

Please do your ratings for Best of Web by 5 pm

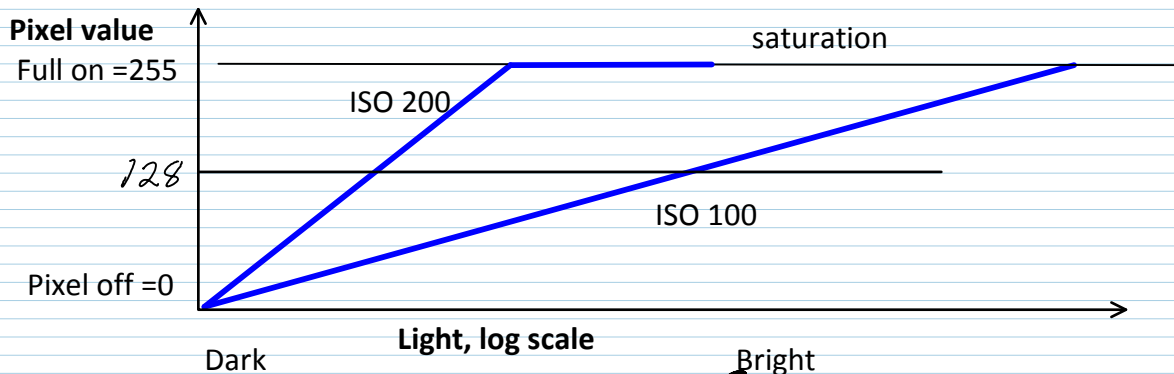
<https://www.cu.edu/coltt/galloping.html>

Intermediate-advanced Photoshop workshop
9-11:30 Weds Feb 26.

Today: Finish exposure, tradeoffs.

Motion blur calculation

Thursday: Intro Photoshop



With 8 bit depth on a pixel, can count up to $2^8=256$ = 11111111 in binary = FF in hexadecimal (base 16)
different brightness levels in the image ↑ NIBBLE

0 | = BIT BASE 2

Base 10

10	1's
3	5

2^3	2^2	2^1	2^0
8	4	2	1
0	1	0	1
	4	+	1

$4 + 1 = 5$

BYTE = 8 bits

With 12 bit $2^{12}=4,096$ levels

Minute paper: Have you been taught to count in binary? When?

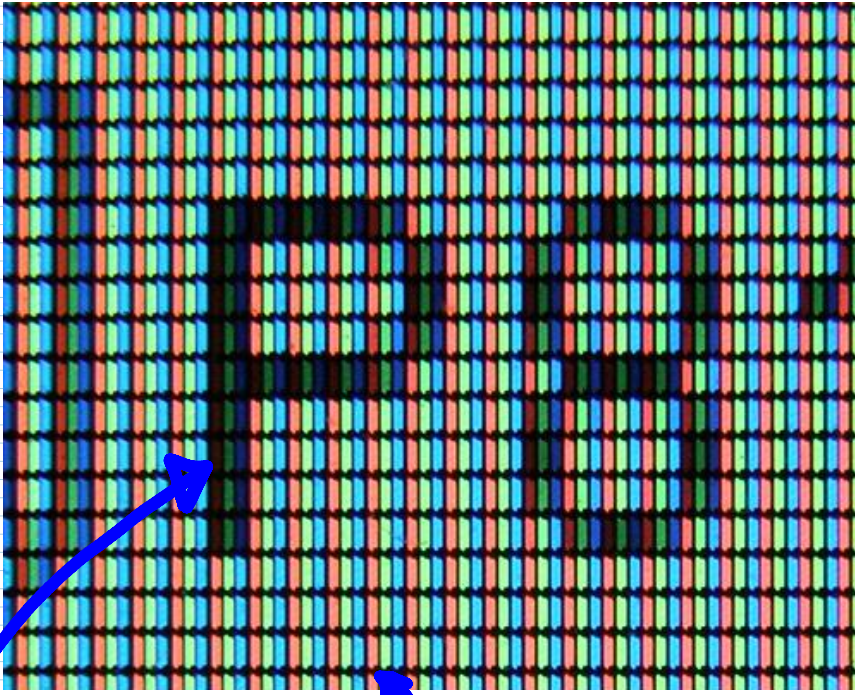
Minute paper: What is a pixel? What is it made of (for software purposes)?

The word *pixel* is based on a contraction of *pix* ("pictures") and *el* (for "element");

Pasted from <http://en.wikipedia.org/wiki/Pixel>

On a screen, = 1 red, 1 blue, & 1 green light emitter.

1 PIXEL



http://en.wikipedia.org/wiki/File:Closeup_of_pixels.JPG

R,G,B = 0,0,0 = black, off.

R,G,B, = 255, 255, 255 = all full on = white (8 bits = $2^8 = 256$ possible levels)

R,G,B = 0,0, 256 = blue

bits used per pixel per color = color depth, bit depth

Cameras are often 12 bit depth, but Photoshop has limited capabilities for depths > 8 bits

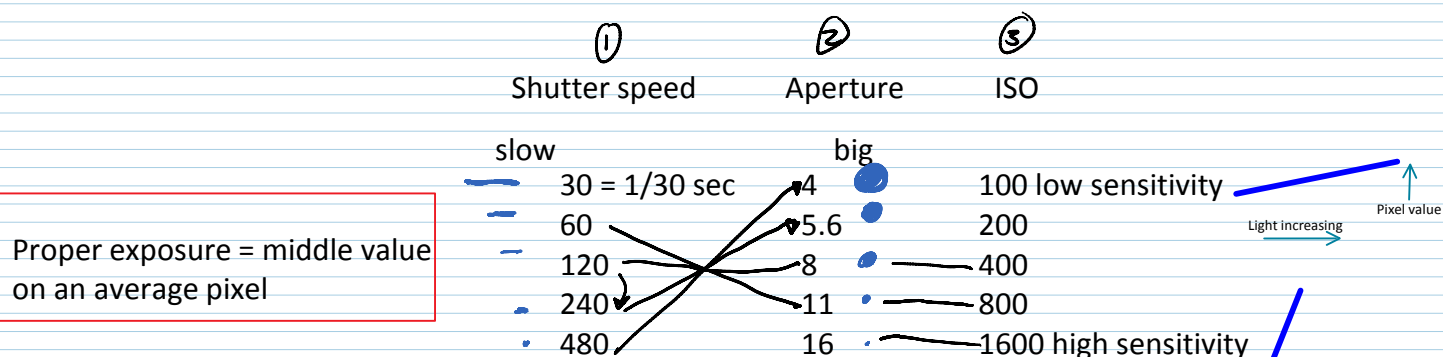
In RGB color space, have 3 color channels per pixel; Red, Green and Blue subpixels each has 8 bit range

FF,FF,FF= full white, all subpixels at max

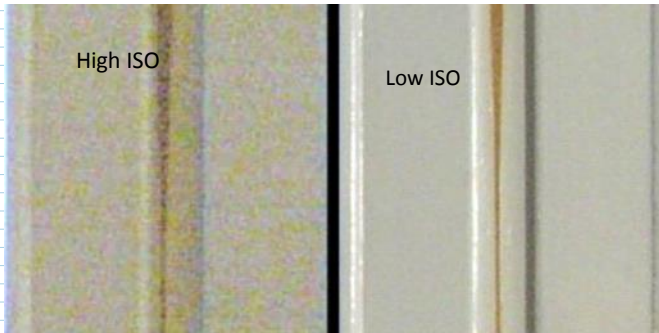
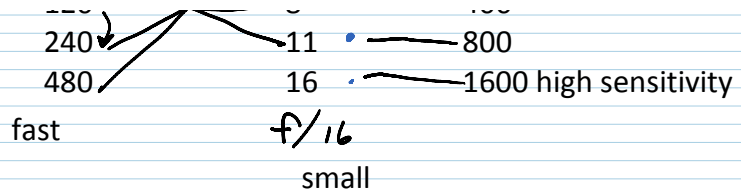
FF 00 00 = red

Values of R=G=B, (i.e. 100,100,100) should be neutral grays. If not, check your screen calibration. Calibrator is available for checkout.

3 ways to control pixel values so far



on an average pixel



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.



to set over/under exposure

Lighten image, overexpose compared to AE suggestion +++

Darken, underexpose compared to AE, ----

4 ways to control pixel values

① Deliberate over/under exposure

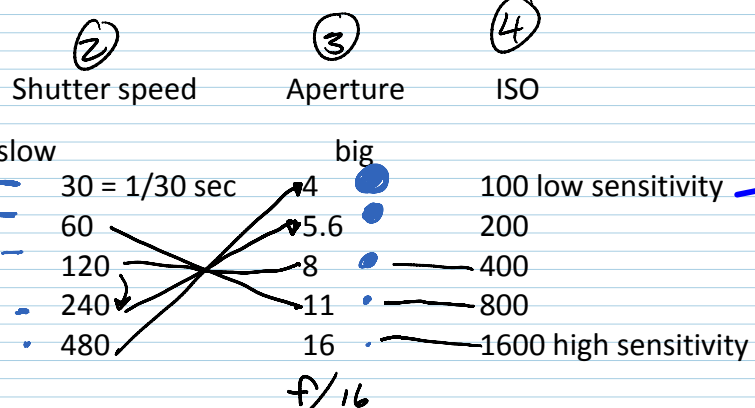
Overexposed = More light, or
more sensitive ISO

EV = +1

Proper exposure = middle value
on an average pixel

Underexposed = Less
light, less sensitive

EV = -1



How to choose?

Minute paper: list pros and cons of

1. small aperture vs large aperture
2. short shutter (high shutter speed) vs long (slow)
3. high ISO vs low
4. Deliberate over/under exposure

SMALL
APERTURE

1. Aperture: large $f/$ = better DOF, but less light, maybe less sharpness overall
2. Short shutter = freeze the flow, minimize motion blur, but less light
3. High ISO adds noise, but can use low light
4. Need to be careful about which value gets changed to achieve what you asked for.

Usually, set ISO for overall conditions, then choose

Av = aperture priority, let AE (auto exposure) choose shutter

or

Tv = shutter priority, AE chooses aperture

Other considerations of shutter speed:

Short enough to 'freeze' flow, or long enough to get desired particle tracks.

If long shutter is needed, might be too much light, even at low ISO.

Try a

NDF = Neutral Density Filter. Neutral = all wavelengths equally. Gray.

NDF 1 = 1 / 10 light transmission.

NDF 2 = 1/100 etc. Log scale.

http://en.wikipedia.org/wiki/File:Strickland_Falls_Shadows_Lifted.jpg

30 seconds. NDF 8x



Need a tripod for macros, or shutters $> 1/30$ sec
Full size start at \$25. Highly recommended.

Several available for checkout.

Estimate motion blur *in pixels* to guide choice of shutter speed.

Example:

Field of view = 10 cm

Fluid moving at 0.5 m/s

10 Mpx sensor

Minute paper: what shutter speed will 'freeze' this flow?

Can tolerate maybe 5 px blur?

10 Mpx $\sim 3750 \times 2750$

$$0.1 \text{ m} / 3750 = 2.6 \text{ e-}5 = 0.000026 \text{ m/px} = 26 \text{ }\mu\text{m/px}$$

5 px = $1.3 \text{ e-}4 \text{ m} = 0.00013 = 0.13 \text{ mm}$ estimated acceptable

object displacement x

time $t = x/\text{velocity}$

$$1.3\text{e-}4 \text{ m} / (0.5 \text{ m/s}) = 2.6\text{e-}4 \text{ seconds}$$

$2.6\text{e-}4 \text{ sec} = 1/3750$ Very short. Can your camera do this?

$$5/3750 = 0.0013 = 0.13\% \text{ of image width}$$

Do this analysis for each image. Motion blur is surprisingly common and annoying.