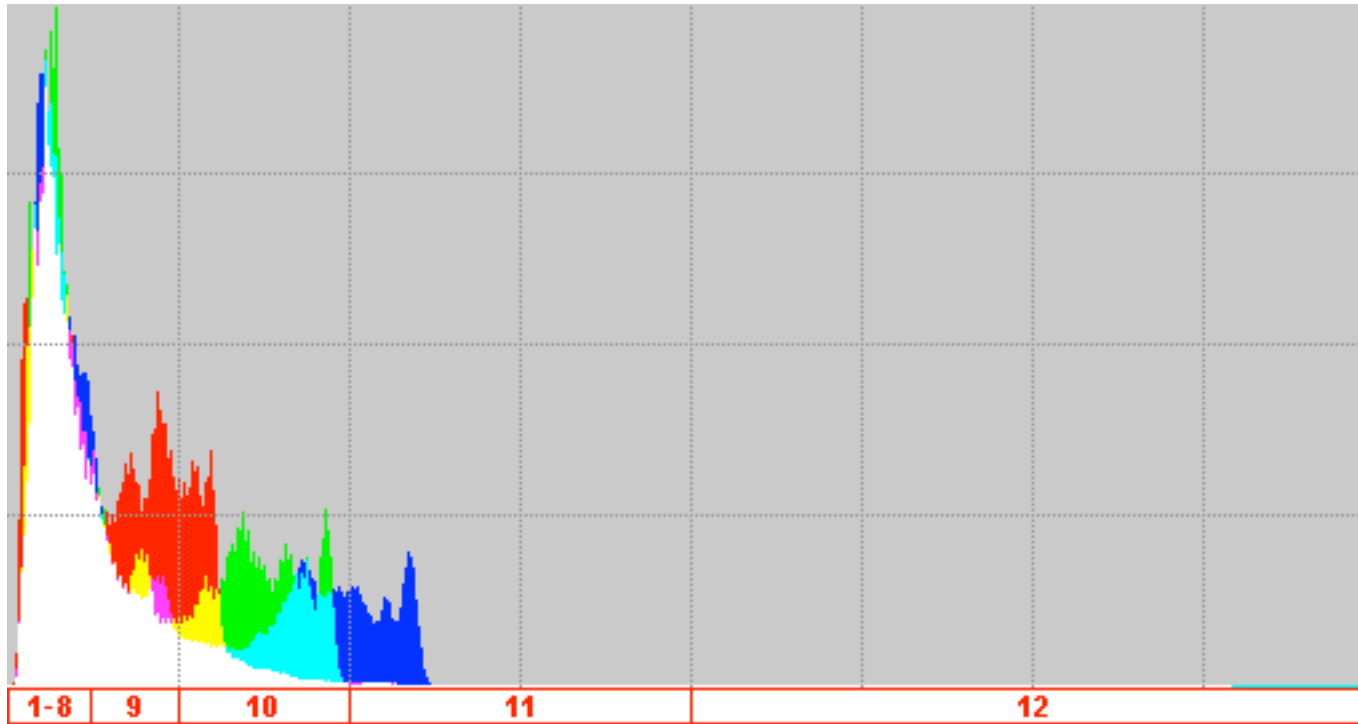


Image from [http://www.guillermoluijk.com/tutorial/dcraw/index\\_en.htm](http://www.guillermoluijk.com/tutorial/dcraw/index_en.htm)

# Digital Cameras

“Expose to the Right”

# Computer Science E-7

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