



# Measure & Control Light in Camera

by:

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# Quality of Light vs. Quantity of Light

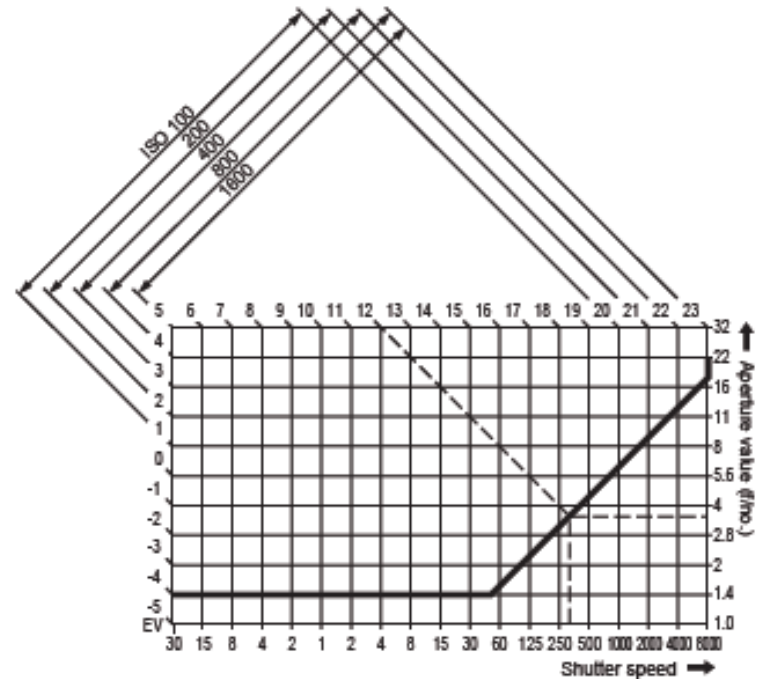
- **Quality of Light is Subjective**
  - Defined by color, hardness of shadows, contrast, specularities...
  - This is NOT what we're going to talk about
- **Quantity of Light is an Absolute**
  - Measured and controlled in camera
  - Relate what your eye measures to a proper exposure

# What we are going to talk about...

- Ambient Light
- The 3 in Camera Controls of Light: ISO, Shutter Speed, Aperture, what they are, what they do, and their interrelationship
- In Camera Light Metering Concepts
  - Spot, Evaluative, Weighted
  - 18% Grey: Black Tuxedo vs. White Wedding Dress
- Histogram as a guide
- Some Comments on Flash
  - Flash has Depth of Field
  - Compressing dynamic range
  - Outdoors, Indoors

# Why Should I Care?

- Repeat after me...  
I want the images  
I want, not what  
happens to fall on  
an ambivalent line  
of good enough  
exposures.



## Program Line Description

The lower horizontal axis represents the shutter speed, and the right-hand vertical axis represents the aperture value. The combinations of shutter speed and aperture value automatically determined by Program AE are shown as lines with respect to the subject brightness (Exposure Value) gradations on the left and top edges of the graph.

Example: Using an EF50mm f/1.4 USM lens with a subject brightness of EV12, the point where the diagonal line from EV12 (on the top edge) intersects the Program AE line represents the corresponding shutter speed (1/320 second) and aperture value (f/3.5) that the program sets automatically.

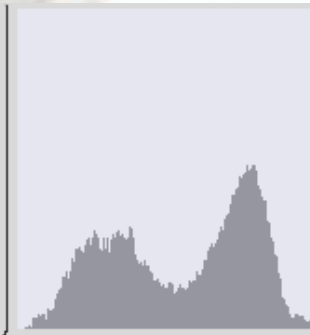
Image © Canon, Inc

# Time, Space, & Sensitivity

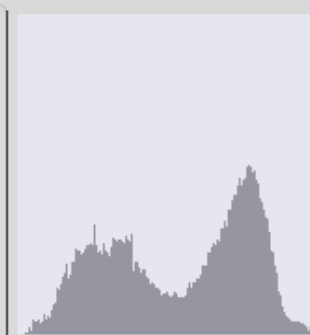
- Shutter Speed (Tv), Lens Aperture (Av), & ISO
  - Each independently influences how much light hits your film or digital sensor.
  - A “correct” exposure has many correct combinations of the three.
  - If you have a “correct” exposure, and then change one of these you will have to change at least one other to maintain the same exposure.
  - Maybe better said as, your camera gives you three controls to get the image you want.

# Different Settings Same Exposure

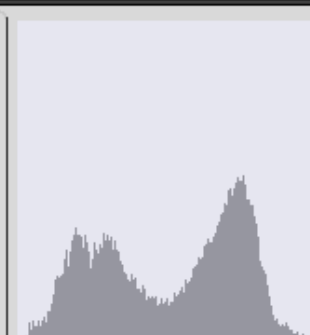
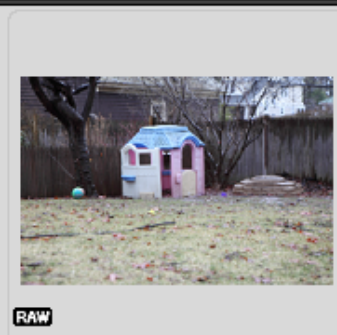
- 1/60<sup>th</sup> Second
- f 8.0
- ISO = 400
  
- 1/125<sup>th</sup> Second
- f 5.6
- ISO = 400
  
- 1/125<sup>th</sup> Second
- f 4.0
- ISO = 200



File name	IMG_9696.CR2
Camera Model Name	Canon EOS 5D Mark II
Shooting Date/Time	3/30/2009 2:41:38 PM
Tv(Shutter Speed)	1/80
Av(Aperture Value)	8.0
Exposure Compensation	-
ISO Speed	400
Brightness(RAW)	0.00
White balance	Shot settings



File name	IMG_9697.CR2
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Brightness(RAW)	0.00
White balance	Shot settings

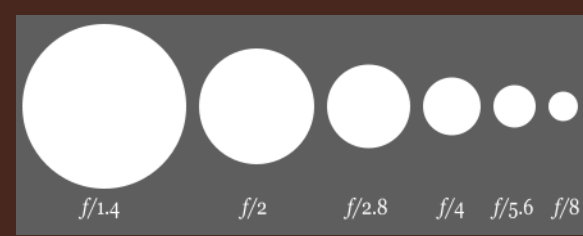


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Av(Aperture Value)	4.0
Exposure Compensation	-
ISO Speed	200
Brightness(RAW)	0.00
White balance	Shot settings

# Time / Shutter Speed

- Shutter Speed defines in time how long the shutter stays open.
- Measured in Seconds, usually fractions of a second ex.,  $1/200$ ,  $1/80$ ,  $1/4000$  or 2 Seconds
- Direct mathematical relationship to how much light hits the focal plane (sensor or film)
- $1/200$  is half the amount of light as  $1/100$ ,  $1/400$  is half the amount of light as  $1/200$
- What is the importance?
  - Primarily to control motion blur caused by camera shake or object movement
  - Can effect how hard your flash has to work
  - Controls Ambient Light level

# Space / Aperture Value



- A measurement of how “open” your lens is.
- Mathematically the opening diameter is equal to the focal length divided by the  $f/\#$ . The standard f/stop scale corresponds to the sequence of the powers of the square root of 2 which is approximately 1.4.
  - 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. Inverse relationship.
- What is the importance
  - Aperture controls depth of field
  - Definite influence on how hard your flash has to work, and inverse square law effect of flash use

# Time & Space Together

## ■ Equal Exposures

- $1/125 @ f/8 = 1/250 @ f/5.6 = 1/500 @ f4$
- Now an Exercise, based on above exposure
  - ? @ f/2.8
  - ? @ f/11

## ■ A word about f/stops

- f/stop can relate to Aperture, Shutter Speed, or ISO changes
- Your camera probably will let you do 1/3<sup>rd</sup> f/stops.
  - f/2.8, f/3.2, f/3.5, f/4.0, f/4.5, f/5.0, f/5.6...
  - 1/60, 1/80, 1/100, 1/125, 1/160, 1/200, 1/250, 1/320, 1/400...
  - 100, 125, 160, 200, 250, 320, 400,

# Sensitivity / ISO



- ISO = International Standards Organization
- ISO Number refers to the light sensitivity of the capture medium; the higher the number the greater the sensitivity
- In the beginning there was film
  - Cellulose with Silver Halide Grains
  - The bigger the Grains the greater the sensitivity to light, the higher the ISO number.
  - Alas, there was a tradeoff. Bigger grains made low light photography possible, but created grainy images.

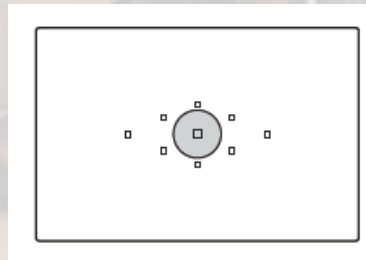
# Sensitivity / ISO

- Then came the digital image sensor
- Same ISO reference numbers apply as in film; higher number is greater light sensitivity
- Digital Sensor is an electronic device. To increase the sensitivity of the sensor more power is applied.
- Just like film there is a tradeoff, more power applied to the digital sensor allows low light photography, but creates noise. Just like the snow on your TV.

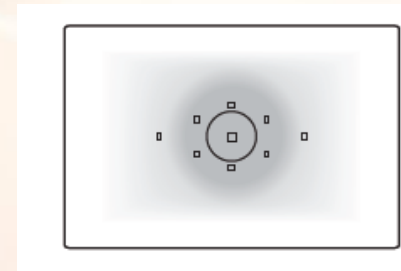
# Metering – Where to Look

- The first step is to know what you're metering. Your camera has 3 basic modes.

- Spot

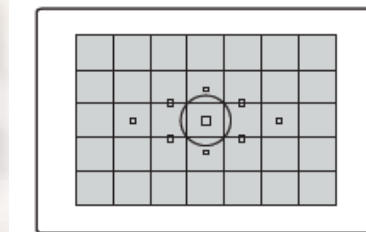


- Center-weighted Average



- Evaluative (Canon)

- Matrix (Nikon)



*Images © Canon, Inc*

# Metering – Swing Your Partner

- What is it telling you?

Increased exposure



Decreased exposure



*Image © Canon, Inc*

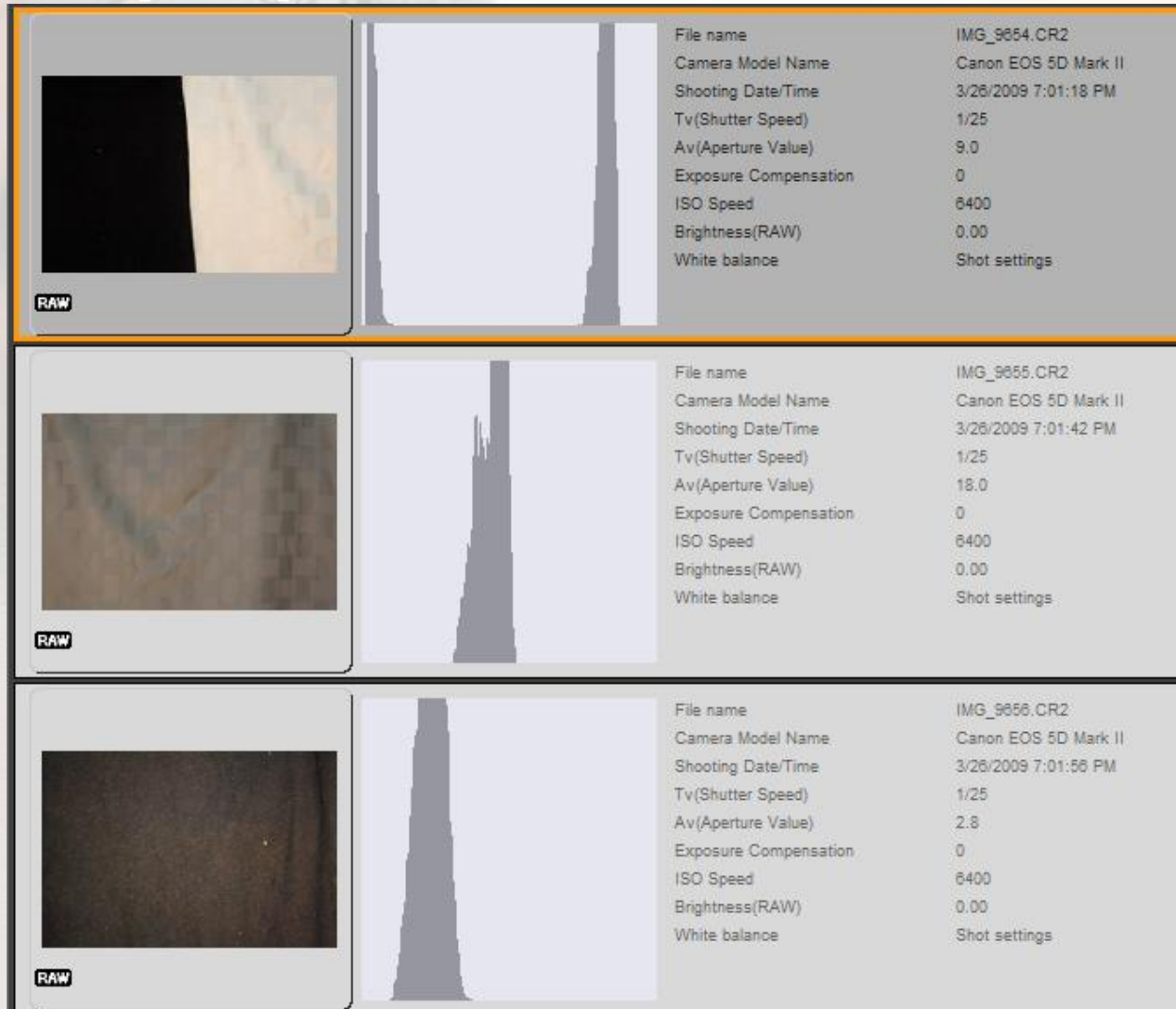
# The World is 18% Gray – Just not always your Subject

▪ Center of meter placed at intersection of black and white =  $1/25^{\text{th}}$ , f9.0 the average of both, and each correctly exposed.

▪ Metering only the white =  $1/25^{\text{th}}$ , f18.0, and image is underexposed.

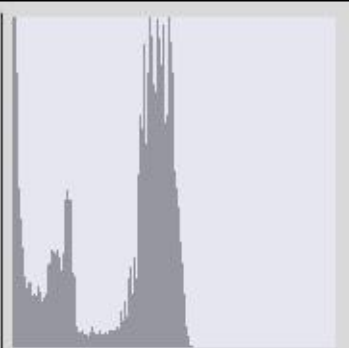
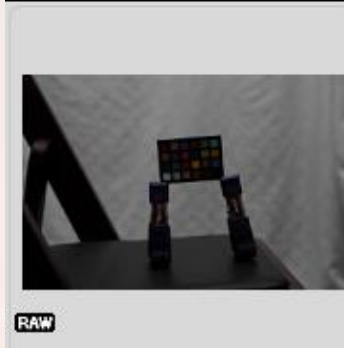
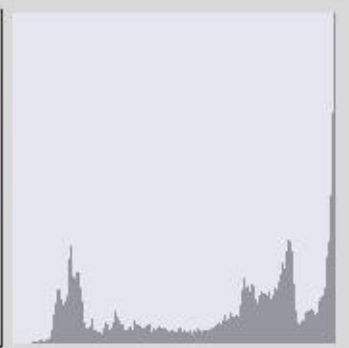
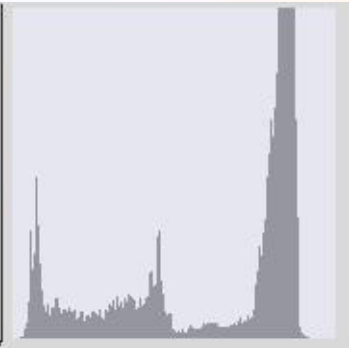
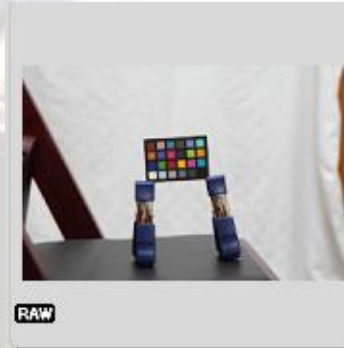
▪ Metering only the black =  $1/25^{\text{th}}$ , f2.8, and image is overexposed.

▪ (all at ISO = 6400, constant light source)



# Reading the Histogram

- The histogram is the most accurate indicator of your exposure. The LCD screen is back lit and can fool you.
- It is a graph showing the brightness levels of the image, from darkest on the left, to brightest on the right.
- The amplitude, or height of the blobs indicates how many pixels are at that brightness.
- The distribution and location of the blobs should be as expected for a proper exposure.
- An over or under exposed image will be clipped on the corresponding edge, and bunched up there.



# Flash & the Inverse Square Law

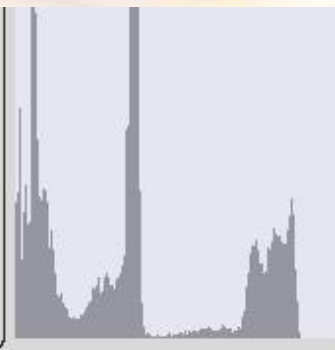
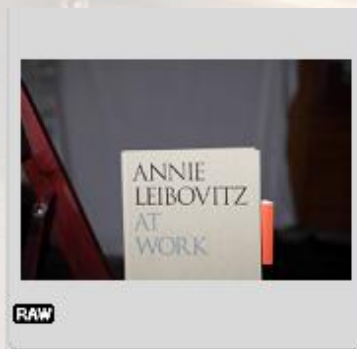
- Don't worry no real math here.
- The closer you are to the light source the more powerful it is.
- The closer you get to the light source, the quicker the intensity changes as you move in. When you get farther away, small differences in distance become meaningless.
- Light has depth of field.
- Your flash lights your subject to the brightness determined by your Aperture.

*(The following presumes a single on camera (or flash bracket) mounted flash)*

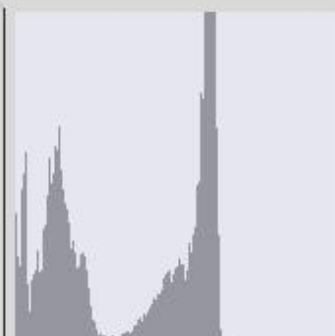
# Using Distance to Control Flash Depth of Field

- In the first image the book is close to the light source (on camera flash) and the sheet is relatively far away. The effect is that the book is properly exposed, but the sheet is underexposed and gray.
- In the second image they're both evenly light because the distance between the two is relatively small compared to the distance to the light source.

Note camera settings the same.



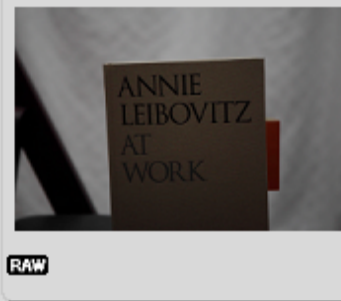
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Tv(Shutter Speed)	1/200
Av(Aperture Value)	4.0
Exposure Compensation	-
ISO Speed	1800
Brightness(RAW)	0.00
White balance	Shot settings



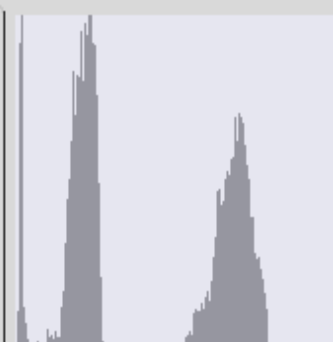
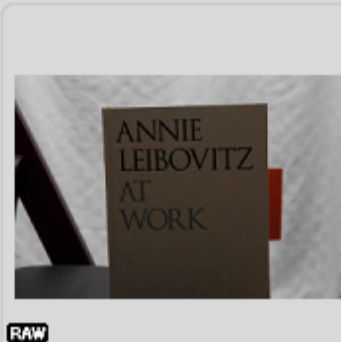
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Camera Model Name	Canon EOS 5D Mark II
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Tv(Shutter Speed)	1/200
Av(Aperture Value)	4.0
Exposure Compensation	-
ISO Speed	1800
Brightness(RAW)	0.00
White balance	Shot settings

# Using Aperture to Control Flash Depth of Field

- In this experiment the book is close to the light source (on camera flash) but the sheet is relatively far.
- In the first image the book is lit to f/2.8 so the flash intensity is low and falls off quickly.
- In the second image the book is lit to f/8 requiring a more powerful flash, so the fall off is less dramatic.



File name	IMG_9666.CR2
Camera Model Name	Canon EOS 5D Mark II
Shooting Date/Time	3/26/2009 7:37:34 PM
Tv(Shutter Speed)	1/200
Av(Aperture Value)	2.8
Exposure Compensation	-
ISO Speed	1600
Brightness(RAW)	0.00
White balance	Shot settings



File name	IMG_9667.CR2
Camera Model Name	Canon EOS 5D Mark II
Shooting Date/Time	3/26/2009 7:37:58 PM
Tv(Shutter Speed)	1/200
Av(Aperture Value)	8.0
Exposure Compensation	-
ISO Speed	1600
Brightness(RAW)	0.00
White balance	Shot settings

# Using Flash to Compress the Dynamic Range of Your Scene, Man

- Dynamic range is defined by the extremes of your light zones – how dark are my darks, how bright are my brights within the same scene.
- Becomes an issue when this range exceeds the range of your image sensor.
- One solution is to set your exposure for the brightest area of your image, and use your flash to bring up the dark areas.
- An example is shooting against a bright sky and you want to maintain some color in the sky without underexposing everything else.

# High Dynamic Range Samples



# A few other thoughts on Flash

- Flash Exposure Compensation (Presumes automatic mode)
  - Dark Objects will be over exposed because of the camera metering we saw earlier.
  - Light Objects likewise will be underexposed.
  - So adjust your Flash Exposure Compensation (FEC) accordingly depending on what you're metering.
- Lifting Shadows requires a little fill flash. Perhaps Negative 1 or 2 FEC depending on Flash to Subject distance.
- Battling the Sun you might need perhaps Plus 1 or 2 FEC depending on Flash to Subject distance.
- In daylight you should “typically” use your fastest Flash Synch speed. This is because your flash duration at its longest is about  $1/700^{\text{th}}$  of a second. So this gets the effect of your flash the closest in parity to the ambient light as possible.

# A Few More Thoughts on Flash

- Indoor Specific, or more relevant
  - Shutter Speed controls the amount of ambient light that contributes to the image. Most important for indoors. For example a Shutter Speed of  $1/60^{\text{th}}$  or  $1/80^{\text{th}}$  will allow a good bit of ambient light in. A high Shutter Speed or  $1/200^{\text{th}}$  (Canon) or  $1/250^{\text{th}}$  (Nikon) will cut down on the ambient light. This impacts the image White Balance, and how hard (quality) your Flash will be.
  - When indoors, bounce your flash to soften shadows and for a more pleasing (quality of) light.
  - In a dark room, or outside at night you can “drag the shutter” (use a slow shutter speed, e.g.,  $1/20^{\text{th}}$ ) to maximize the ambient light and rely on the flash to freeze motion. You still need to be steady to prevent light motion.
- For consistent flash exposures don't make your flash work too hard. For example, limit the flash contribution to 1 f/stop.
- Bump your ISO. Use the Highest ISO that provides an acceptable noise level. Hint, noise shows up in the dark areas first.
- Flash may act differently in Manual mode compared to Program mode. See your User Guide.

# Time, Space, & Sensitivity @ Work

## ■ What do I set first?

### ■ It is a process based on what you want to accomplish.

- Speed to capture a fast moving object,
- Shallow depth of field to blur an ugly background or to emphasize your subject,
- Great depth of field for a vast scene
- Are you working in changing conditions e.g., sun moving in and out of clouds and having to work quickly
- Are you outdoors using fill flash
- Are you indoors using flash as your primary light source, to balance ambient light, or to bring up shadows

# End of the Tunnel

## ■ Time to Experiment

## ■ A Few Resources

- <http://strobist.blogspot.com/2006/03/lighting-101.html>
- <http://www.usa.canon.com/dlc>
- <http://www1.nikonusa.com/slrlearningcenter/index.php>
- <http://www.planetneil.com/tangents/>

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