

Exposure



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Enhanced
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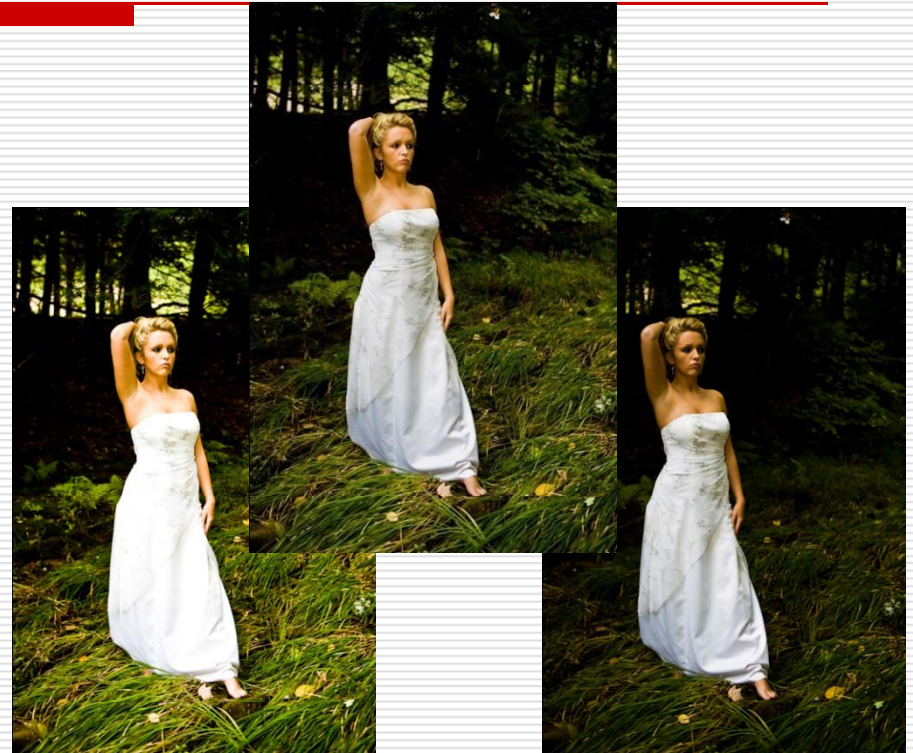
Images

Digital Photography Exposure

- Exposure
- Sensor Sensitivity - ISO
- Aperture
- Shutter Speed
- Exposure all over again
- Shooting Modes
- Exposure Meters
- Metering Modes
- Histograms

Quantity of Light

- ❑ Quantity of light is an absolute. It can be measured by your camera very accurately
- ❑ Quantity of light is called **Exposure**
- ❑ Exposure can be controlled either Automatically in your camera or Manually.
- ❑ **Accurate Exposure** makes the difference between a good photograph and a bad photograph

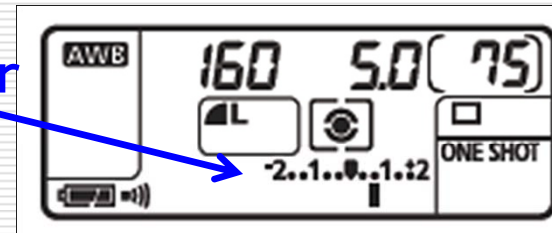


Exposure Meter

- ❑ In order to set exposure accurately photographers carried exposure meters with them to measure the light.
- ❑ Modern cameras now have exposure meters built into them.
- ❑ Cameras use these exposure meters to accurately set exposure regardless of what mode the camera is in – Auto, Program, Aperture Priority, Shutter Priority, or Manual
- ❑ Understanding the use of this meter is essential to getting good exposure in your images



Meter



Viewfinder



Under
exposed

Exposure

- Quantity of Light or Exposure is controlled by three factors:

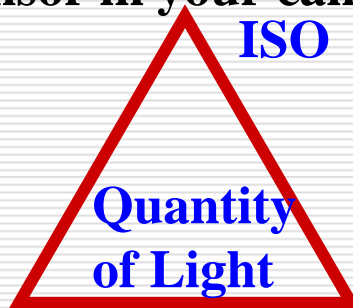
How sensitive to light is the sensor in your camera?

ISO



How fast does the shutter in your camera open and close?

Shutter Speed



Aperture or f/stop

How wide is the lens opening in your camera?



Accurate Exposure can be achieved by more than one selection of these three controls

ISO — Sensor Sensitivity

- ❑ ISO is the sensitivity of your camera sensor to light
- ❑ Higher Values are more sensitive, i.e. 100, 200, 400, 800, 1600
- ❑ Why should you care?
 - High ISO lets you take photos in low light situations
 - Because of interaction between sensor pixels, more sensitivity generates noise of two kinds:
 - ❑ Luminance – Black & White noise
 - ❑ Chrominance – Color noise
- ❑ Noise shows up at high magnifications typically in the shadow areas of your image
- ❑ Larger sensors have less noise
- ❑ Noise can be reduced in post processing

f/2.8
24 mm
1/100
ISO1600



f/5.6
400 mm
1/250
ISO1600



f/2.8
57 mm
1/125
ISO1600



Aperture Value

- Size of opening through which light passes to the sensor
- Opened up to let in more light or closed (stopped down) to let in less.
- Aperture opening diameter is equal to focal length divided by f/#.
 - f/stop is a fraction = 50 mm Lens length/ 25 mm lens opening = f/2
 - f/stop is a fraction = 200 mm Lens length/ 50 mm lens opening = f/4
- Standard f/stop scale corresponds to the sequence of the powers of the square root of 2 which is approximately 1.4
 - Standard f/stop numbers are:
 - 1, 1.4, 2.0, 2.8, 4.0, 5.6, 8.0, 11, 16, 22, 32
 - Each whole f/stop increase halves the light passing through the opening; each decrease doubles the amount of light



Aperture Value

- ❑ These are standard f/stop numbers – 1.4, 2, 2.8, etc.
- ❑ You should memorize them
- ❑ Some cameras allow for half stops; some allow for third stops. You probably don't need to know these.
- ❑ Why should you care?
 - Aperture is a major control for Depth of Field
 - Aperture allows for blurring background



f/5.6
300mm
1/2000
ISO400

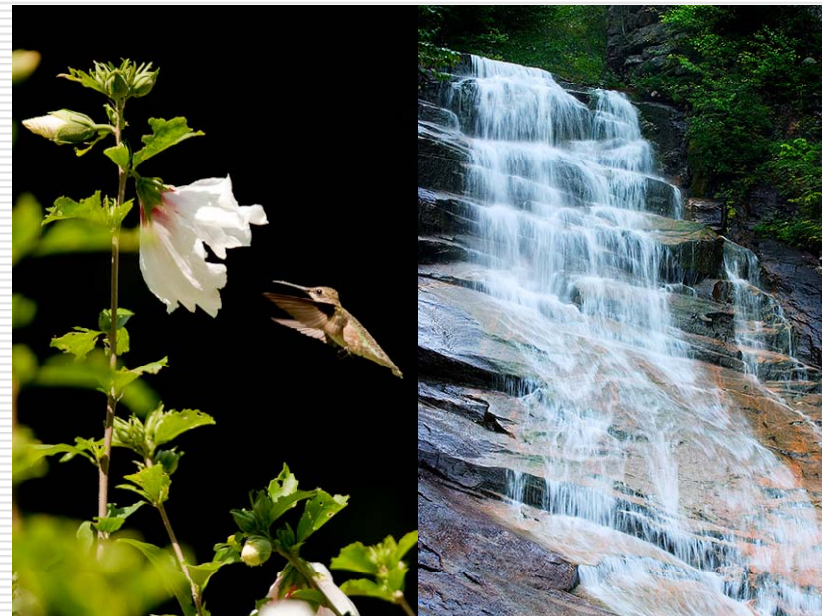


f/3.5
100mm
1/2000
ISO640

	<u>One Stop</u>	<u>1/3 Stop</u>	<u>1/2 Stop</u>
f/16		f/14 f/13	f/13
f/11		f/10 f/9.0	f/9.5
f/8		f/7.1 f/6.3	f/6.7
f/5.6		f/5.0 f/4.5	f/4.5
f/4		f/3.5 f/3.2	f/3.5
f/2.8		f/2.6 f/2.2	f/2.5
f/2		f/1.8 f/1.6	f/1.7
f/1.4			

Shutter Speed

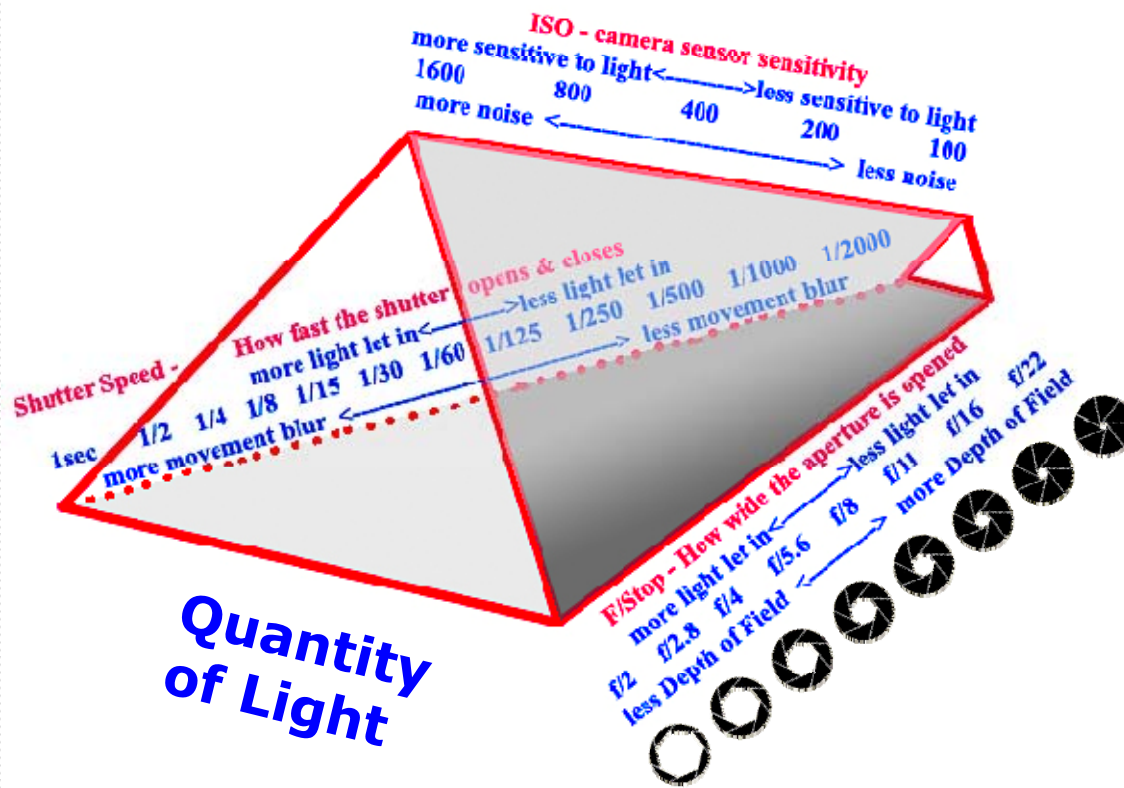
- ❑ Defines how long the shutter stays open
- ❑ Measured in Seconds or fractions of seconds – 1/60, 1/125, 1/250, 1/500
- ❑ 1/125 is half the light of 1/60; 1/250 is half the light of 1/125, etc.
- ❑ Why should you care?
 - Fast shutter speeds can stop action, i.e., hummingbird in flight
 - Slow shutter speeds cause blur in your photos, e.g. blurring a waterfall so that water appears to be flowing rather than still
- ❑ To avoid blur with telephoto lenses, shutter speed should be greater than the focal length of the lens, e.g. 300 mm requires $> 1/300$ sec.



1/2000 sec
f/5.6
ISO 800

1/10 sec
f/13
ISO 100

Exposure



Each Step in this diagram represents “One Stop”.
Most cameras allow for $\frac{1}{2}$ or $\frac{1}{3}$ stop increments

- Quantity of Light or Exposure is controlled by three factors:
 - ISO** - How sensitive to light is the sensor in your camera? Higher ISO creates more noise in your photo
 - Aperture or f/stop** - How wide is the lens opening in your camera? Higher f/stops yield increased Depth of Field
 - Shutter Speed** - How fast does the shutter in your camera open and close. Slow Shutter Speeds cause movement blur in your photos. Fast shutter speed stops action.

Exposure Value

EXPOSURE FACTOR RELATIONSHIP CHART B ©1995-2008 Fred Parker

EV	TYPE OF LIGHTING SITUATION
0	Subjects lit by dim ambient artificial light.
1	Distant view of lighted skyline.
2	Lightning (with time exposure). Total eclipse of moon.
3	Fireworks (with time exposure).
4	Candle lit close-ups. Christmas lights, floodlit buildings, fountains, and monuments. Subjects under bright street lamps.
5	Night home interiors, average light. School or church auditoriums. Subjects lit by campfires or bonfires.
6	Brightly lit home interiors at night. Fairs, amusement parks.
7	Bottom of rainforest canopy. Brightly lighted nighttime streets. Indoor sports. Stage shows, circuses.
8	Las Vegas or Times Square at night. Store windows. Campfires, bonfires, burning buildings. Ice shows, football, baseball etc. at night. Interiors with bright florescent lights.
9	Landscapes, city skylines 10 minutes after sunset. Neon lights, spotlighted subjects.
10	Landscapes and skylines immediately after sunset. Crescent moon (long lens).
11	Sunsets. Subjects in open shade.
12	Half moon (long lens). Subject in heavy overcast.
13	Gibbous moon (long lens). Subjects in cloudy-bright light (no shadows).
14	Full moon (long lens). Subjects in weak, hazy sun.
15	Subjects in bright or hazy sun (Sunny f/16 rule).
16	Subjects in bright daylight on sand or snow.

This is probably a chart you won't carry around with you, however, it may help you out in planning shoots, e.g. preliminary settings for a fireworks shoot.

Exposure Value chart

ISO

f/stop

Exposure Value	ISO 100	ISO 200	ISO 400	f/4	f/5.6	f/8	f/11	f/16	Shutter Speed
	0	-1	-2	15 sec	30 sec	1 min	2 min	4 min	
	1	0	-1	8 sec	15 sec	30 sec	1 min	2 min	
	2	1	0	4 sec	8 sec	15 sec	30 sec	1 min	
	3	2	1	2 sec	4 sec	8 sec	15 sec	30 sec	
	4	3	2	1 sec	2 sec	4 sec	8 sec	15 sec	
	5	4	3	1/2 sec	1 sec	2 sec	4 sec	8 sec	
	6	5	4	1/4 sec	1/2 sec	1 sec	2 sec	4 sec	
	7	6	5	1/8 sec	1/4 sec	1/2 sec	1 sec	2 sec	
	8	7	6	1/15 sec	1/8 sec	1/4 sec	1/2 sec	1 sec	
	9	8	7	1/30 sec	1/15 sec	1/8 sec	1/4 sec	1/2 sec	
	10	9	8	1/60 sec	1/30 sec	1/15 sec	1/8 sec	1/4 sec	
	11	10	9	1/125 sec	1/60 sec	1/30 sec	1/15 sec	1/8 sec	
	12	11	10	1/250 sec	1/125 sec	1/60 sec	1/30 sec	1/15 sec	
	13	12	11	1/500 sec	1/250 sec	1/125 sec	1/60 sec	1/30 sec	
	14	13	12	1/1000 sec	1/500 sec	1/250 sec	1/125 sec	1/60 sec	
	15	14	13	1/2000 sec	1/1000 sec	1/500 sec	1/250 sec	1/125 sec	
	16	15	14	1/4000 sec	1/2000 sec	1/1000 sec	1/500 sec	1/250 sec	
	17	16	15	1/8000 sec	1/4000 sec	1/2000 sec	1/1000 sec	1/500 sec	
	18	17	16		1/8000 sec	1/4000 sec	1/2000 sec	1/1000 sec	
19	18	17			1/8000 sec	1/4000 sec	1/2000 sec		
20	19	18				1/8000 sec	1/4000 sec		

EXPOSURE FACTOR RELATIONSHIP CHART B ©1995-2008 Fred Parker

<http://www.fredparker.com/ultexp1.htm#EV>

Shooting - Auto Mode

- All P&S Cameras have Auto Mode that sets focus & Exposure Automatically. User has no control. Select Auto Mode on your camera.

- ❑ Hold Camera as if you were a tripod – minimize camera shake
- ❑ **Frame** the Image – **Compose** in view finder
- ❑ **Zoom** the Lens – Zoom in and out to bring subject closer or further away
- ❑ Auto-**focus** – press **shutter button halfway** down
 - Are you too close?
 - Is it too dark to focus
- ❑ Auto-**exposure** – Camera adjusts aperture & shutter for correct amount of light onto the sensor
- ❑ Auto-**flash** – Flash will automatically fire in low light situations. What is the indication that Flash will fire? Red Eye Reduction?
- ❑ Auto-**White balance** – adjusts for color of light, e.g. sunny day, cloudy day, florescent lamp, tungsten lamp
- ❑ Press **shutter button fully down** to take photo

Shooting - Program Mode

- ❑ For Point & Shoot Cameras, this is the most common setting.
- ❑ Most P&S Cameras have a Program Mode that allows user some ability to control image.
- ❑ Camera still makes most of the decisions but usually allows:
 - Setting ISO, i.e. the Sensitivity of the sensor to light, allowing shoots in low light situations
 - White Balance - adjusts for color of light, e.g. sunny day, cloudy day, florescent lamp, tungsten lamp
 - Control of Flash

Aperture Priority

- **Aperture-priority auto exposure:**
 - you specify the aperture, or f-stop; camera then selects the shutter speed needed to produce a good exposure.
 - Having control over aperture is important because the setting you use affects *depth of field*, or the distance over which objects in the scene appear in sharp focus.
 - So if you're shooting a portrait, for example, you can select an aperture that keeps the subject sharp while blurring the background.
- This mode typically is Av

Shutter Priority

- ❑ **Shutter-priority auto exposure:**
 - You select the shutter speed; camera selects aperture needed to expose the picture properly.
 - Because shutter speed determines whether moving objects appear blurry or “frozen” in place, gaining control over this exposure setting is especially important if you shoot action pictures.
- ❑ Shutter-priority auto exposure mode is usually labeled S or Tv (*time value*) on the camera’s exposure dial.



**Ball is
stopped in
mid air**

**1/640 sec
f/16
ISO 800
275 mm**

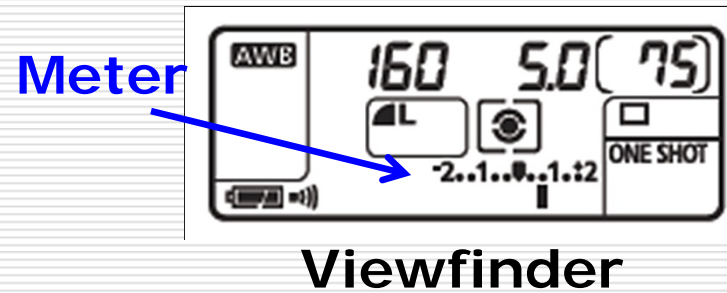
Exposure Compensation

- ❑ Photos taken in Aperture or Shutter Speed Priority have exposure calculated by the camera
- ❑ Camera doesn't always get it right
- ❑ Most cameras have "Exposure Compensation" that allows manual over-ride of the camera exposure value by a + or - factor

Manual shooting — With a point & shoot camera, Manual shooting is cumbersome at best.

□ Manual exposure:

- You specify both aperture and shutter speed to precisely control exposure.
- Most cameras have a display meter that lets you know whether your picture will be properly exposed

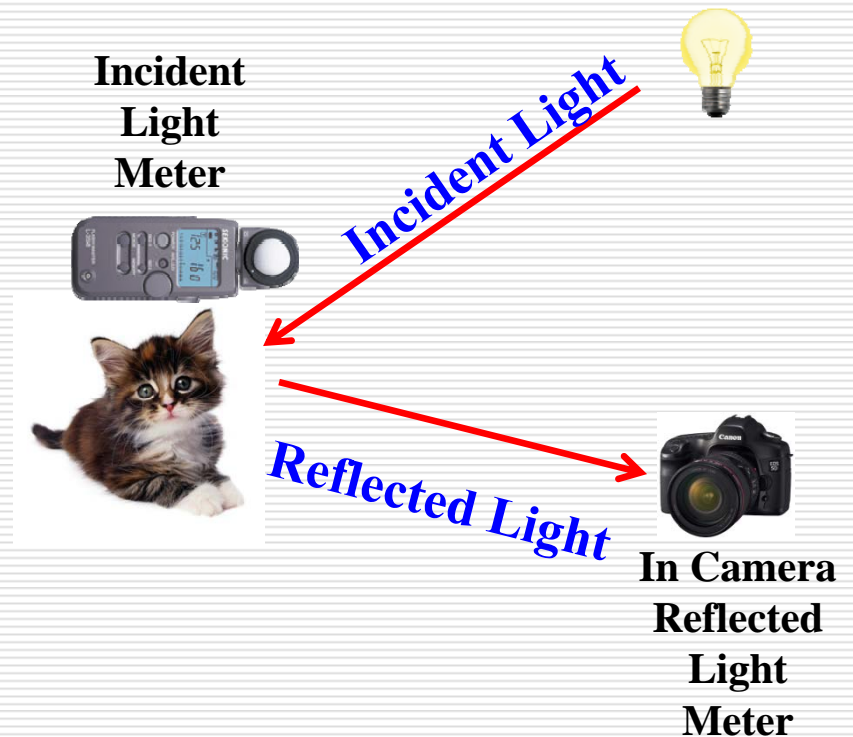


**Under
exposed**

Increase the Aperture size (smaller f/stop; or decrease the shutter speed to set needle to zero (0)

Exposure Meters

- ❑ In camera Exposure Meter measures reflected light
- ❑ If all objects reflected light equally, measurement would be accurate
- ❑ All objects do not reflect light equally
- ❑ Light meter calibrated for mid gray tone (18% gray)
- ❑ If tones in your viewfinder were evenly spread throughout the image, meter would average and measurement would be accurate



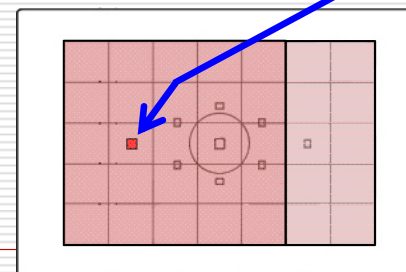
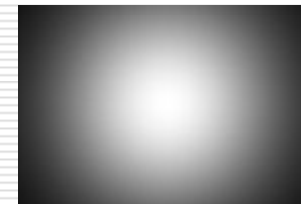
Exposure Meters

- ❑ Unfortunately they are not spread evenly
- ❑ Also there may be a significant imbalance from 18% gray, e.g. a Black Cat in a coal mine or a Polar Bear on an iceberg
- ❑ In all automatic modes in your camera:
 - The cat would be over exposed and you would have to use exposure compensation to reduce the exposure
 - The Polar Bear would be under exposed and you would have to use exposure compensation to increase the exposure.
- ❑ In Manual mode you would have to manually adjust exposure to ensure the snow was not slightly blue or gray.
- ❑ Because of this Camera manufacturers have added metering modes to your camera



Metering modes

- ❑ **Spot**
 - Measured area is quite specific and very small
 - More difficult to use effectively
 - Can measure known gray in your photo, e.g. gray card, bottom of clouds, driveway, green forest, etc.
- ❑ **Partial**
 - Slightly larger area useful to measure specific areas, e.g. face of a backlit person silhouetted by the sun
- ❑ **Center-weighted**
 - Once was default metering mode in most cameras
 - Handles mixed lighting situations very well and some photographers prefer this metering mode
- ❑ **Evaluative (Canon) or Matrix (Nikon)**
 - Uses complex algorithms to evaluate zones in the image, light intensity, color, and selected auto focus points.
 - Sometimes gives unpredictable results
 - Generally the default setting



**Auto
Focus
Point**

Metering
emphasis in
darker red area

Exposure Lock

- ❑ Point your camera at the subject you want, press shutter half way, recompose and expose
- ❑ Example - To avoid sun causing under exposure, point camera down at beach, press shutter half way and /or AE Lock button, recompose, and shoot exposure
- ❑ Also very effective for shooting a sequence of shots with same exposure
- ❑ Different cameras implement Exposure Lock in different ways
- ❑ Learn how your camera implements it, as this is very effective way to obtain the exposure you want in unusual lighting situations



**Auto
Exposure
Lock Button**

Auto Exposure Bracketing (AEB)

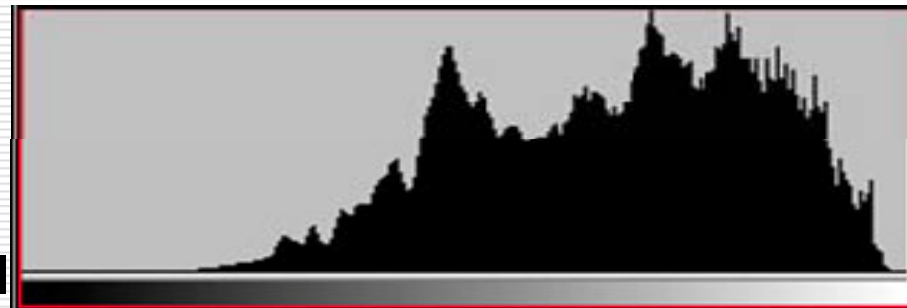
- ❑ Some cameras allow the photographer to select exposure bracketing
- ❑ This is a technique to ensure proper exposure particularly in difficult lighting situations
- ❑ Exposure Bracketing means that in addition to a properly exposed image you take two more photos, one slightly under exposed and a second on slightly over exposed
- ❑ The amount of over and under exposure can be dialed in prior to taking the shot
- ❑ Once set up the camera can take three shots with a single press of the shutter.
- ❑ **With Digital Cameras there are no wasted shots, so why not use AEB all of the time?**
 - Storage Space
 - Post processing time
 - The exposure may be outside the AEB bracket anyway and you still have inaccurate exposure
 - **Learn proper accurate exposure so that you are not a sloppy photographer**

Histogram

- ❑ Histogram is graph of number of pixels in an image at each level between black and white.
- ❑ Black is typically on left; white on right.

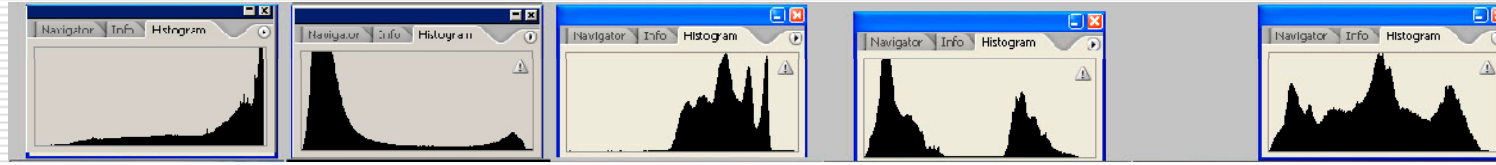
**More
Pixels**

Fewer Pixel



Black - Dark - Medium - Light - White

Histogram



1

2

3

4

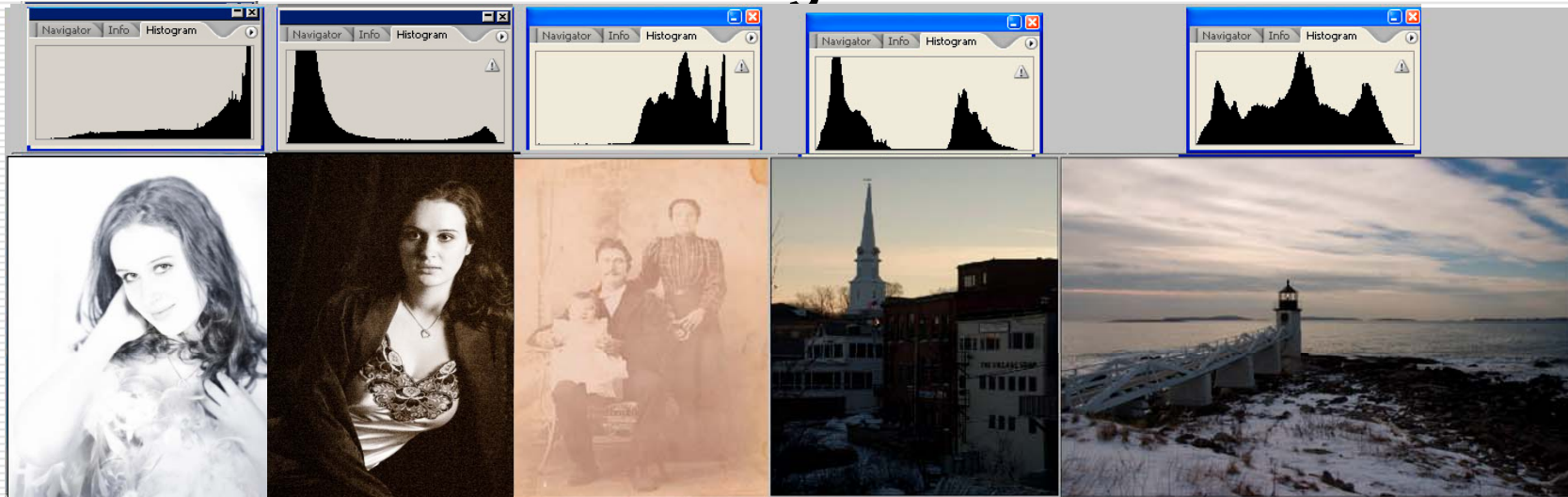
5

- What are the characteristics of the images represented by these histograms?
- Which one is the best photograph?
- What makes a good photo histogram?
- What about the photograph below?



6

Histogram



High Key Image

Low Key Image

All Midtones.
Dull, Drab image with no blacks and no highlights

Bimodal image.
All blacks and whites.
No Midtones

Broad range of tones.

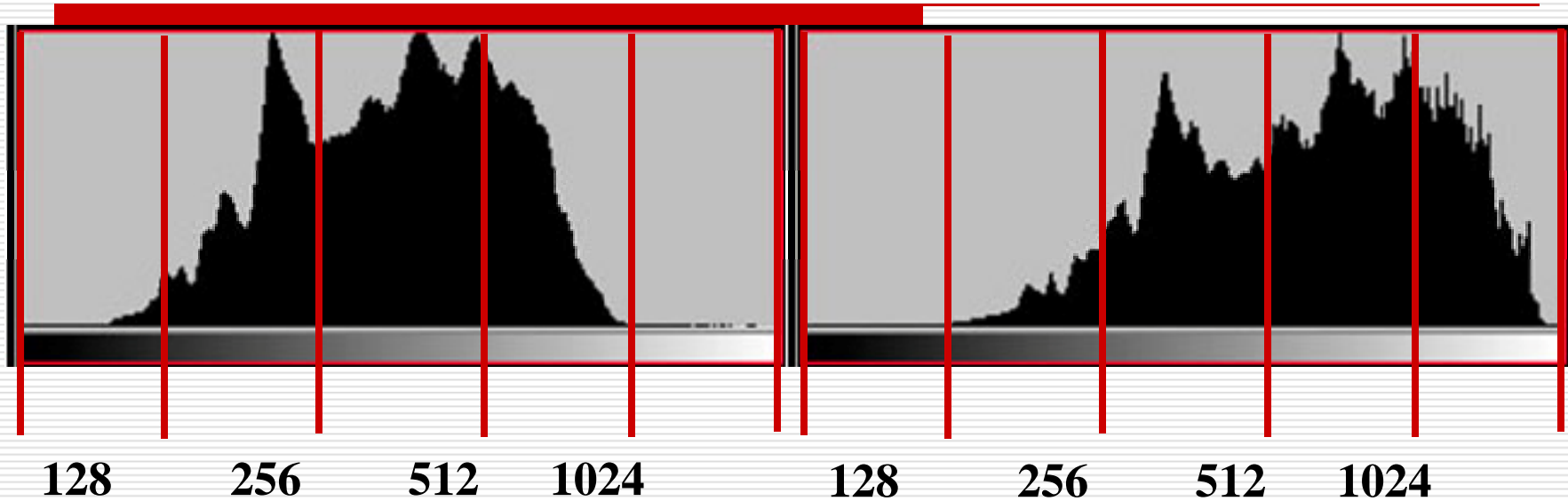
Expose for the highlights but don't blow them.

Process for the Shadows

Blown Highlights



For best exposure look at the histogram not the LCD!



2048

128 256 512 1024 16 bit Raw image (actually only 12 are used) – 4096 bits of information

Camera dynamic range is approximately 5 stops, i.e. you would expect $4096/5 = 819$ bits per stop, however CCD sensor is linear and each stop is half the prior one, i.e. distribution is $2048 + 1024 + 512 + 256 + 128 = 4096$

To capture the maximum information, **expose for the highlights**

However, do not blow out any of the highlights!

What is wrong with this Photo?



- ❑ ISO = 100
- ❑ Lens Length = 55 mm
- ❑ Aperture = f/8
- ❑ Shutter Speed = .6 Sec.

What would you do to fix it?

Aperture Priority Shooting Mode – Hand Held

What is wrong with this Photo?



- ❑ ISO = 400
- ❑ Lens Length = 59 mm
- ❑ Aperture = f/8
- ❑ Shutter Speed = 1/160 Sec.

What would you do to fix it?

Aperture Priority Shooting Mode – Hand Held

What is wrong with this Photo?



- ❑ ISO = 400
- ❑ Lens = 59 mm
- ❑ Aperture = f/8
- ❑ 1/160 Sec.

What would you do to fix it?
Aperture Priority Shooting Mode – Hand Held

What is wrong with this Photo?



- ISO = 200
- Lens Length = 27 mm
- Aperture = f/9.5
- Shutter Speed = 1/125 Sec.

What would you do to fix it?

Aperture Priority Shooting Mode – Hand Held

What is wrong with this Photo?



- ❑ ISO = 200
- ❑ Lens Length = 100 mm
- ❑ Aperture = f/5.6
- ❑ Shutter Speed = 1/125 Sec.

What would you do to fix it?

Aperture Priority Shooting Mode – Hand Held

What is wrong with this Photo?



- ISO = 100
- Lens Length = 300 mm
- Aperture = f/7.1
- Shutter Speed = 1/250 Sec.

What would you do to fix it?

Shutter Priority Shooting Mode – Hand Held

What is wrong with this Photo?



- ❑ ISO = 400
- ❑ Lens = 600 mm
- ❑ Aperture = f/11
- ❑ 1/1000 Sec.

What would you do to fix it?

Aperture Priority Shooting Mode – Hand Held