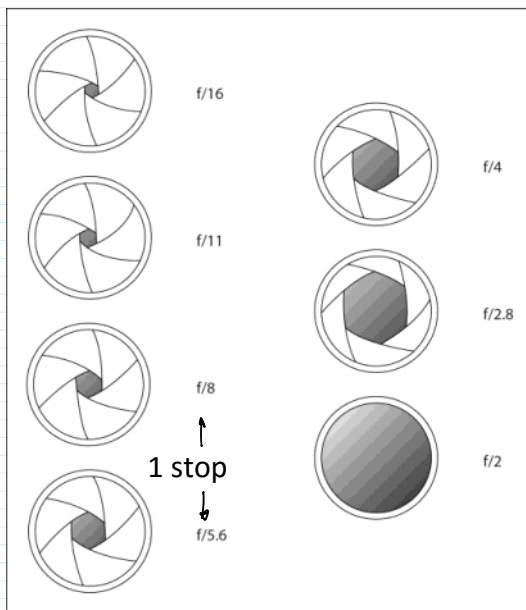Today: Focus, Exposure, shutter speeds,
ISO/Sensitivity

Minute paper:
1. Have you been taught to count in binary or base 8 or 16? When?
2. What is a pixel? What is it made of (for software purposes)?

Aperture (iris) mechanism made from overlapping pivoting leaves.

Aperture has impact on exposure too, how much light total hits the sensor.
Units: 1 stop = 1 EV Exposure Value = factor of 2 in area, light.
Camera adjustments in 1/3 stops

Stop used to be a metal plate with hole punched in it. It stopped light.

2.8, 3.5, 4, 5.6, 8, 11, 16, 22, 32, 45, 64

http://media.wiley.com/assets/1007/41/0-7645-9802-3_0213.jpg

http://www.lavideofilmmaker.com/cinematography/f-stops-focal-length-lens-aperture.html

Ansel Adams founded f/64 club. Tiniest hole, maximum DOF. Modern lenses often best sharpness at f/5.6 or design point.

Exercise: Make the same image with three f/stops: max, min and low medium. (Keep ISO the same, and use tripod or keep shutter time short.) Inspect the three images closely. What happened?

$$\frac{f}{D}$$

4. EXPOSURE

For a given light intensity, exposure = (aperture area) X (time shutter is open)

Shutter speeds: 30 = 1/30th of a second etc.
                5 = 1/5th of a second
                30" = 30 seconds
                T = time, click to open shutter and again to close
                B = bulb, shutter stays open as long as button is pressed (or bulb is squeezed)

Check your camera shutter speed options. What is the range?
Tv or S = Time priority; you set the shutter speed and ISO, camera AE will choose the aperture.
Av = aperture priority. You choose the aperture, camera will choose shutter speed.

Equivalent exposures: f/5.6, 1/100 sec
                      f/8, 1/50 sec
                      f/11, 1/25 sec

(handwritten, top right:) B – 4000
B   8000
4" – 2000

ISO = sensor sensitivity, gain
1 EV = 1 stop = factor of 2 in ISO
100 200 400 800 *(handwritten:)* 1600   3200   6400   12800   25000

(handwritten, right:) 4-32 db video

Used to be called ASA for film.
From [American Standards Association](#) (now named [ANSI](#))

ISO = International Organization for Standardization

Fixing the speed (B/W)

density of the negative →

Density 2.5 2.0 1.5 1.0 0.5 0

Maximum density (D$_{max}$) — Shoulder
Straight part
Threshold
0.1 above stain
Minimum density (D$_{min}$) = stain
Speed point

Dark — Irradiance → — Bright
lg exposure
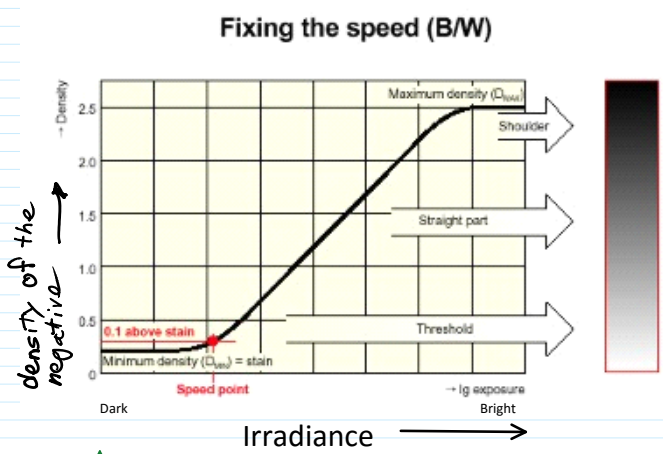
http://www.sapiens.itgo.com/documents/foto/photographic_terms8.htm

Pixel value
(handwritten:) 1024
255

saturation

ISO 200
ISO 100

Ideal response.
Real response

0

0

Dark **Light, log scale** Bright
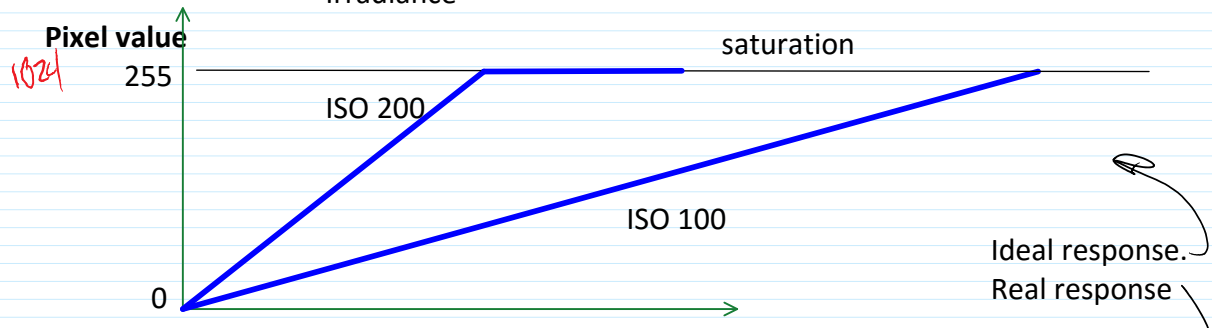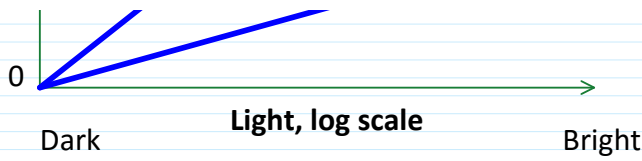
Ideal response.
Real response

Digital camera response database
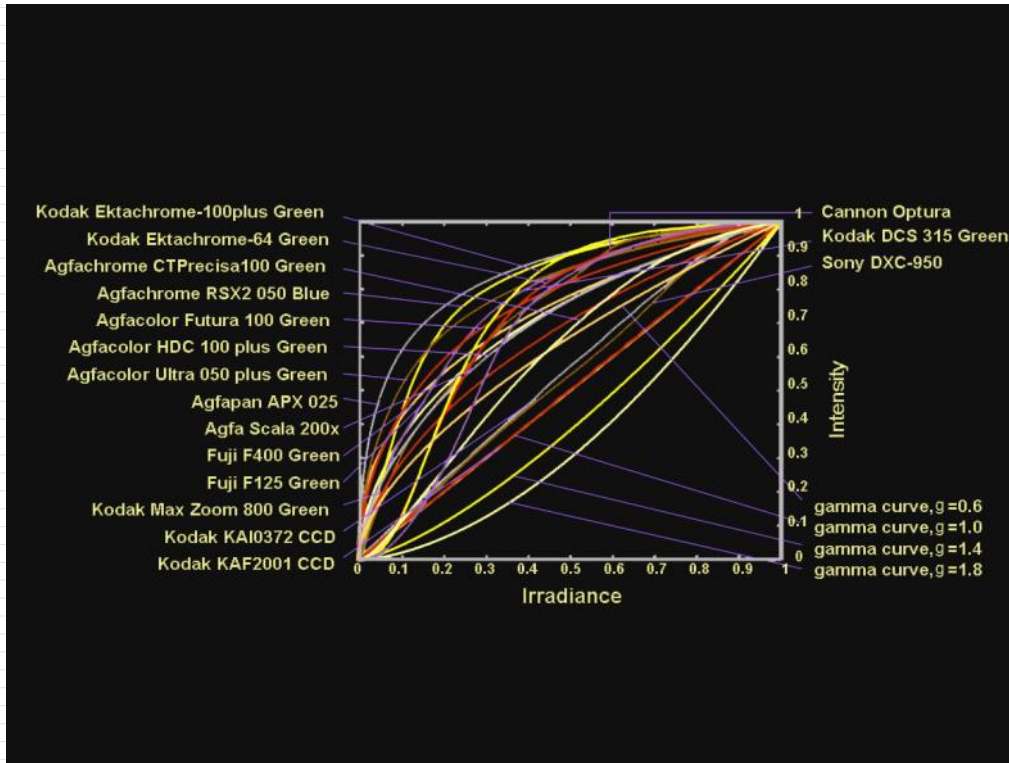
FLIR in ITLL

TIC

Human spectral sensitivity to color
Three cone types (ρ, γ, β) correspond *roughly* to R, G, B.

Human spectral sensitivity to color
Three cone types (ρ, γ, β) correspond *roughly* to R, G, B.

Relative sensitivity

β   γ   ρ

400   460 490 500 530   600   650   700
Wavelength (nm)

Blue Cyan Green   Red
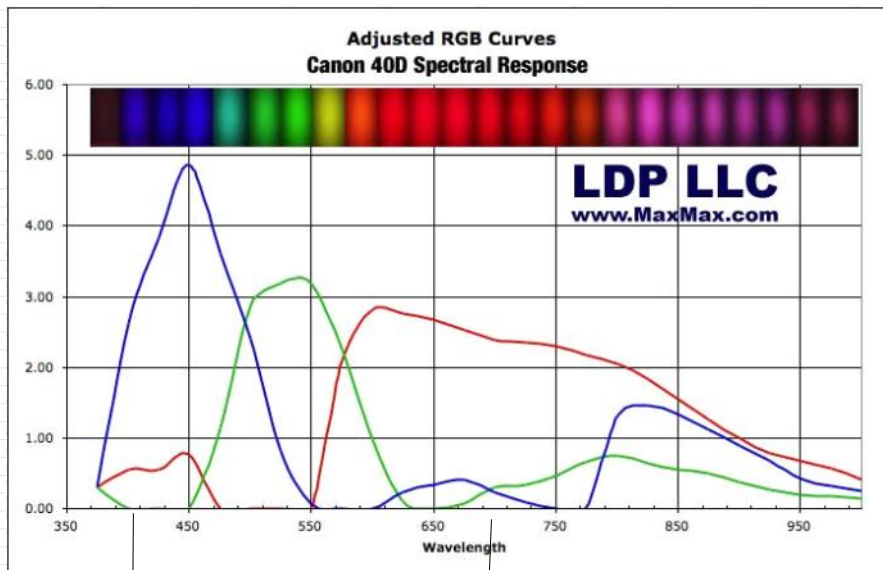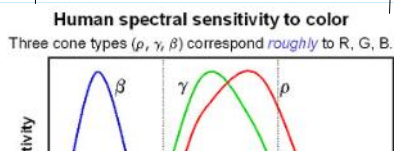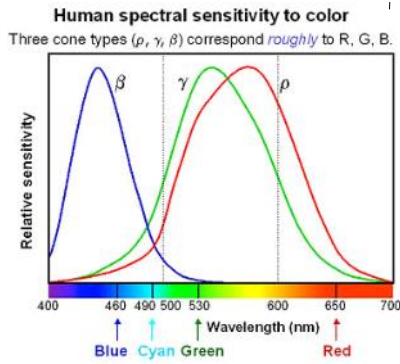
Don't worry, images come from camera with compensation done automatically (mostly); color management again.

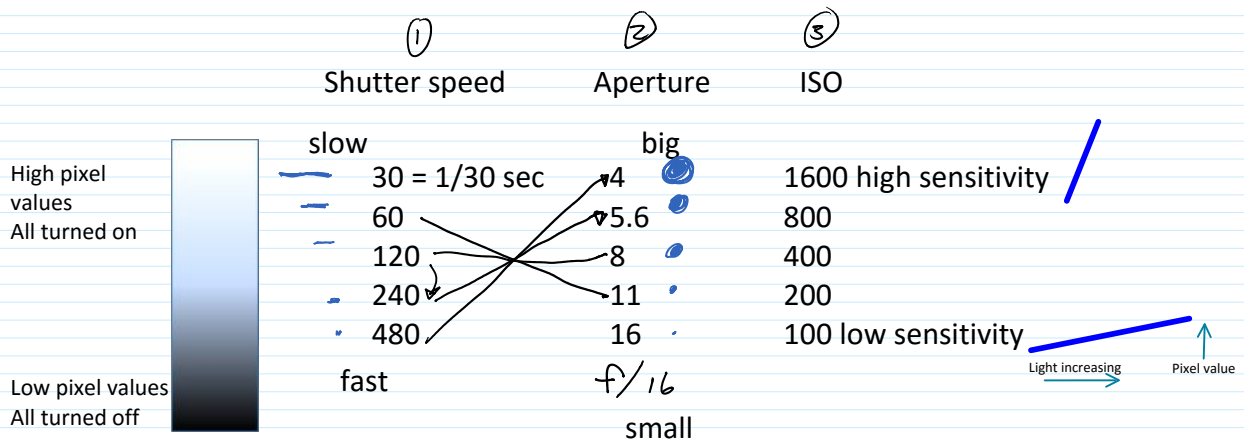Same image density f/5.6, 1/100 sec, ISO 200
f/8, 1/100 sec, ISO 400
f/4, 1/200 sec, ISO 400

Used to be hard to change sensitivity , ISO: change film or go into menus.
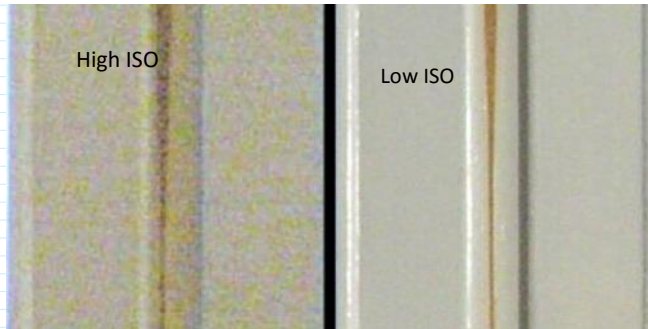Now is becoming easier; single button or thumbwheel select.

Check your camera ISO settings. How easy to change?

Proper exposure = middle value on an average pixel

3 ways to control pixel values so far

① Shutter speed ② Aperture ③ ISO

	slow	big	
High pixel values All turned on	30 = 1/30 sec	4	1600 high sensitivity
	60	5.6	800
	120	8	400
	240	11	200
	480	16	100 low sensitivity
Low pixel values All turned off	fast	f/16 small	

Light increasing   Pixel value

Other implication of ISO: Noise

High ISO

Low ISO

http://en.wikipedia.org/wiki/Image_noise#Low_and_high-ISO_noise_examples

$$$$ in camera buys less noise at high ISO
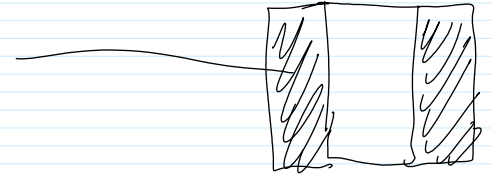
Autoexposure programs (AE)
Wide variety. Stay away if you can.
Semi -automatic programs are better.
Av = aperture priority. You choose the aperture, camera will choose shutter speed. ISO might be automatic too.
Tv = Time priority; you set the shutter speed and ISO, camera AE will choose the aperture.
M = Manual (maybe). You choose both aperture and shutter speed. Meter will tell you if exposure is OK.