Digital Photography

An Overview

Presented By Dan Feighery

For
OLLI Personal Computer User Group (OPCUG)
Washington Area Personal Computer User Group (WACUG)
Feb 2012

- We'll plow across several acres
  - But only go a few inches deep

Photo from ruralblacksmith.blogspot.com

2

What We'll Cover

- **Digital Cameras General Concepts**
   - Camera types & specifications
    - Basic Auto picture taking + Bundled Software overview
    - Histogram
    - Pixels & Aspect Ratio
    - Color Management
    - White Balance
    - Grain
    - Lens: (Focal Length, Crop Factor, Angle of View, Zoom ratio)
    - Exposure Triangle (Aperture, Shutter Speed, Chip Sensitivity)
    - Depth of Field
    - Discussion

TYPES & SPECIFICATIONS

Large Variety of Cameras

Over $40,000.00

PRICE

Less than $100.00

5

The Camera

DSLR EXAMPLE

LCD Display

Aperture

Image sensor

Lens

Optical Viewfinder

LCD Display on Back

Memory Card

Shutter
Mechanical
or sensor on-off switch

Cable Connections
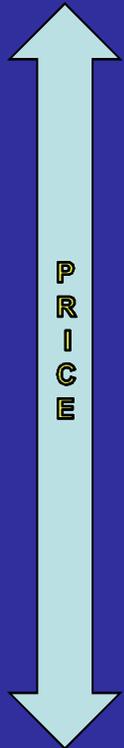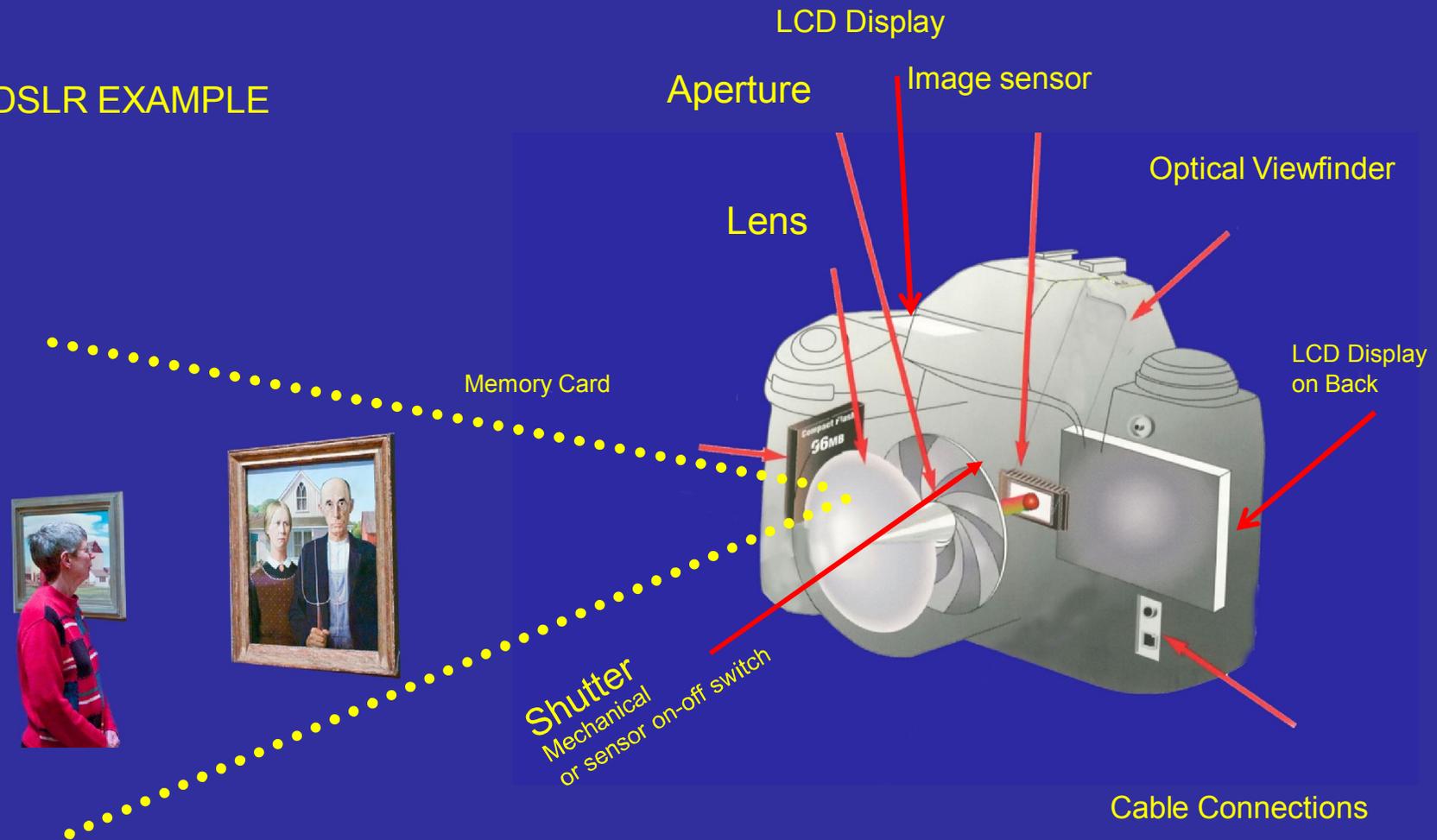
Note: Four Thirds format cameras have no mirror / optical viewfinder but do have interchangeable lens. (allows for smaller size camera)

Dan Feighery

Camera drawing from
A short Course in
Photography
7th Edition

6

Digital Single Lens Reflex Camera

- A Mechanical, Digital & Optical Marvel

Primary Types (1)

Pocket Camera (Point & Shoot)

Factory did the thinking

You capture an Image

You Do The Thinking

You Make a Photograph

<u>D</u>igital <u>S</u>ingle <u>L</u>ens <u>R</u>eflex (DSLR)

Dan Feighery

Primary Types (2)

Pocket Camera (adjustable)

Single Retracting lens

Specification Highlights
12.1 MP CMOS Sensor
5x Optical Zoom - 24-120 mm Equivalent
3.0" TFT Color Display
DIGIC 5 Image Processor
1920 x 1080p HD Video W/Stereo Sound
Fast f/2.0-5.9 Lens for Low Light Photos
Control Ring for Easy Manual Control
ISO Up to 6400
Intelligent IS Image Stabilization
33 Shooting Modes for Better Control

3.93 x 2.34 x 1.05 inches
Weight 6.1 oz

http://www.bhphotovideo.com/c/product/822124-REG/Canon_PowerShot_S100_Digital_Camera.html

Micro Four thirds

Interchangeable lens

Specification Highlights
16.05MP Live MOS Sensor
3" Free-Angle LCD W/460,000 Dots
1920x1080 60i HD Video
MEGA O.I.S. (Optical Image Stabilizer)
Fastest Level of Light Speed AF
High Sensitivity Up to ISO 12800
Touch Screen Control for Stills/Video
iA (Intelligent Auto) Mode Stills/Video
Dust Reduction System
Dolby Stereo Sound W/Video

4.88 x 3.53 x 2.98 INCHES
Weight 13.82 oz Body only

http://www.bhphotovideo.com/c/product/736365-REG/Panasonic_DMC_GH2K_K_Lumix_DMC_GH2_Digital_Camera.html

9

Specifications

Example Highlights

- **Canon EOS 5D MK II**
  ($2175.00 body only)
  - 21.1 Megapixel Full-Frame Sensor
  - 3.0" High Resolution LCD Display
  - Live View Mode
  - 1080p Movie Mode
  - Dust & Weather-Resistant
  - Self Cleaning Sensor
  - Broad ISO Range (50-25600)
  - 3.9 fps Burst Mode

- **Canon Powershot A 800 ($79.00)**
  - 10MP Resolution
  - 3.3x Optical Zoom Lens 37-122mm Equiv
  - 2.5" TFT LCD Monitor
  - Up to 3200 ISO for Low Light Photos
  - Multiple Shooting Modes
  - Red-Eye Correction
  - Low Light, Vivid, Kids & Pets Modes
  - Macro Close-up Photography
  - Portrait Mode
  - Blur Reduction

Check Web Sites for full details

http://www.bhphotovideo.com/c/product/583953-REG/Canon_2764B003_EOS_5D_Mark_II.html

http://www.bhphotovideo.com/c/product/750174-REG/Canon_Powershot_A800_Digital_Camera.html

10

Basic Automatic Picture Taking

Study User Guide For Your Camera

Table of Contents

Conventions Used in This Guide

- Icons are used in the text to represent the camera buttons and dials.
- Language that displays on the screen appears inside [ ] (square brack
- The directional buttons, control dial, FUNC./SET button and control ri
  are represented by the following icons.

Up Button ▲   FUNC./SET Button
Left Button ◄   ► Right Button
Control Dial   ▼ Down Button

() Control Ring
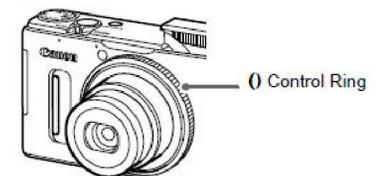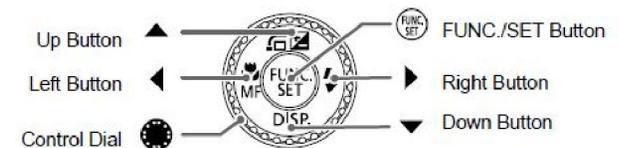
- ①: Things you should be careful about
- ❷: Troubleshooting tips
- ☼: Hints for getting more out of your camera
- ✎: Supplemental information
- (p. xx): Reference pages ("xx" stands for a page number)
- This guide assumes all functions are at their default settings.
- The various types of memory cards that can be used in this camera a
  collectively referred to as memory cards in this guide.

Study User Guide For Your Camera

- Image Quality, RAW & "Special Scenes"

Table of Contents

6

7

13

Study User Guide For Your Camera

- <u>Image Quality</u>, RAW & "Special Scenes"

Changing the Recording Pixel Setting (Image Size)

You can choose from 4 recording pixel settings.

12M 4000x3000
4:3
For printing up to A2 size (16x20 in.) prints

L M1 M2 S 752

1 Choose the recording pixel setting.
- After pressing the button, press the ▲▼ buttons to choose L.

2 Choose an option.
- Press the ◀▶ buttons or turn the dial to choose an option, then press the button.
- The setting will appear on the screen.
- To restore the original setting, choose L in Steps 1 – 2.

The digital zoom (p. 50) can only be used in an aspect ratio of 4:3.

Changing the Compression Ratio (Image Quality)

You can choose from the following 2 compression ratios (image quality): (Fine), (Normal).

Fine
4:3
Shoot high quality images

752

1 Choose the compression ratio setting.
- After pressing the button, press the ▲▼ buttons to choose L, then press the MENU button.

2 Choose an option.
- Press the ◀▶ buttons or turn the dial to choose an option, then press the button.
- The setting will appear on the screen.
- To restore the original setting, choose in Steps 1 – 2.

56

Changing the Compression Ratio (Image Quality)

Approximate Values for Recording Pixels and Compression Ratio (for 4:3 Aspect Ratios)

Recording Pixels	Compression Ratio	Single Image Data Size (Approx. KB)	Number of Shots per Memory Card (Approx. shots)	
			4 GB	16 GB
L (Large)		3084	1231	5042
12M/4000x3000		1474	2514	10295
M1 (Medium 1)		1620	2320	9503
6M/2816x2112		780	4641	19007
M2 (Medium 2)		558	6352	26010
2M/1600x1200		278	12069	49420
S (Small)		150	20116	82367
0.3M/640x480		84	30174	123550

- The values in the table are measured according to Canon standards and may change depending on the subject, memory card and camera settings.
- The values in the table are based on 4:3 aspect ratio. If the aspect ratio is changed (p. 55), more images can be shot because the data size per image will be smaller than with 4:3 images. However, since M2 16:9 images have a setting of 1920 x 1080 pixels, their data size will be larger than 4:3 images.

Approximate Values for Paper Size (for 4:3 Aspect Ratios)

A2 (16.5 x 23.4 in.) L
A3 – A5 (11.7 x 16.5 – 5.8 x 8.3 in.) M1
5 x 7 in. Postcard size 3.5 x 5 in. M2

- S For sending images as e-mail attachments.

Throws away data from the already compressed jpg Image
- Take test shots & Compare
- Buy Highest # card camera will accept

57

14

Study User Guide For Your Camera

- Image Quality, <u>RAW</u> & "Special Scenes"

Study User Guide For Your Camera

- Image Quality, RAW & "<u>Special Scenes</u>"
  - The Camera engineers did the thinking
    - -- The latter part of this presentation will help you understand how you can use manual, shutter priority and aperture priority settings

Basic Automatic operations

- For "Point & Shoot" Camera
  - Buy & insert chip
  - Charge & insert Battery
  - Press "ON" button
  - Select "AUTO"
  - Point camera at subject
  - Adjust zoom control
  - Hold camera still
  - Press shutter button half way
  - Observe FOCUS & content OK
  - Press shutter the rest of the way
  - Take chip to photo store for prints
  - Or upload on computer.

Don't Forget Your Software User Guide

➢ Most digital camera boxes also include software

Basic View of Bundled Software

- ## Review Image Data

Editing with Bundled Software

- ## Some RAW as well as JPG post processing

Canon Map Utility

- ## Link to Google Map – IF GPS was on
  - ### Requires On-Line access to Google Maps

Histogram

Check Image Capture (Histogram)

- ## Understand what your camera can display
  - ### And how to find it

Playback (Detailed Information Display)
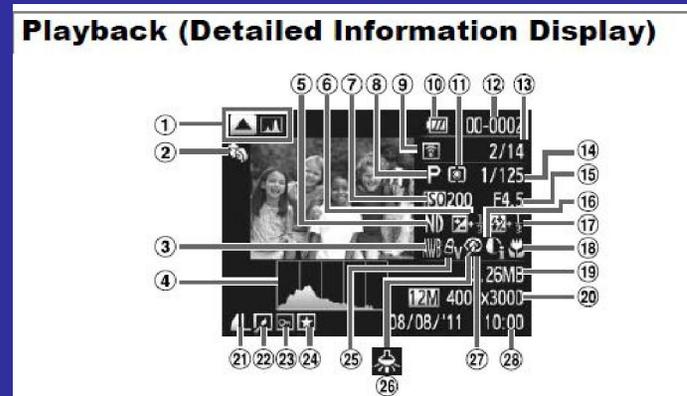
- ## One of the MOST Important pieces of information
  - ### The Histogram

  - ➢ A frequency distribution of pixel brightness

23

Check Image Capture (Histogram)

- ## What is a histogram

  - ### Graph showing all the brightness levels

    - Horizontal Axis:
      - Various levels of pixel brightness
        - » Very dark on left, very bright on right
    - Vertical Axis:
      - how many pixels a given brightness level

Shadow Area
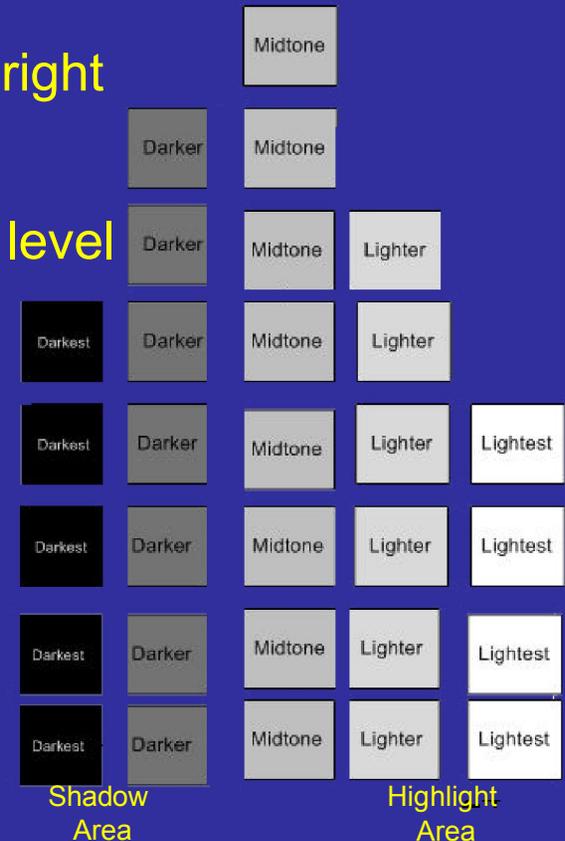
Highlight Area

Check Image Capture (Histogram)

Properly exposed image

Illustrative stacks of pixels

Histogram

Shadows   Midtones   Highlights

0   255
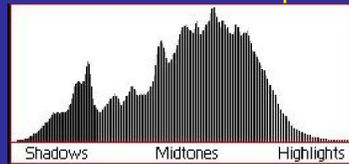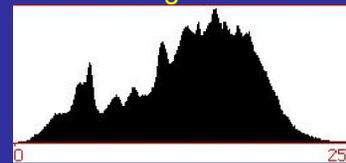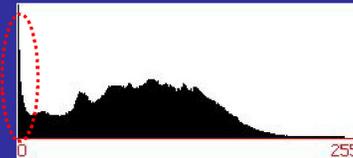
Image captured only the midtones – lacks contrast

Under exposed (TOO DARK)

255

0   255
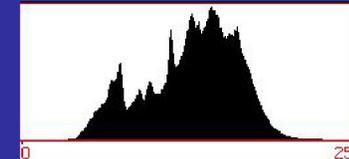
Over exposed (TOO LIGHT)

0   255
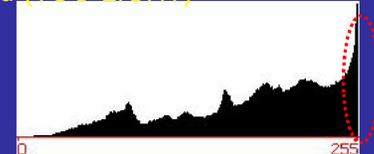
Shadows and Highlights clipped- Dynamic range of scene greater than Dynamic Range of camera

0   255
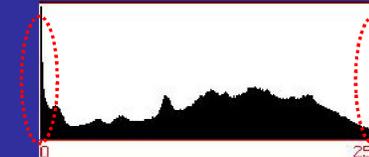
Above images from dpreview,. See Link:
http://www.dpreview.com/learn/?/Glossary/Digital_Imaging/Histogram_01.htm

25

Check Image Capture (Dynamic Range)

- Dynamic Range: Ratio of the highest (lightest) signal it can record to the lowest (darkest) signal

A Simplified Understanding

Consider an imaginary scene that might contain tones from the blackest black to the bright white

- For this example consider only several dozen levels of brightness
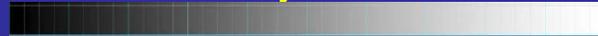
- We make a graph by stacking pixels of the same intensity level in the scene
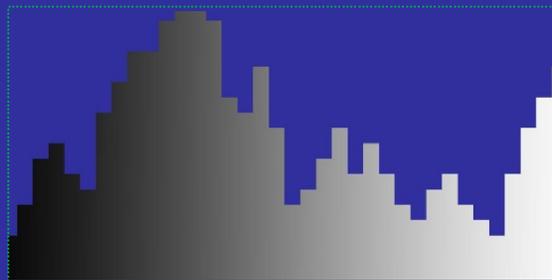
Our eyes can discern perhaps this range of dark to bright

A camera sensor may only capture this range of intensity

But is selectable
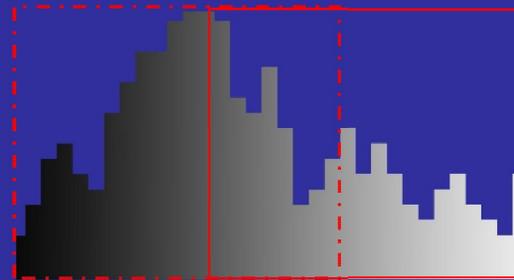
"Blown Out No detail

Software can not recover blown out highlights!!!

26

Check Image Capture (Highlight Warnings)

- Playback may highlight blown out areas
  - Be sure it is turned on in Menu
  - In addition to Histogram off the right edge,
    - Blown-out areas will blink on and off

Check Image Capture (Histogram slightly to right)

- ## Assume 12 bit image & range of 5 F-stops

  - It can capture 4096 discrete tonal values with each recording half the light value of the previous one.

Within the first F/Stop, which contains the Brightest Tones	2048 levels available
Within the second F/Stop, which contains Bright Tones	1024 levels available
Within the third F/Stop, which contains the Mid-Tones	512 levels available
Within the fourth F/Stop, which contains Dark Tones	256 levels available
Within the fifth F/Stop, which contains the Darkest Tones	128 levels available

  - If you don't use the right hand 5th of histogram for recording some of your image – you waste about half the encoding levels
    - Bias exposure so histogram is toward the right, BUT don't blow out highlights

Normal Exposure Centered Histogram	Histogram to the Right For Maximim S/N Ratio

    - The RAW Image may appear to bright -> In RAW converter adjust brightness level and contrast so data is spread out and the image looks right.

    Note: You have to try it to see if it works on your camera. It only works in 16bit space (12 bit recording) in a RAW converter before using Photoshop or other post processing

Ref: http://www.luminous-landscape.com/tutorials/expose-right.shtml

Pixels & Aspect Ratio

Pixels & Aspect Ratio (1)

- Understand the # in a # Megapixel Camera
  - A Megapixel = 1 million pixels
    - A Pixel is the smallest single component of an image
      - Also used as a measure of image resolution
      - (# of pixels across image) x (# of pixels in image height)
        - Examples (DSLR cameras) (aspect Ratio 2:3)
          3888 x 2592 = 10,077,696 (Canon 40D)
          5616 x 3744 = 21,026,304 (Canon D Mk II)
        - Examples Macro Four Thirds Camera (aspect Ration 4:3)
          4000 x 3000=12,000,000 (Panasonic Lumix G1)
        - Examples (Pocket Camera (S-100) – Also called point & shoot)
          4000 x 2248 = 8,992,000
          4000 x 2264 = 9,056,000
          4000 x 3000 = 12,000,000
          2992 x 2992 = 8,952,064
          2400 x 3000 = 7,200,000

- Aspect Ratio $= \dfrac{2592 \text{ pixels in image height}}{3888 \text{ pixels across image}} = 2/3$

Pixels & Aspect Ratio (2)

Are All Pixels the Same?

- Trade-off: pixel size and digital noise

A smaller pixel size allows more pixels to fit in a given size chip (field size), increasing resolution.

However as the pixel size becomes smaller, fundamental physical limits become increasingly important, placing a practical lower limit on pixel size.

Ability to capture photons changes with pixel size

More photons captured in an exposure time means lower noise.

Signal to noise ratio increases directly with an increase pixel pitch,

so larger pixels will provide higher useful ISO ratings for a digital camera.

- For detailed reading see:
- http://www.outbackphoto.com/dp_essentials/dp_essentials_02/essay.html

31

Pixels & Aspect Ratio (2)

Many Cameras offer selectable aspect ratios
-- Examples are from Canon S-100 camera

Some Common Display Resolutions
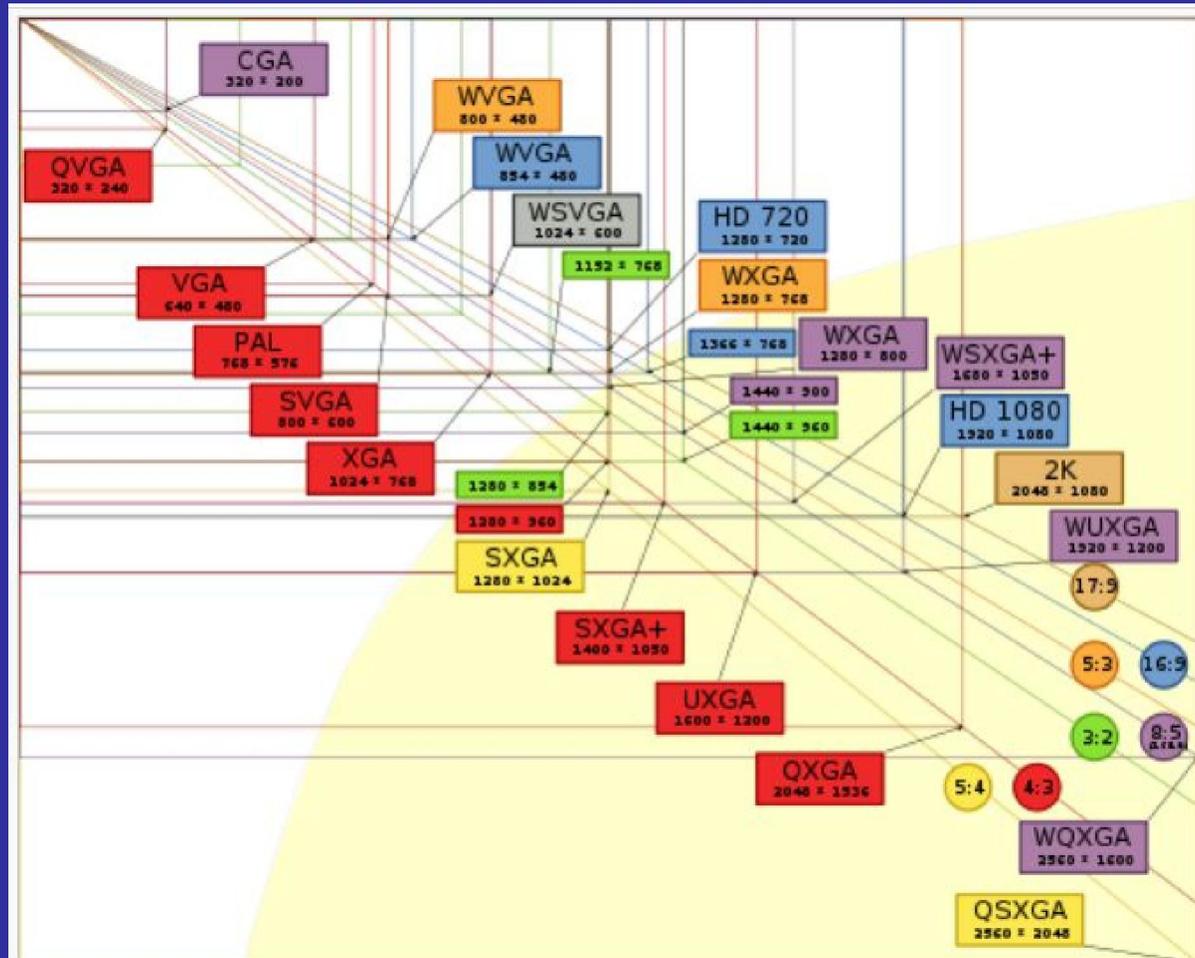
- Color of each type indicates display ratio
  - Wikipedia : http://en.wikipedia.org/wiki/Display_resolution 33

How Many Megapixels do you want / need [1]

- OK for most Computer monitors: 1024 x 768

- For WEB: 800x600 often recommended

- For digital projector:
    1024 x 768 (XGA) $
    1280 x 800 (WXGA) $$
    1400 x 1050 (SXGA+) $$$ (e.g. Hatachi CPSX 635 in TA-1)
    1920 x 1200 (WUXGA) $$$$

- Free Download program for Downsizing JPGs

http://www.irfanview.com/

Monitor pxls & usage		
Width	Height	% of Internet Users
1024	768	22.63
1366	768	15.63
1280	800	14.55
1280	1024	7.96
1440	900	6.92
1680	1050	3.75
1920	1080	3.70
1600	900	3.12
1360	768	2.65
1024	600	2.37
1152	864	1.91
1280	768	1.84
1280	720	1.66
800	600	1.44
1920	1200	1.04
2560	1600	

Source: Wikipedia

- For Printing: Depends on print size
  See following slide

➢ For Printing: It depends on print size.

Note: For purposes of this discussion we'll equate dots per inch to Pixels per inch.

Megapixels	Pixel Resolution*	Print Size @ 300ppi	Print size @ 200ppi	Print size @ 150ppi**
3	2048 x 1536	6.82" x 5.12"	10.24" x 7.68"	13.65" x 10.24"
4	2464 x 1632	8.21" x 5.44"	12.32" x 8.16"	16.42" x 10.88"
6	3008 x 2000	10.02" x 6.67"	15.04" x 10.00"	20.05" x 13.34"
8	3264 x 2448	10.88" x 8.16"	16.32" x 12.24"	21.76" x 16.32"
10	3872 x 2592	12.91" x 8.64"	19.36" x 12.96"	25.81" x 17.28"
12	4290 x 2800	14.30" x 9.34"	21.45" x 14.00"	28.60" x 18.67"
16	4920 x 3264	16.40" x 10.88"	24.60" x 16.32"	32.80" x 21.76"

Downsizing for upload

Color Management

Color Components

The Munsell color system, showing: a circle of hues at value 5 chroma 6; the neutral values from 0 to 10; and the chromas of purple-blue (5PB) at value 5.
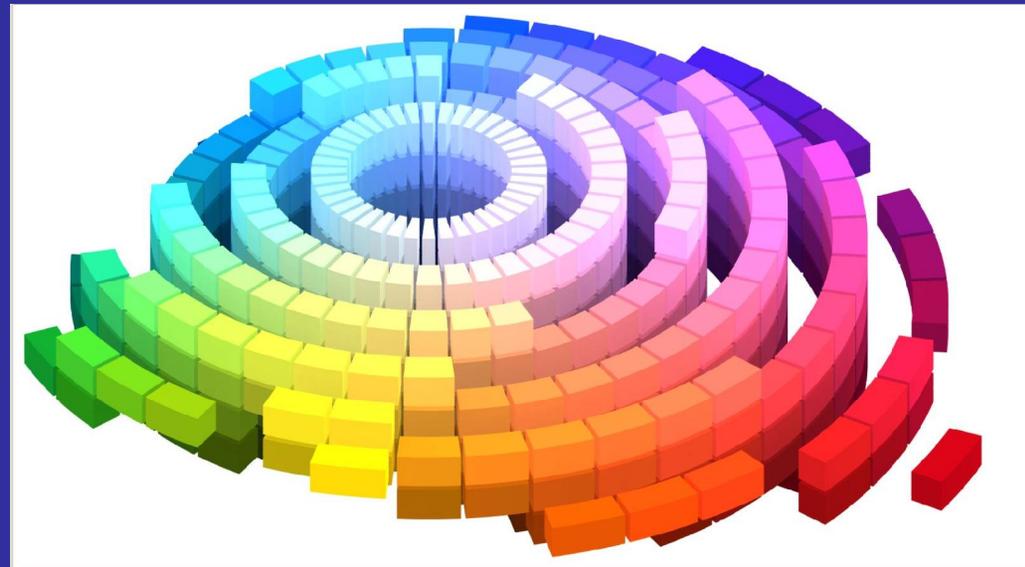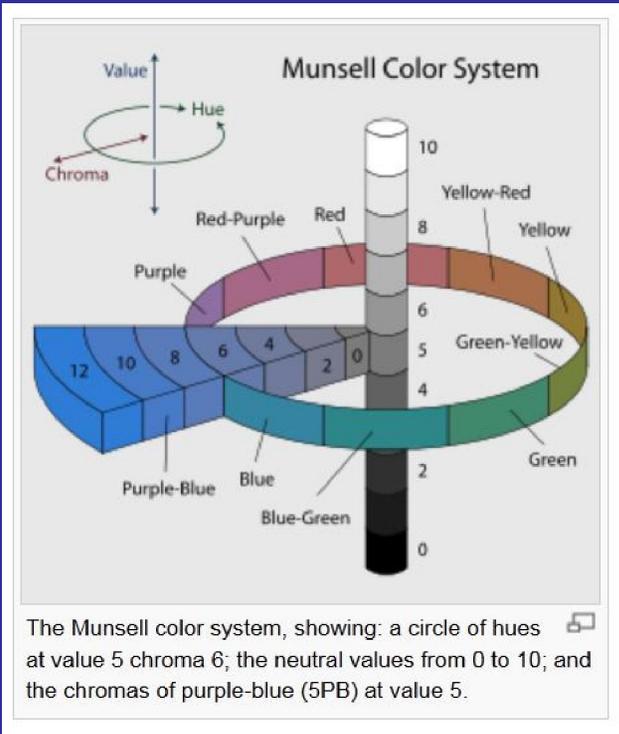
Munsell hues; value 6 / chroma 6

Color Checker Card (RGB)

81,66,52	160,138,116	94,102,134	74,86,56	118,111,154	128,168,157
164,117,48	79,75,140	143,84,80	68,51,83	144,168,74	184,155,61
59,48,126	85,123,67	122,58,46	200,188,68	142,83,123	76,108,145
241,241,241	190,190,190	145,145,145	104,104,104	67,67,67	37,37,37

Note: The illuminant will change our eye's perception of colors

Color Management

- Color Management helps reproduce colors as truthfully as possible across different devices
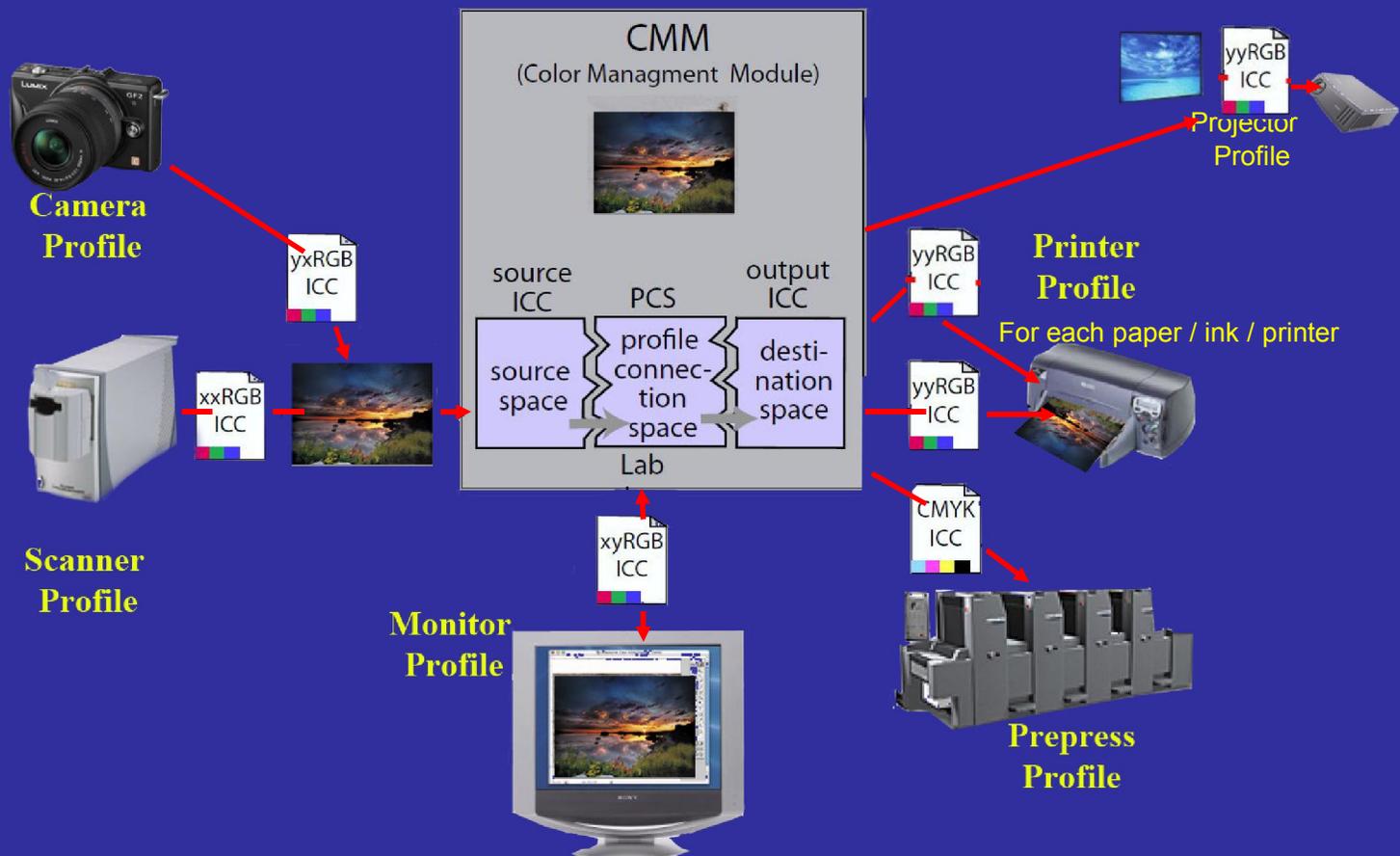
Monitor Calibration

My NEC Multisync LCD 2490 WQXI (2560 x 1600)

My NEC Multisync LCD 2490 WUXI (1920 x 1200)

41

Test Images

Printer white point & black point test ramp

© 2006 Uwe Steinmueller
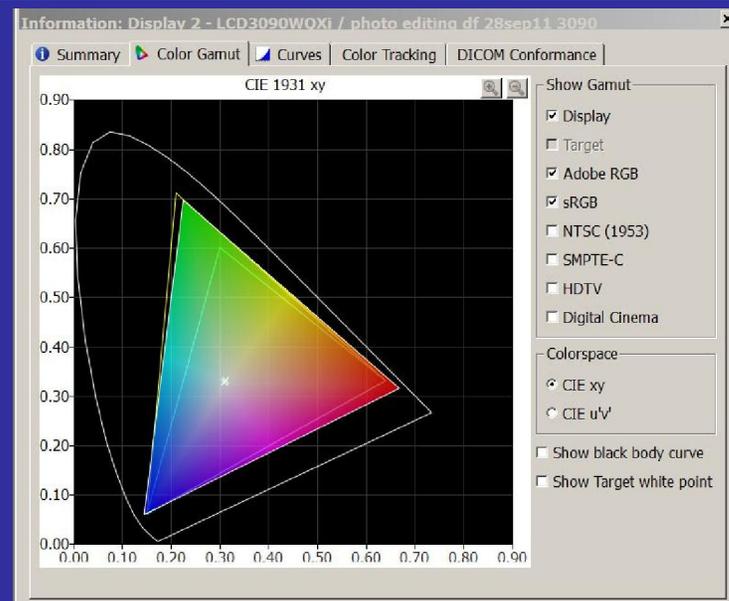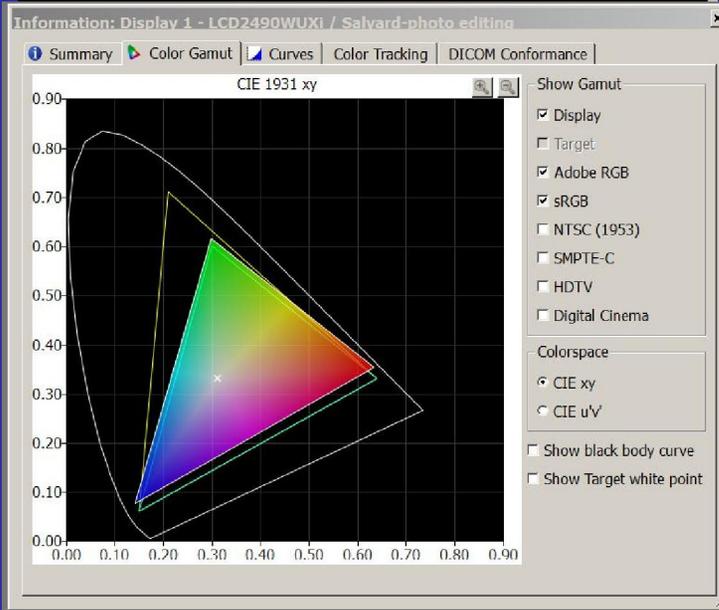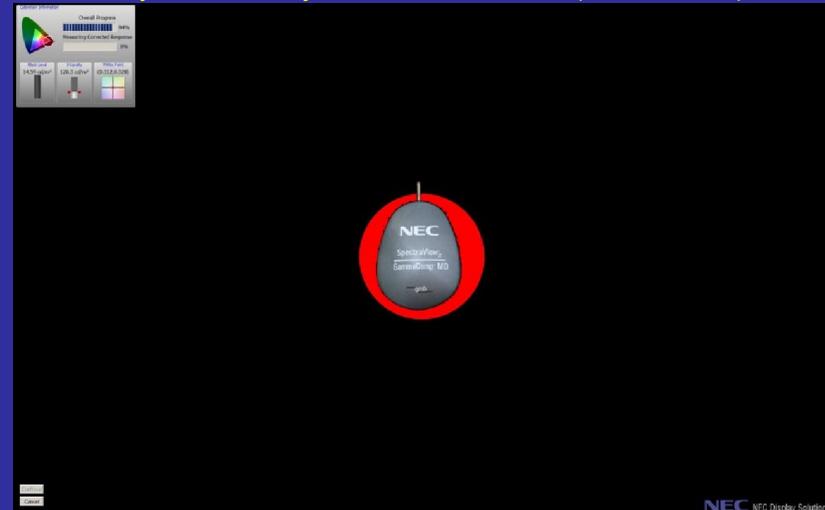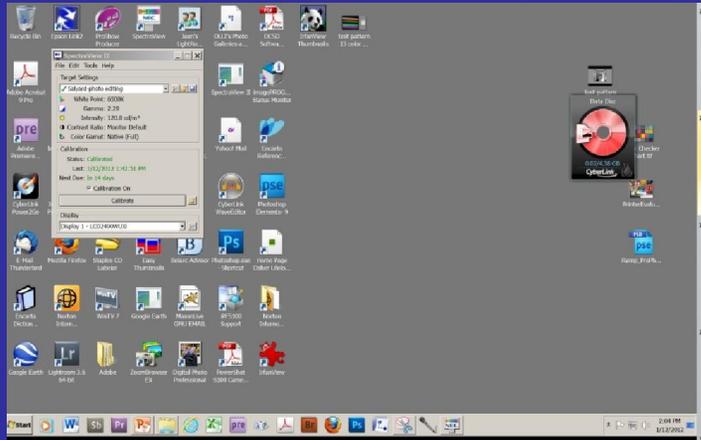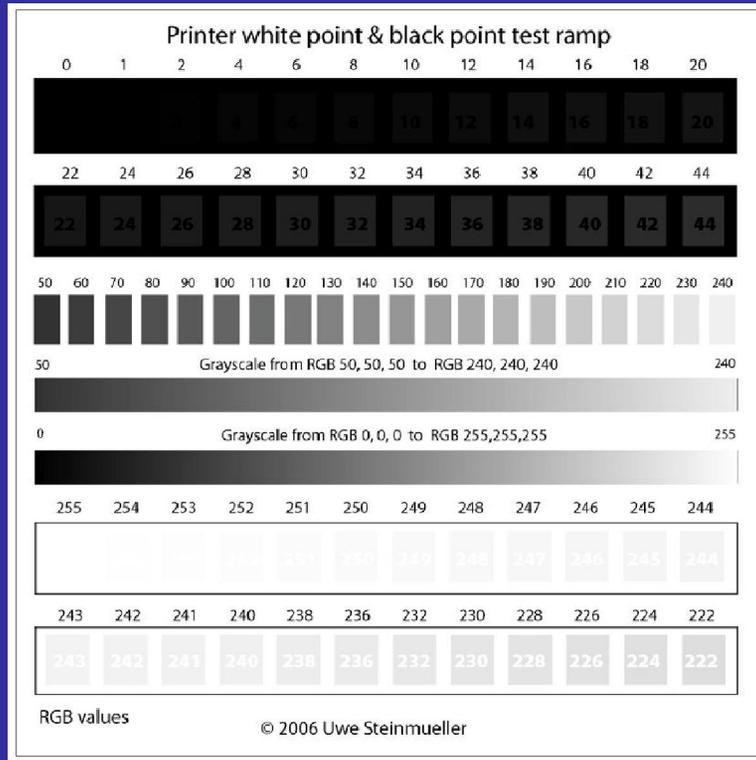
Printer Ramp used to determine how your printer prints black & white
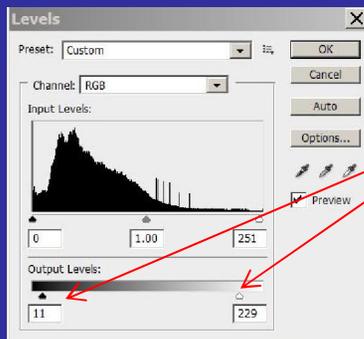
Can adjust output in
Photo Shop LEVELS control

Figure 3-27: Image for your sanity check of your monitor profile or your printer profile and printer settings (www.jirvana.com/resources/printing/bills_lab_test_image.zip, designed by Bill Atkinson)
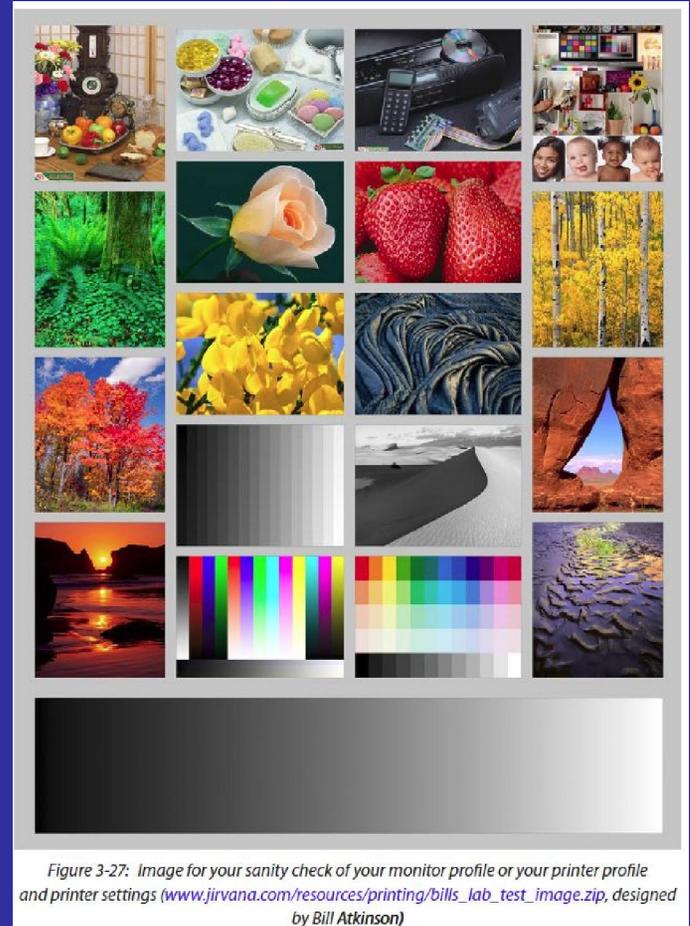
Note: Images from The Art of Digital Fine Art Printing
By Steinmueller & Gulbins

42

White Balance

White Balance (1)

Adjusting for composition of the light spectrum
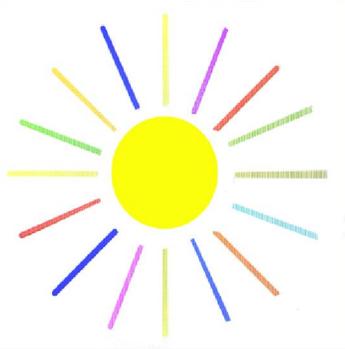
- ## Sun emits spectrum of Light (all colors)
  -- White Light (~ 5200° K)
- Spectrum partially lost in atmosphere
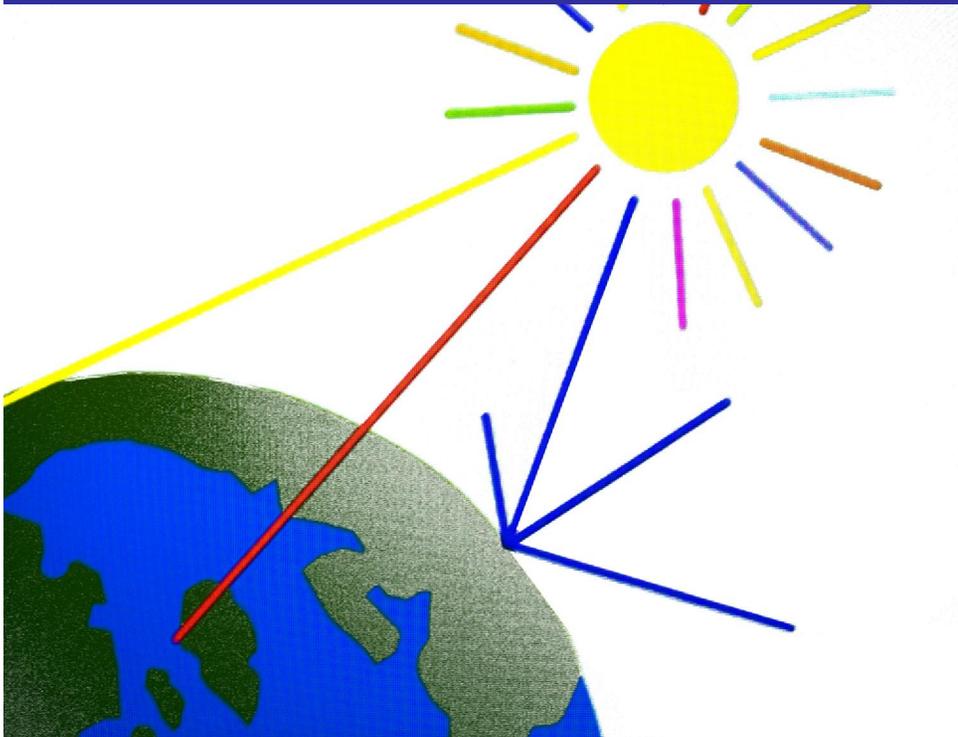
EXAMPLE

- Sun low on the horizon
- Short wavelengths scattered
- More "golden light"
  -- Color Temp is lower (~2900° K)

√ On AUTO camera may give improper adjustment

White Balance (2)

Colors the eye sees may not be what the camera records

Adjusting for composition of the light spectrum

1900 K	3200 K	5000 K	6500 K	8000 K	10,000 K
Candle ligsht	tungsten	direct sun	overcast	shade	Pt. cloudy

Increasing Color Temperature

AWB — Auto White Balance
Custom
K — Kelvin
Tungsten
Fluorescent
Daylight
Flash
Cloudy
Shade

•• With digital cameras, we adjust the White Balance
--- Either before taking the shot
--- e.g., Auto, Day Light, Shade, Cloudy, Tungsten, Fluorescent, Flash, Custom
---- Or in post-processing (Raw Images)

Note: White Balance (Blue-Amber) is just one of the two axes. The other is **tint**, from green to magenta.
-> Some cameras allow shift & bracket on both axes

45

White Balance (3)

Indoor shot under incandescent light
but camera was left on daylight setting

Indoor shot under incandescent light
with camera set for incandescent

Grain

Low vs. High ISO (1)

S-100 camera
Jpg file
ISO=100

S-100 camera
Jpg file
ISO=6400

48
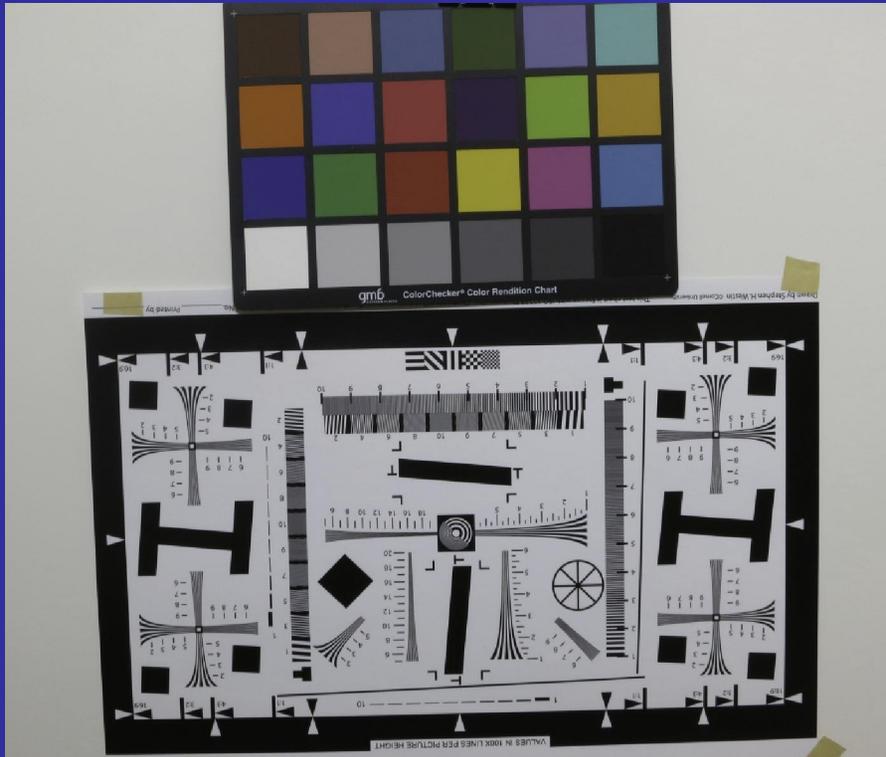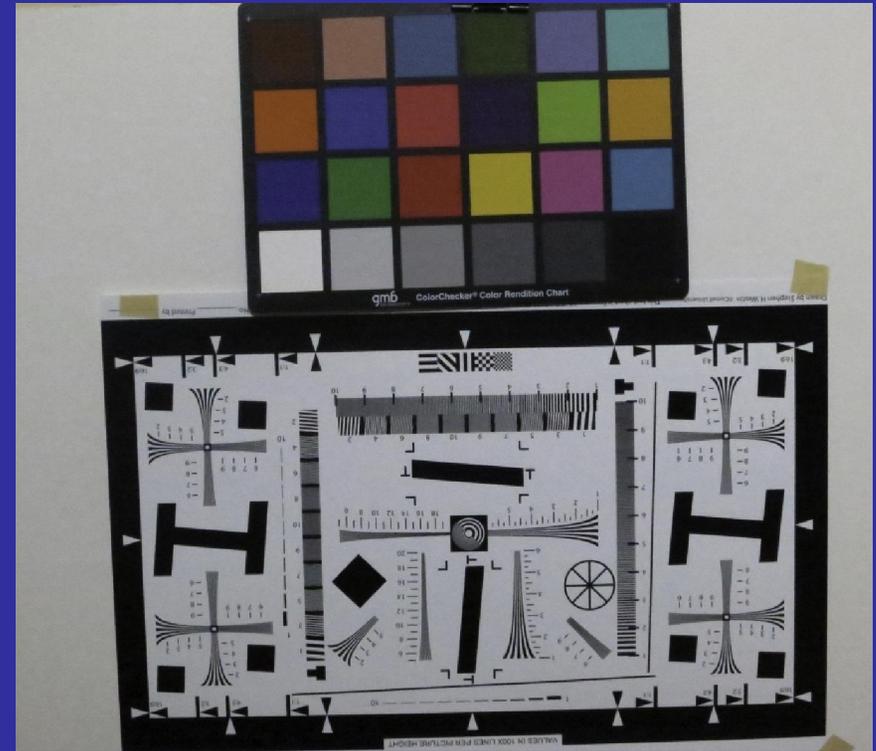
Low vs. High ISO (2a)

S-100 camera
Jpg file
ISO=100

S-100 camera
Jpg file
ISO=6400

49

Low vs. High ISO (2b)
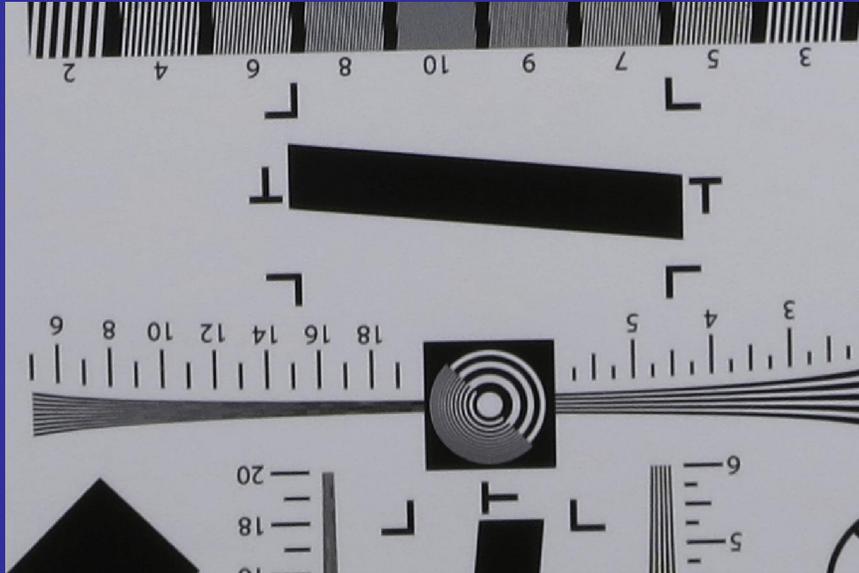
S-100 camera
Jpg file
ISO=100
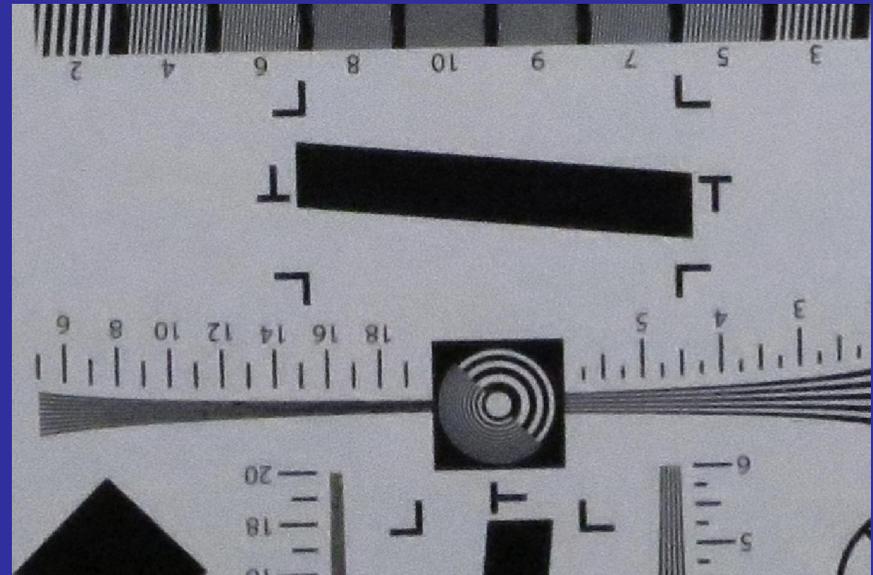
S-100 camera
Jpg file
ISO=6400

Look Closely at Noise

As Shot RAW (.CR2) File - not adjusted

ZOOM In on As Shot RAW (.CR2) File - not adjusted

Camera Adjusted (.jpg) File

Zoom In on Camera adjusted (.jpg) File

51

Lens: Focal Length,
Crop Factor, Angle of View,
& Zoom Ratio

Lens Focal Length

- Focal length -> reference point for Lens categories
  - Single focal length lenses have one focal length
    - 50mm focal length approximates to what eye sees.
  - Zoom Lenses have a range of focal lengths

- shorter focal length called wide-angle
  - -- wide angle of view

- longer focal length called telephoto
  - -- narrow angle of view

15mm

Perspective more apparent

300mm

Perspective less apparent
More compressed – tighter

3
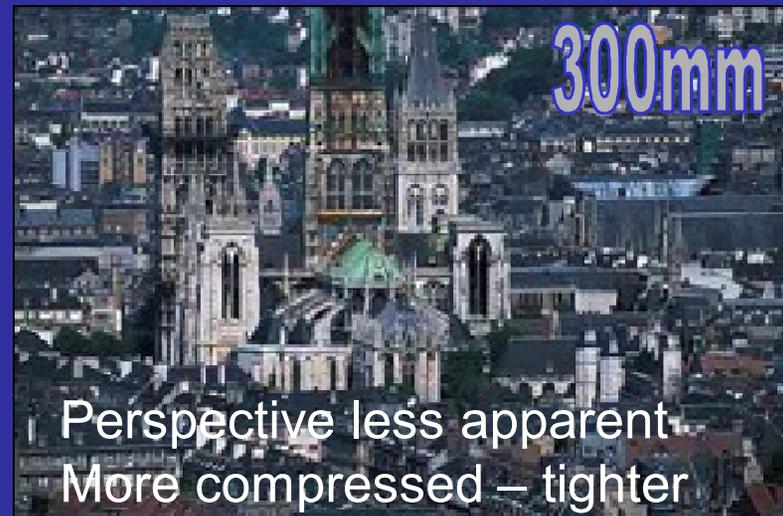
Full Frame & Crop Factor

- A Digital Single Lens Reflex (DSLR) Camera with sensor the size of a 35mm film frame (36x24mm) is called a full frame camera

  – For some DSLR cameras, the ratio of the width to height of the sensor remains 24/36 = 4x6

    – In many DSLRs you'll find that the size of the sensor is smaller than 36 x 24 mm

      - If you take a photo with a smaller sensor and the <u>same</u> lens it will only show a smaller area of the scene.

        – The difference is called the camera's "Crop Factor"

SLR Crop Factor

Cropped capture area has a reduced Field of View (angle), creating what is often called a "Multiplier Effect"

	1.3x	1.5x	1.6x	2.0x
10mm	13mm	15mm	16mm	20mm
17mm	22.1mm	25.5mm	27.2mm	34mm
28mm	36.4mm	42mm	44.8mm	56mm
35mm	45.5mm	52.5mm	56mm	70mm
50mm	65mm	75mm	80mm	100mm
105mm	136.5mm	157.5mm	168mm	210mm
135mm	175.5mm	202.5mm	216mm	270mm
200mm	260mm	300mm	320mm	400mm
400mm	520mm	600mm	640mm	800mm
600mm	780mm	900mm	960mm	1200mm

Example: If the sensor is half the size, the same lens will seem to give twice the magnification

23.7 x 15.6 mm sensor
(Typical Nikon DX DSLR)

22.5 x 15 mm sensor
(Typical Canon DX DSLR)

18 x 13.5 mm sensor
(Typical Olympus DSLR)

13.85 x 9.25 mm sensor
(Kodak DCS 315)

36 x 24 mm sensor
Full Frame (FX) Camera
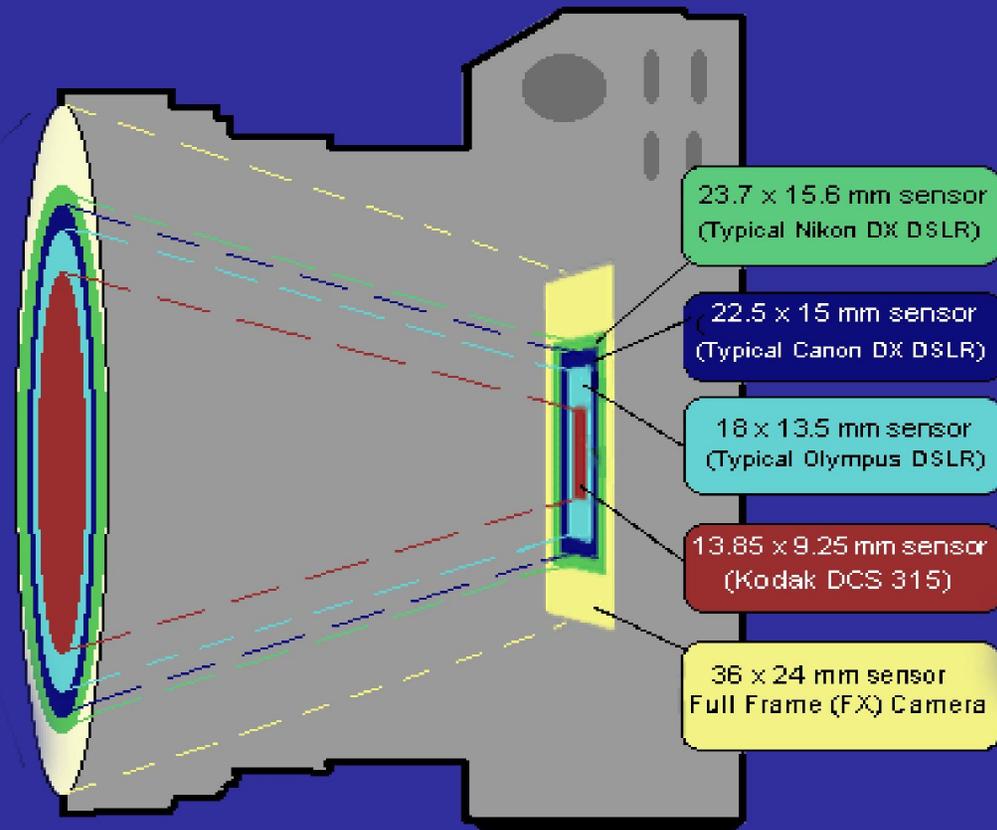
Angle of View Example (1)

Angle of View varies with sensor size

Example: A 50mm lens fitted to our D5 camera (full frame) acts like a 80 mm lens when used on our 40D camera that has a smaller chip -- resulting in a 1.6 crop factor

50mm lens acts like 80mm (50 + (.6 x 50)) = 80
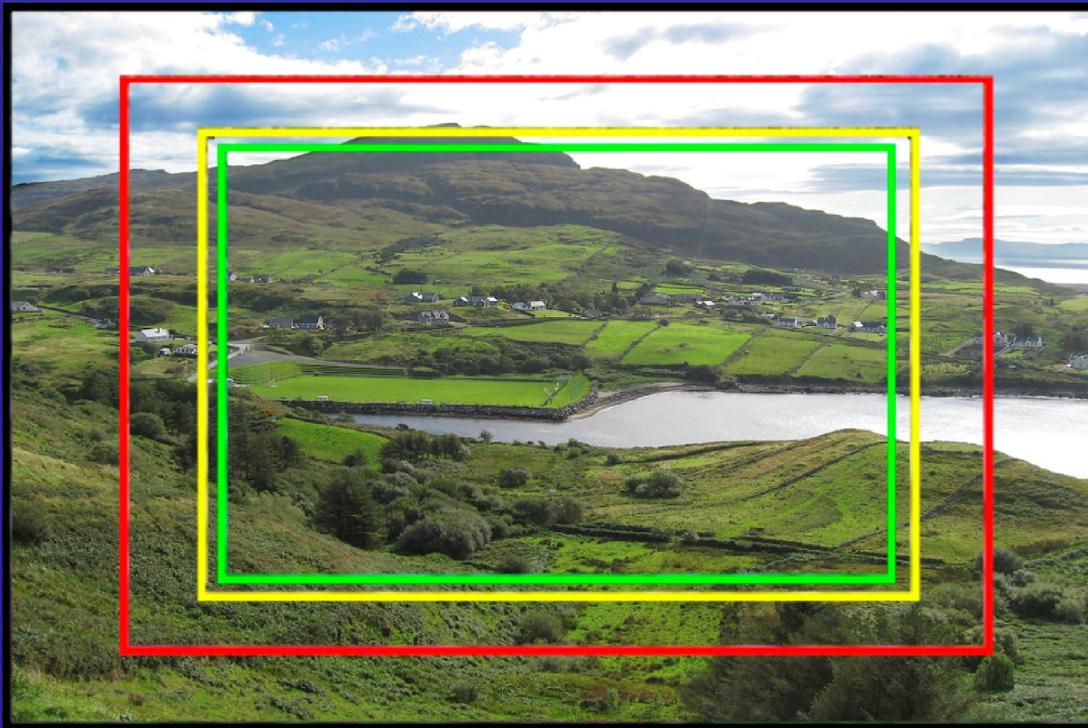
Helps Some Shots

Canon D1-series=1.3,   Nikon DX= 1.5,   Canon Consumer Series 1.6

Angle of View Example (2)

Angle of View varies with sensor size

Example: A 50mm lens fitted to our D5 camera (full frame) acts like a 80 mm lens when used on our 40D camera that has a smaller chip -- resulting in a 1.6 crop factor

50mm lens acts like 80mm (50 + (.6 x 50)) = 80

Canon D1-series=1.3,   Nikon DX= 1.5,   Canon Consumer Series 1.6

57

Zoom Ratio

Zoom ratio is simply the longest focal length divided by the shortest
It says nothing about picture quality

- ## Nikon Coolpix 8200 ($329.00)
  - http://www.bhphotovideo.com/c/product/818665-REG/Nikon_26288_COOLPIX_S8200_Digital_Camera.html

    - ### focal length ranges from 25-350mm* (14x)

- ## Canon Powershot SX 230 HS ($189.00)
  - http://www.bhphotovideo.com/c/product/753782-REG/Canon_5043B001_Powershot_SX230_HS_Digital.html

    - ### Focal Length range 28-392mm* (14x)

- ## Canon Powershot A1200 ($84.00)
  - http://www.bhphotovideo.com/c/product/750177-REG/Canon_Powershot_A1200_Digital_Camera.html

    - ### focal Length 28 - 112mm*. (4x)

*
Focal Length is 35mm equivalent

58

Examine Lens Focus (1)

- Tape paper to a wall - try different lens / settings

- ## Shoot the newspaper

- 28-75mm zoom lens at 50mm, F2.8 1/400sec
- Note: Most lenses are sharpest around F8 (mid Range)

Dan Feighery

Examine Lens Focus (2)

- If you have several lenses redo for each

Canon 180mm f2.8 Macro

Leica 35mm f2 Summicron M

Dan Feighery

Examine Lens Focus (3)

- Series of shots changing aperture between shots
  - Lens is Not equally sharp at all focal points

Exposure Triangle
Aperture, Shutter Speed, Chip Sensitivity

Definitions

- **<u>Aperture</u>** - circular hole in the front of the camera lens which controls the amount of light allowed to pass on to the sensor.
  - Aperture settings are given as F-stops
    - Example f2.8, f4.5, f5.6, f8, f11, f16, f22, f32

- **<u>Shutter Speed</u>**: The action of the shutter that controls the duration of an exposure. The faster the speed the shorter the time the sensor is exposed to light.
  - Shutter speed settings are given in seconds or fraction of a second
    - Example 15"=15sec "3=0.3 sec, 20=1/20sec. 60=1/60 sec. 1/125 sec.

- <u>ISO setting</u>: A measure of the sensor sensitivity to light. Higher ISO settings amplify the signal making the sensor seem more sensitive to lower light leveles
  - But higher ISOs may result in lower quality photos.
    - More Grain

Light Gathering of Aperture

Typical Maximum Apertures	Relative Light-Gathering Ability	Typical Lens Types
f/1.0	32X	Fastest Available Prime Lenses (for Consumer Use)
f/1.4	16X	Fast Prime Lenses
f/2.0	8X	
f/2.8	4X	Fastest Zoom Lenses (for Constant Aperture)
f/4.0	2X	Light Weight Zoom Lenses or Extreme Telephoto Primes
f/5.6	1X	

How Much Light *(Volume)*

How Much Light (Volume) passes through lens

- Determined by the size of the opening

  - **F stop**

f/1.4   f/2   f/2.8   f/4   f/5.6   f/8
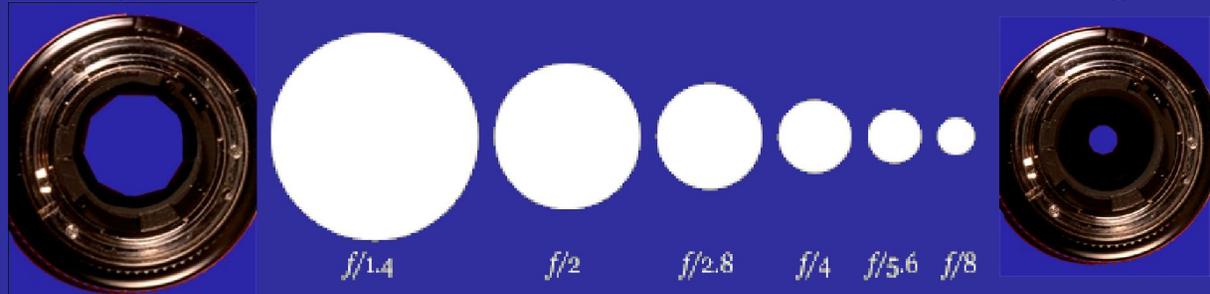
Standard full stop numbers = **F # 1.0, 1.4 2, 2.8, 4, 5.6, 8, 11, 16, 22, 32, 45, 64,**

Many cameras also give ½ or 1/3 stop increments

F Stop Dtermines Depth Of Field

Adjusting ISO

Exposure Triangle (1)

Shutter Speed

F Stop

1/30
Longer Exposure (More Light)
1/60

1/125

1/250

1/500
Shorter Exposure (Less Light)
1/1000

Adjusting for light Intensity

F 2.8
Larger Opening (More Light)
F 4

F 5.6

F 8

F 16
Smaller Opening (Less Light)
F22

3200 2400 1600 1200 800 ISO 600 400 300 200 150 100

Chip Sensitivity / amplification
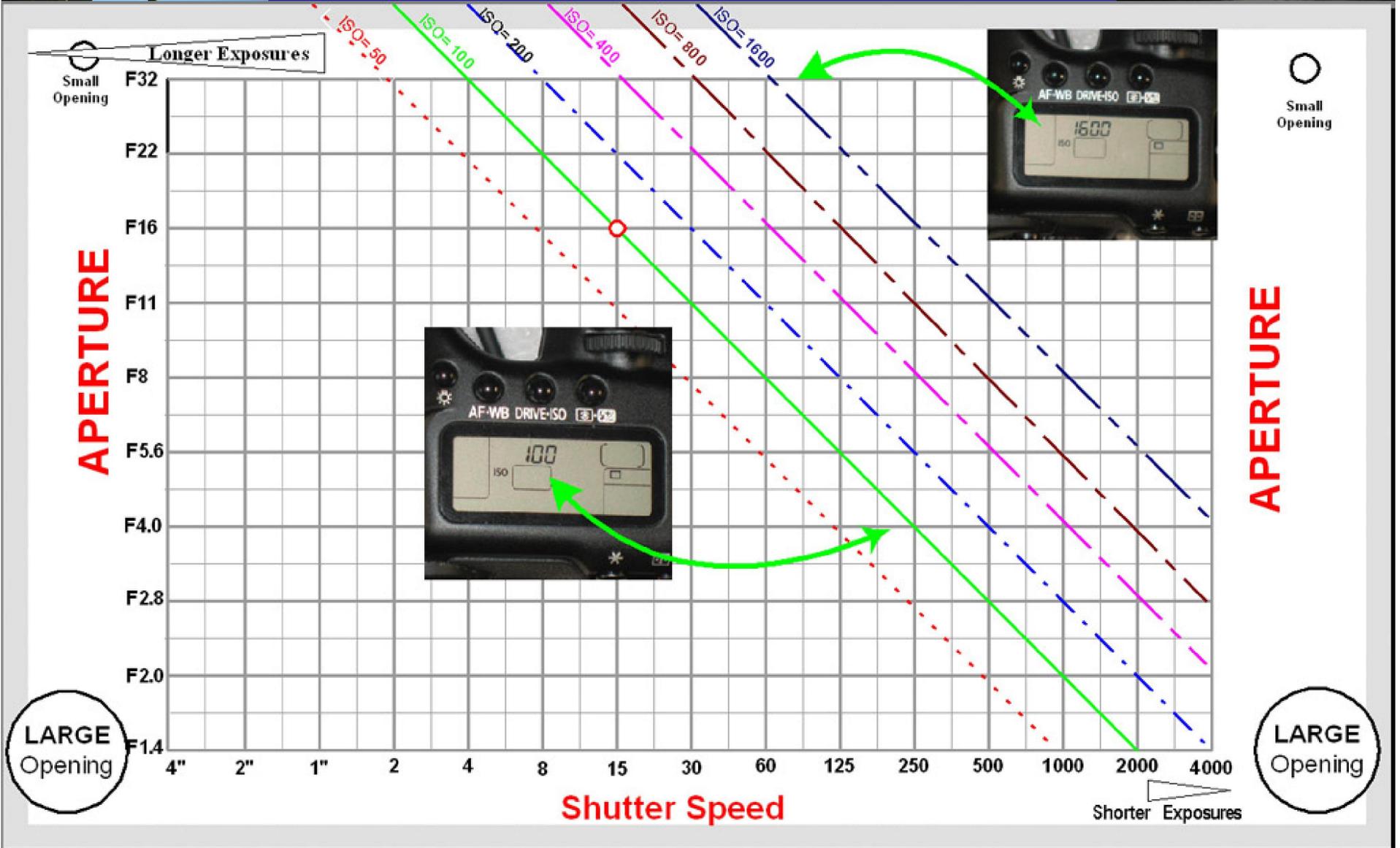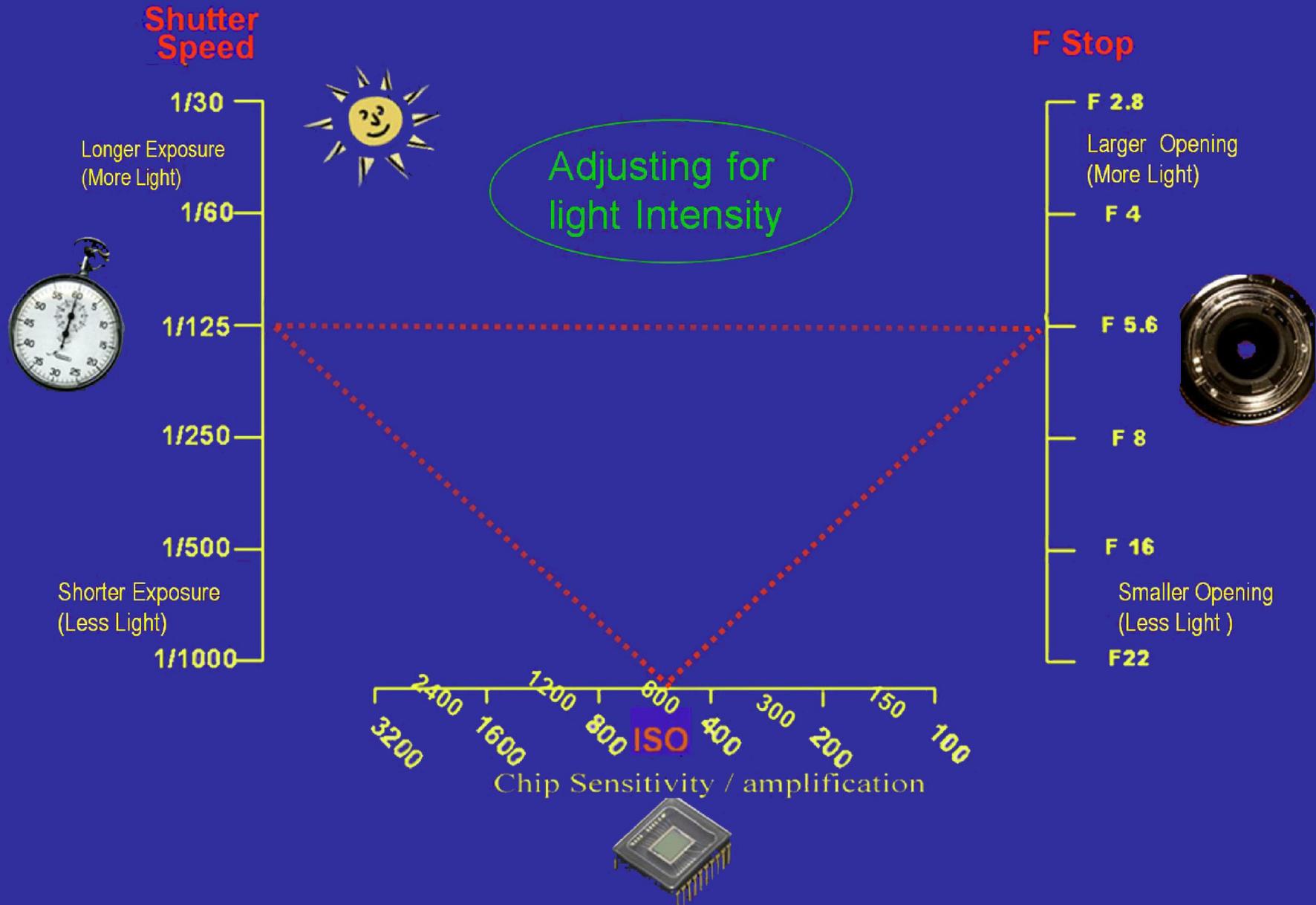
Exposure Triangle (2)
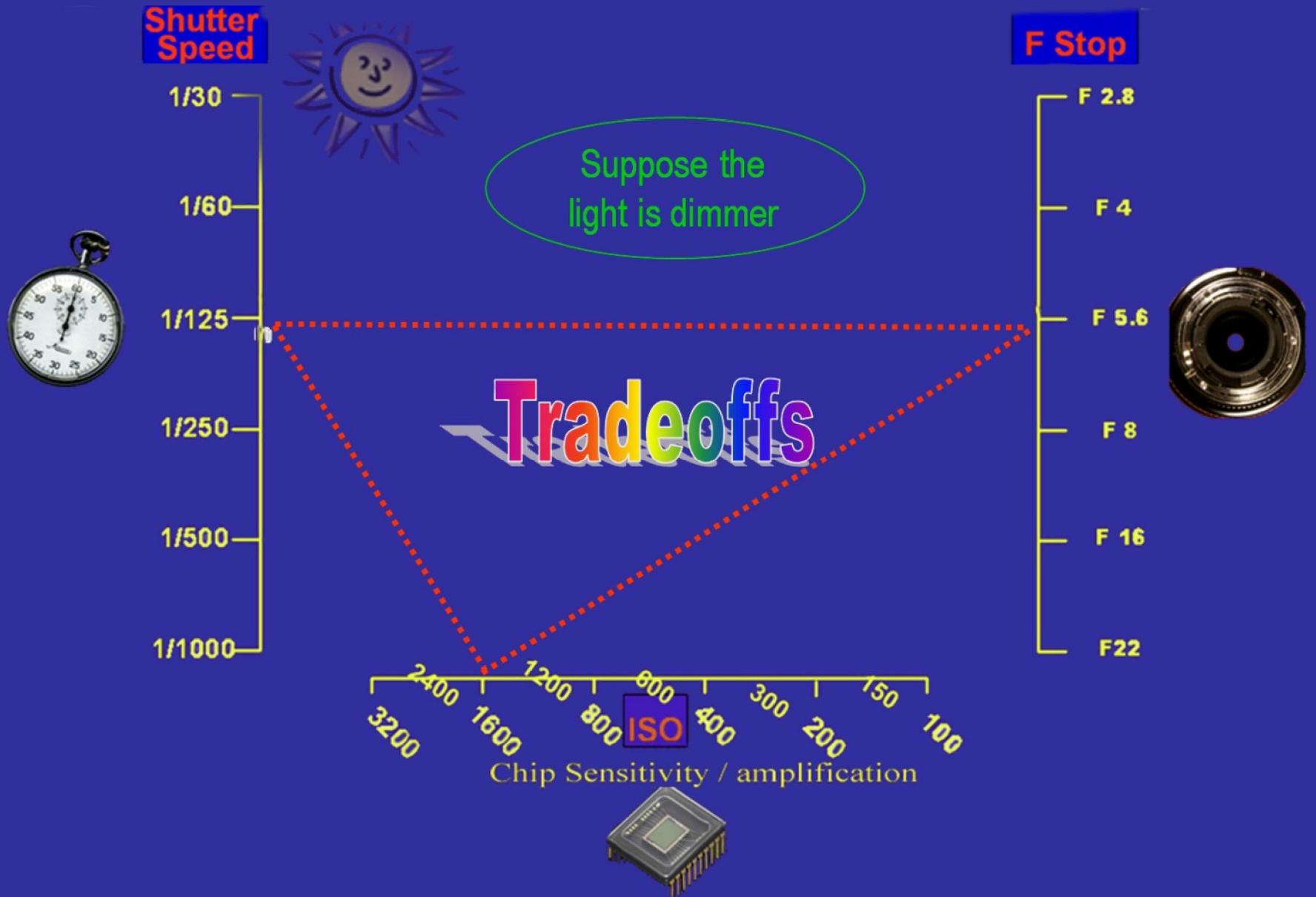
Depth of Field

Depth of Field: The distance between the nearest point and the farthest point in the subject which is perceived as acceptably sharp.

What is Depth of Field (DoF)

Camera sensor to Subject Distance Focus lens at 20 Ft

Perfect Focus here
Only a single plane in perfect focus

Aperture **F** 2.8

50mm Lens

Lens Opening
is referred to as **F Stop**
√ Small **number**
√ **Large** Opening
√ **Narrow in-focus depth**

Total
Depth of Field
8.6ft

Near
Focus good enough
16.6ft

Far
Focus good enough
25.2.ft

Diagram not to exact scale

Dan Feighery

http://www.dofmaster.com/dofjs.html
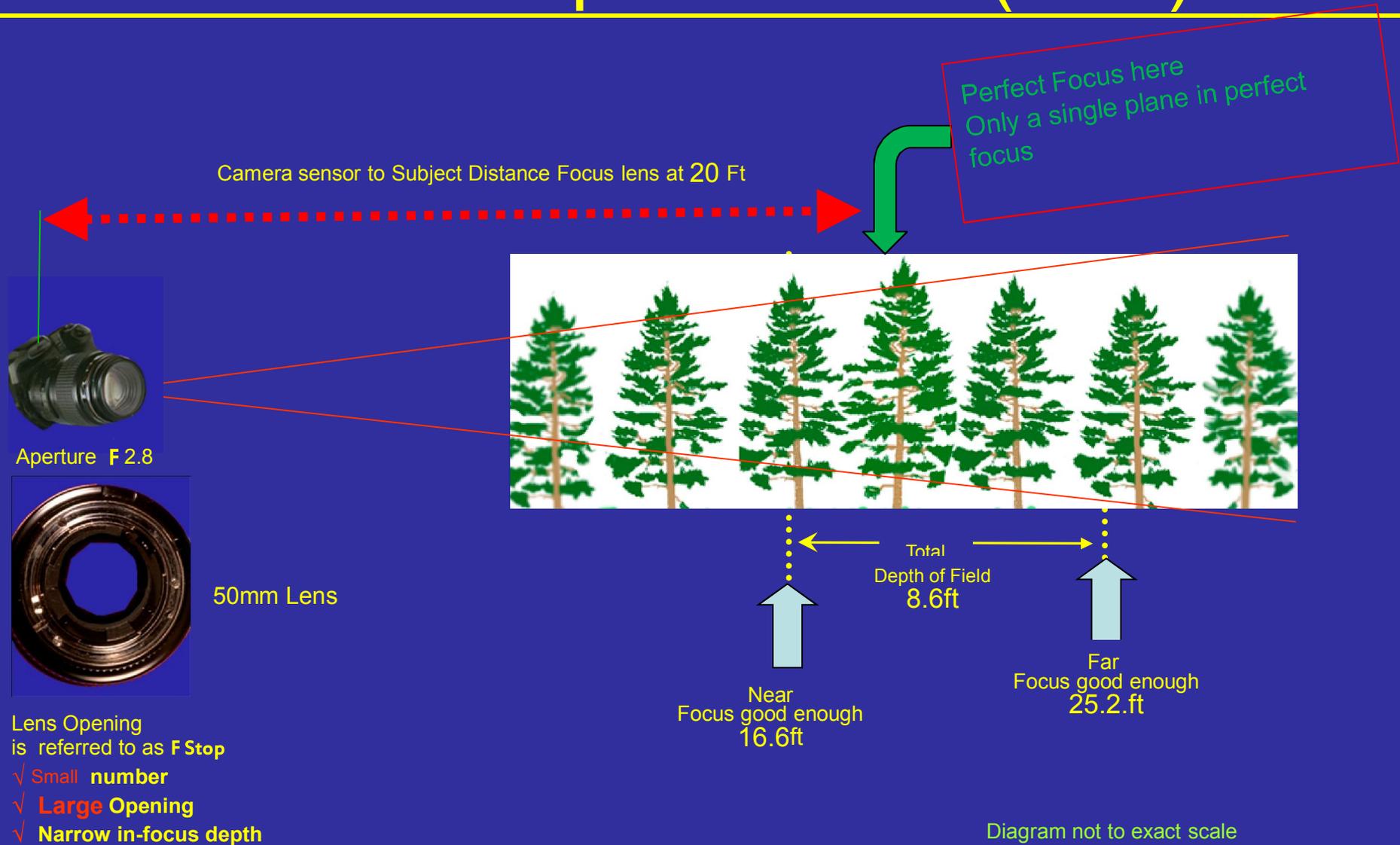
Changing Depth of Field

Lens Focal Length : 70mm
Aperture F32
Far Focus: 54.79Ft
Near Focus: 6.64ft.

Changing Depth of Field

Lens Focal Length : 70mm
Aperture F2.8
Far Focus: 12.88 ft.
Near Focus: 11.23 ft

Factors Affecting Depth of Field (DoF)

- ## Size of Image Sensor
  - Small P&S cameras typically give large DoF

- ## Closeness to subject
  - Moving closer to subject provides for less DoF

- ## Focal Length of Lens
  - Long Telephoto lens provide for less DoF
  - Wide Angle Lens result in More DoF

- ## Size of the Aperture
  - Higher number yields more DoF

73

An Advantage of Adjustable Camera

Camera, film format, or circle of confusion

Canon PowerShot S95

Focal length (mm)   5.2
Selected f-stop   f/2
Subject distance   120   inches

[Calculate]

Subject distance   120 in

Depth of field
Near limit   51.1 in
Far limit   Infinity
Total   Infinite

In front of subject   68.9 in
Behind subject   Infinite

Compact Camera (Small lens)
tend to keep large Depth of Field

Camera, film format, or circle of confusion

Canon 5D (Mark II)

Focal length (mm)   50
Selected f-stop   f/2
Subject distance   120   inches

Calculate

Subject distance   120 in

Depth of field
Near limit   111.9 in
Far limit   129.3 in
Total   17.4 in

In front of subject   8.1 in (46%)
Behind subject   9.3 in (54%)

Digital SLR (with interchangeable lens)
Allow for selective Depth of Field Control

Depth of Field Examples

F stop	Distance to subject	Close in focus	Far in Focus	Interval
F8	10 "	6.94"	17.9 "	11"
F5.6	10 "	7.62"	14.5"	6.92"
F4	10 "	8.19"	12.8"	4.64"
F2.8	10 "	8.65"	11.2"	3.2"
F2	10 "	9.1"	11.2"	2.4"

On Line Depth of Field Calculator :   http://www.dofmaster.com/dofjs.html

75

Homework Assignment

- **READ YOUR CAMERA MANUAL**
  With your camera in hand
  - There may be a "Magic Lantern Guide" and / or Video Disc for your camera. If so, consider them.

Camera Modes
- FULL AUTO ( )
- Aperture Priority (AV)
- Shutter Priority (TV)
-Manual
-Basic (depend on camera)
    -Landscape, Portrait,
    -Sports, Macro, Night
    -Beach, Snow, etc

http://www.youtube.com/watch?v=t9FO0ZeiaMg&feature=youtu.be&cmp=February_12_news&link=image

Discussion