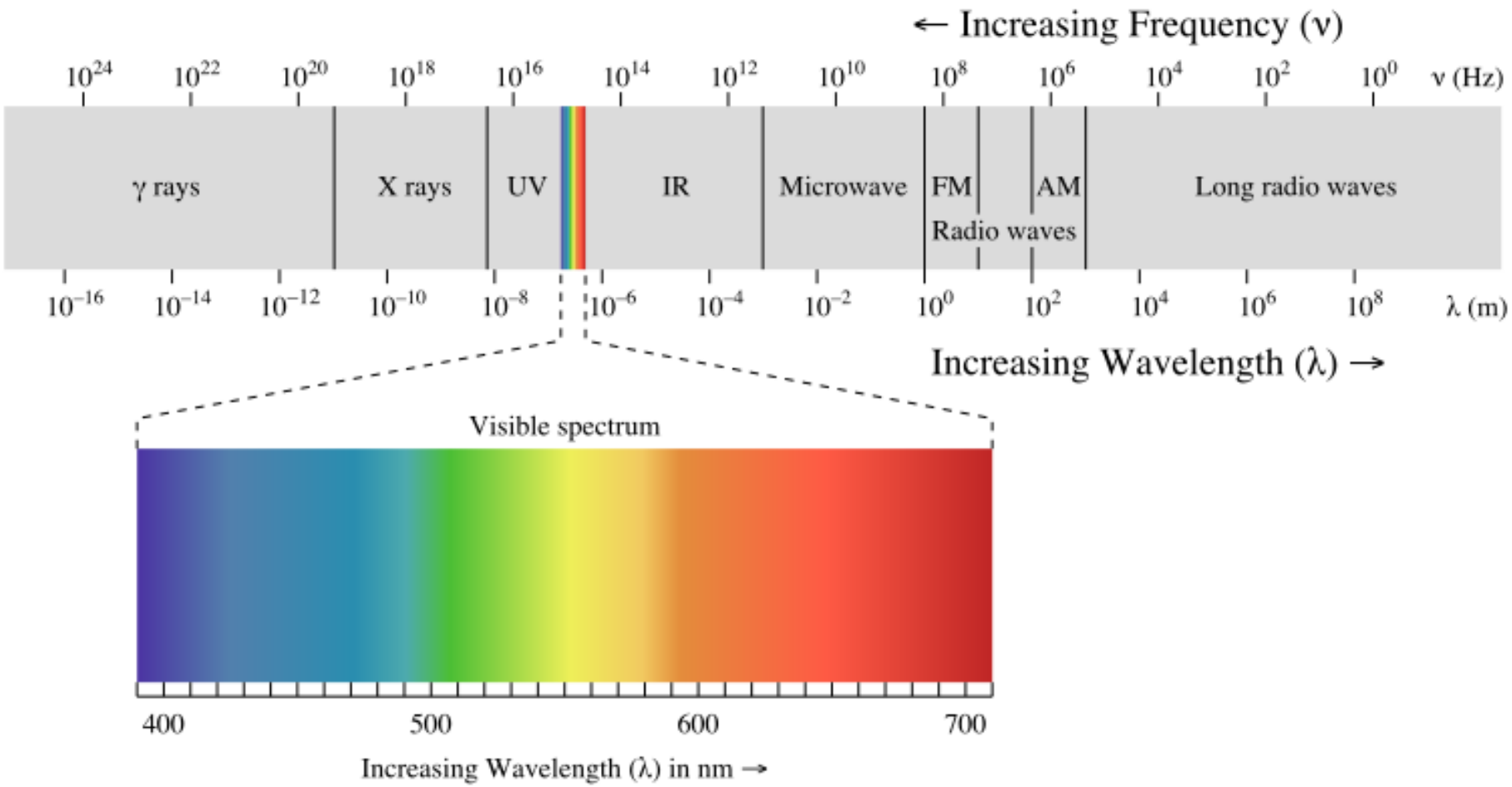

Digital Photography
Warren Mar
Splash!

Outline

Light Biology of Eye Color Theory	Camera Hardware Camera Sensors Lens
Camera Software Camera Settings	GIMP Demo Post-Processing RAW Processing HDR

Light

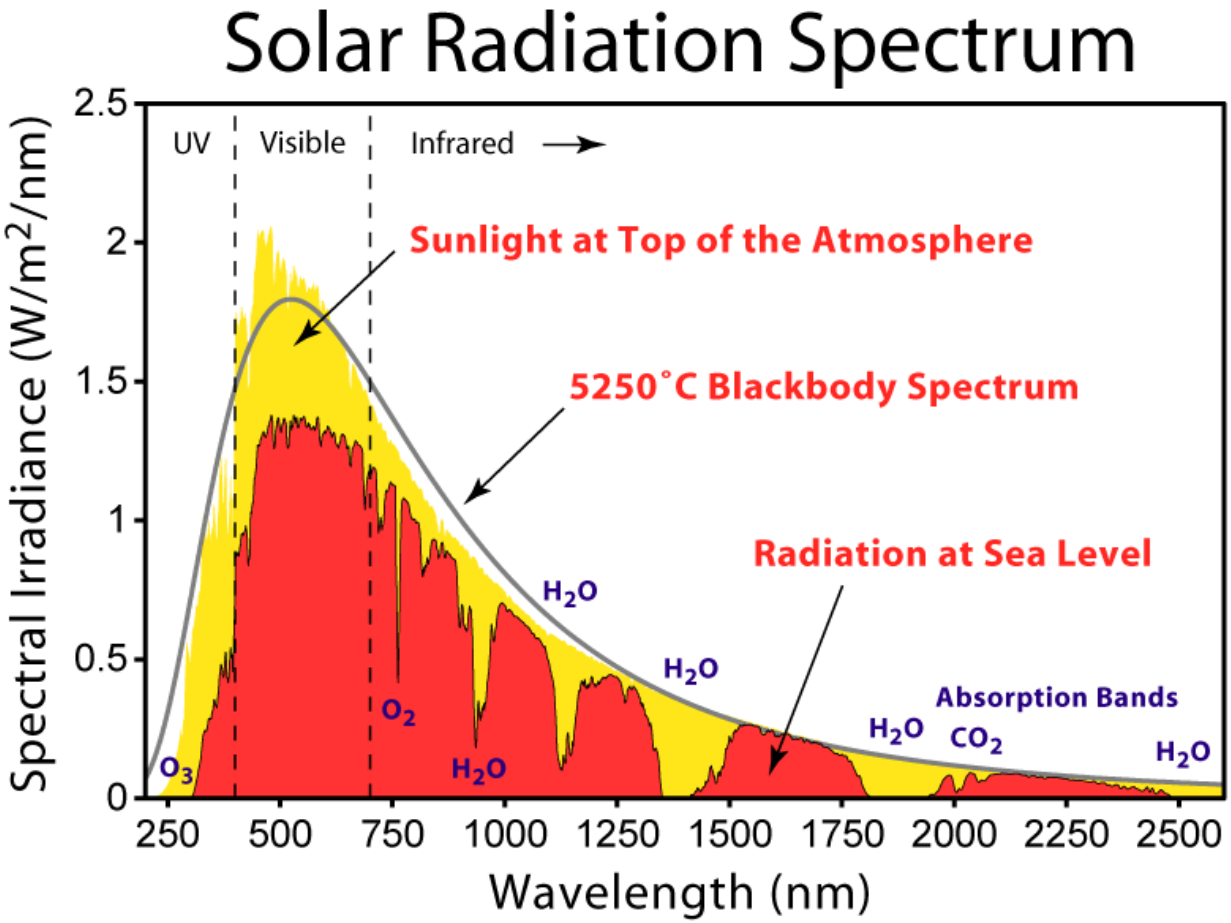


http://en.wikipedia.org/wiki/Electromagnetic_radiation

Light Sources

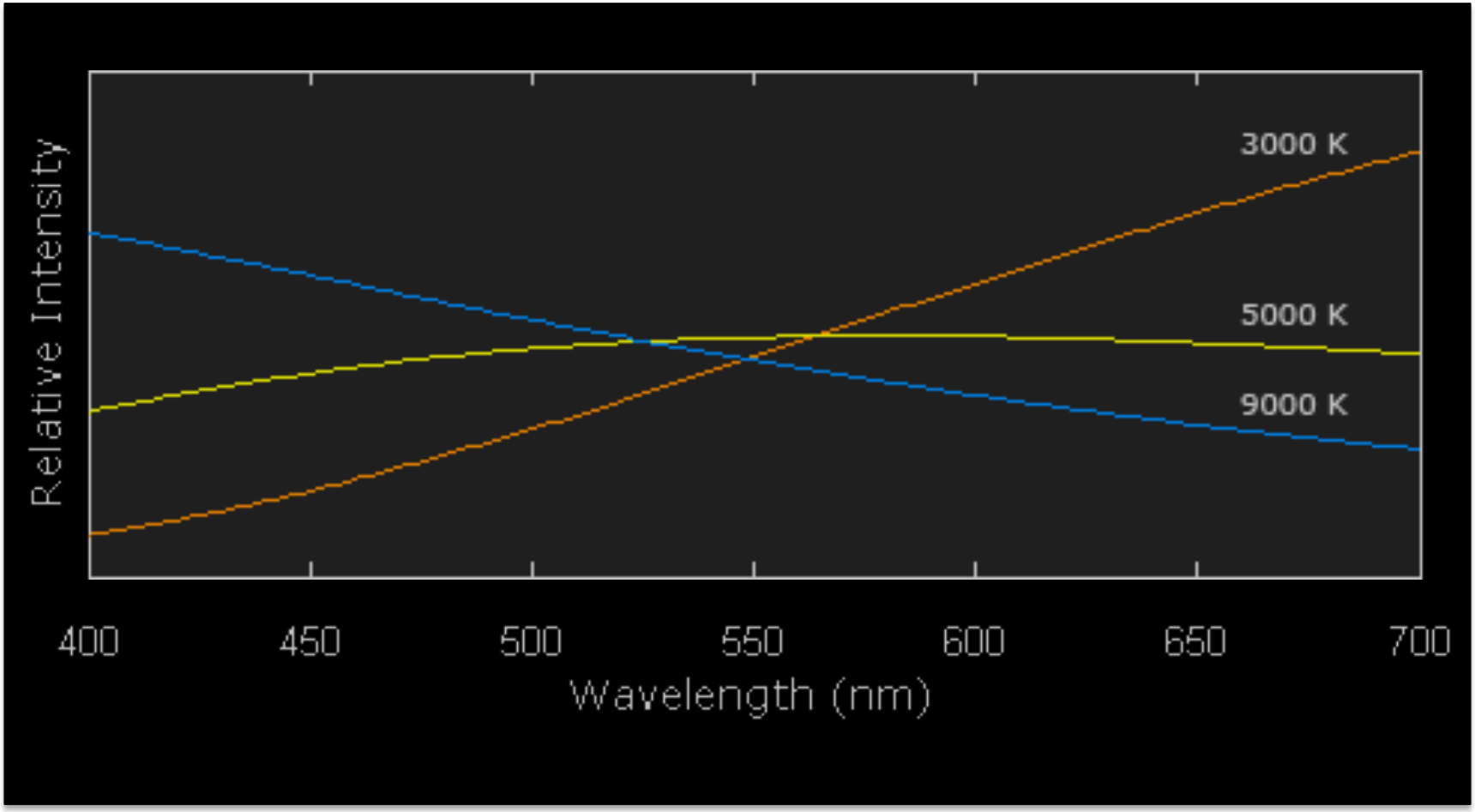
- Blackbody Radiators
  - Light spectrum dependent on temperature
  - Sun
  - Incandescent Bulb
- Atomic and Molecular Emission
  - Neon lights
  - Compact Fluorescent Light
  - OLEDs

Sun



http://en.wikipedia.org/wiki/File:Solar_Spectrum.png

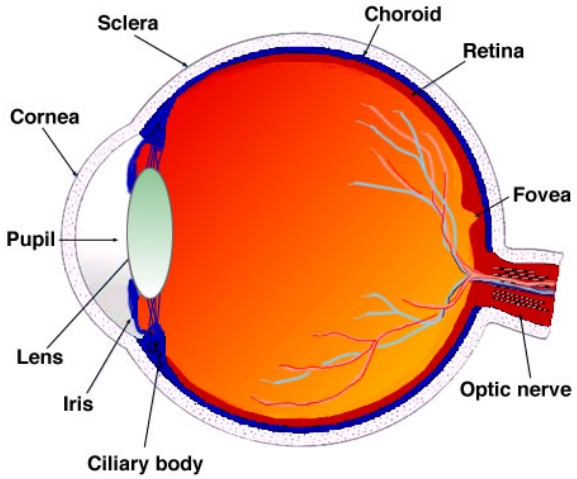
Color Temperature

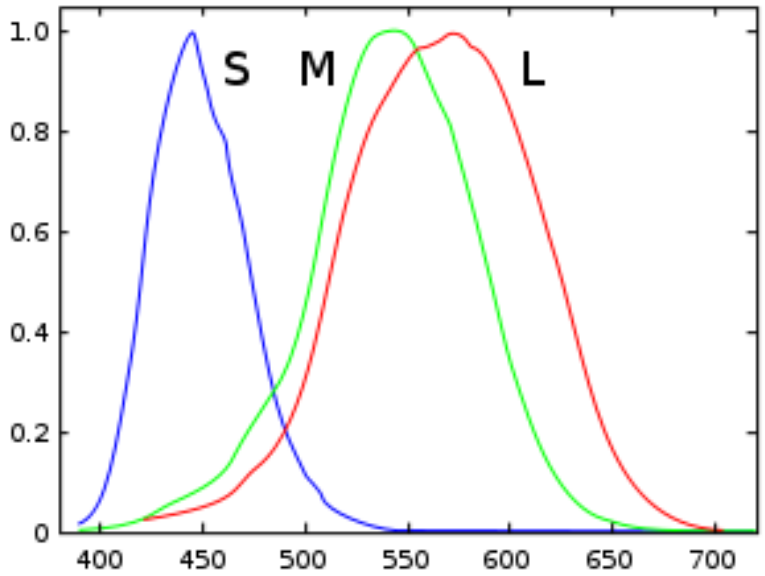


http://www.cambridgeincolour.com/tutorials/white-balance.htm

Biology of the Eye

- Rods and Cones
- Lens and Pupil

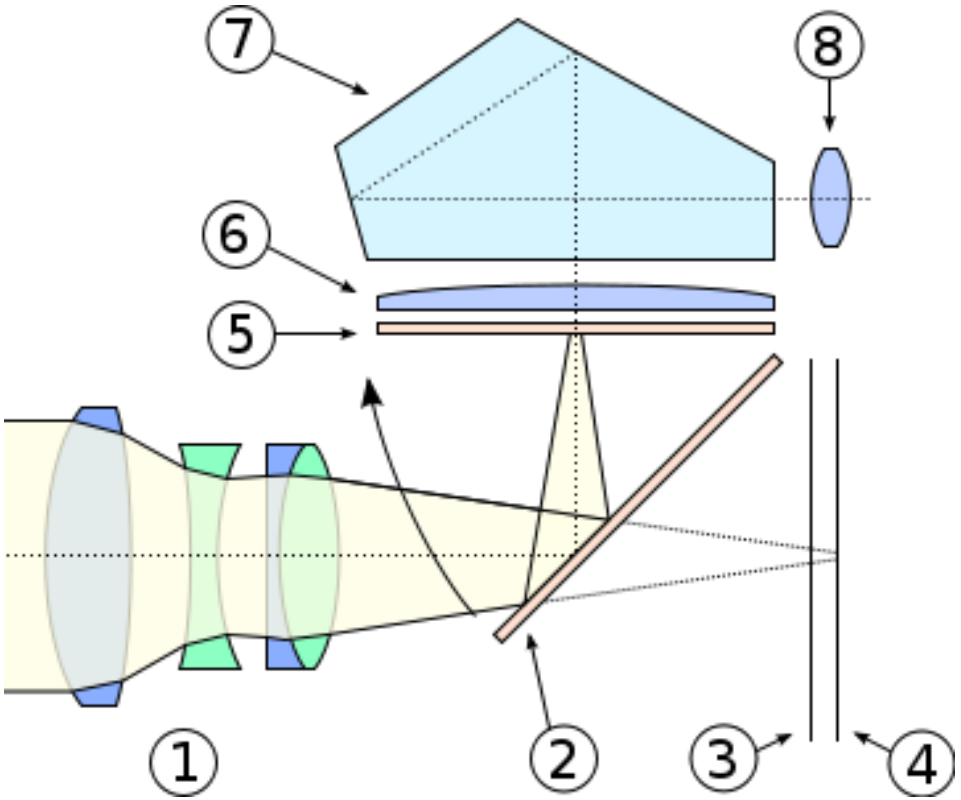




http://en.wikipedia.org/wiki/Color_vision
http://www.optometry.uwaterloo.ca/~tsinger/intro.html

Camera Hardware

- Image Sensor
- Lens



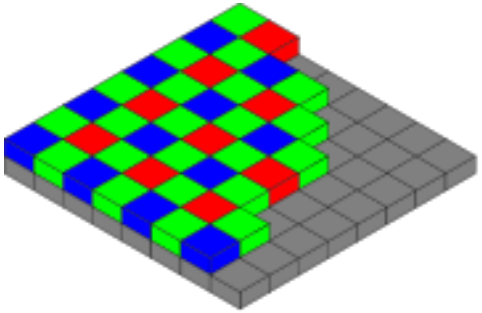
http://en.wikipedia.org/wiki/Single-lens_reflex_camera

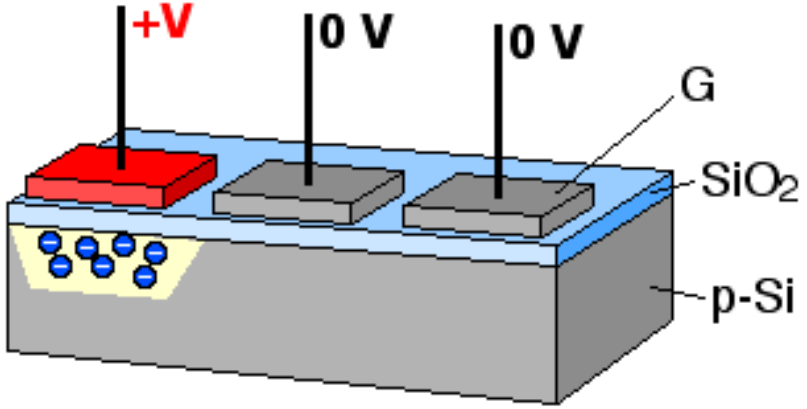
Camera Sensor

- CCD
  - 2009 Nobel Prize in Physics
- CMOS
- Bayer Pattern
- Foveon
- Noise

CCD

- 2009 Nobel Prize in Physics
- Bucket Brigade
- Bayer Pattern
- Megapixels

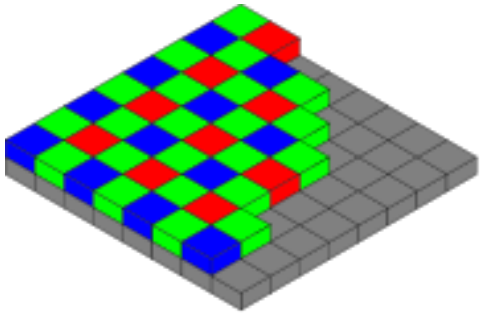


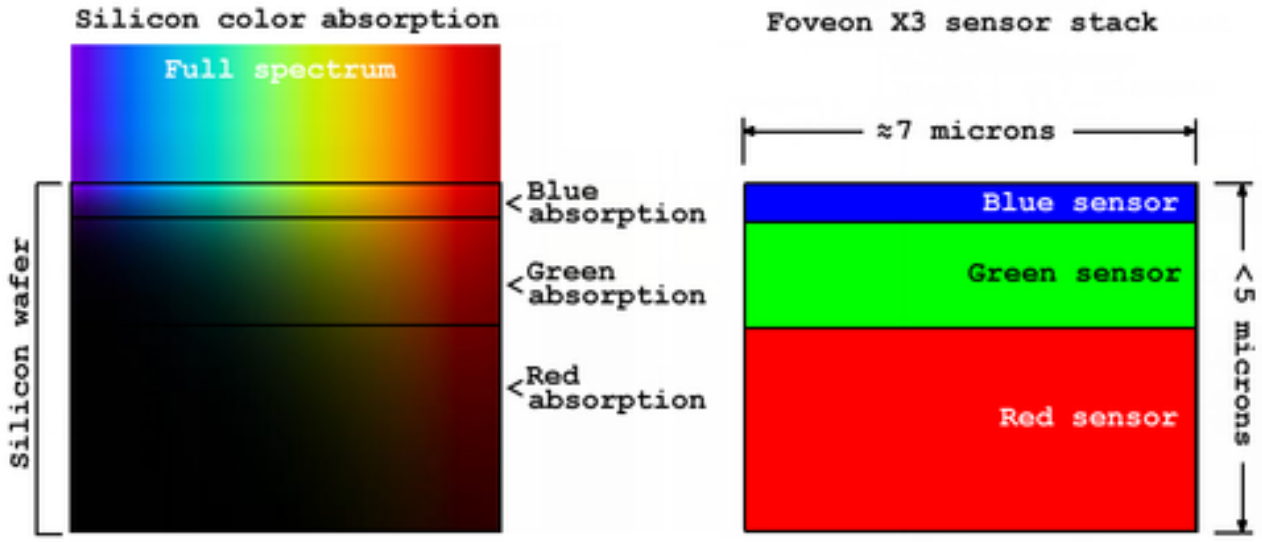


http://en.wikipedia.org/wiki/Charge-coupled_device

Foveon X3 Sensor

- CMOS
- Sigma Corporation
- What's a pixel?





http://en.wikipedia.org/wiki/Foveon_X3_sensor

Digitization

- Spatial
  - Megapixels
- Color Intensity
  - Bit Depth
  - JPG
    - 8 bits per color => 256 values for each color
    - 3 colors => 256^3 = 16.7 Million Colors

Types of Cameras

- Point and Shoot
  - Compact
- Advanced Point and Shoot
  - Better Lens
  - More manual settings
- DSLR
  - Interchangeable Lenses
  - Better Image Sensor

http://www.usa.canon.com/

Hacking Firmware

- Canon Hack Development Kit (CHDK)
- Unlock features by replacing software
- Loaded from memory card
- Non-destructive
- Use at your own risk
  - May void warranty
  - May damage camera
- http://chdk.wikia.com/wiki/CHDK
- Canon SD850

Installing CHDK

Camera Settings

- White Balance
- ISO
- Aperture Size
- Shutter Speed

White Balance

- Adjusts for light source
- Usually in terms of conditions
  - Indoor, outdoor, cloudy, tungsten, etc.
- Some people use calibrated targets
  - Pieces of paper or plastic with known color values
- Camera usually does a bad job with Auto White Balance

ISO

- Dynamic Range
- What do we consider to be max value?
- Fight against noise
  - Due to electrons hoping around since sensor is at absolute zero
- Low iso for bright places
- Higher iso for darker places
- ISO = camera sensitivity

ISO

- Show CS Slides for noise
- http://graphics.stanford.edu/courses/cs178-09/schedule.html

Aperture

- Controls how much light comes in
- Larger Aperture
  - smaller f number
  - more light
  - smaller depth of field
- Smaller Aperture
  - larger f number
  - less light
  - larger depth of field
- Demo with applet

http://graphics.stanford.edu/courses/cs178-09/applets/dof.swf

Bring Subject into focus

Shutter Speed

- Controls how long the sensor is exposed to light
- Stop Action
- Motion Blur
- Night time photography
- Drawing with light

Faster Shutter Speed

http://www.flickr.com/photos/19671083@N00/

Slower Shutter Speed

Slow Shutter Speed (32 sec)

http://www.flickr.com/photos/19671083@N00/

Drawing with Light

http://www.flickr.com/photos/19671083@N00/

GIMP Demo

- **G**nu **I**mage **M**anipulation **P**rogram
  - Free Photoshop alternative
  - Runs on Windows, OS X and Linux
- Post Processing
- RAW Processing
- HDR

Histogram

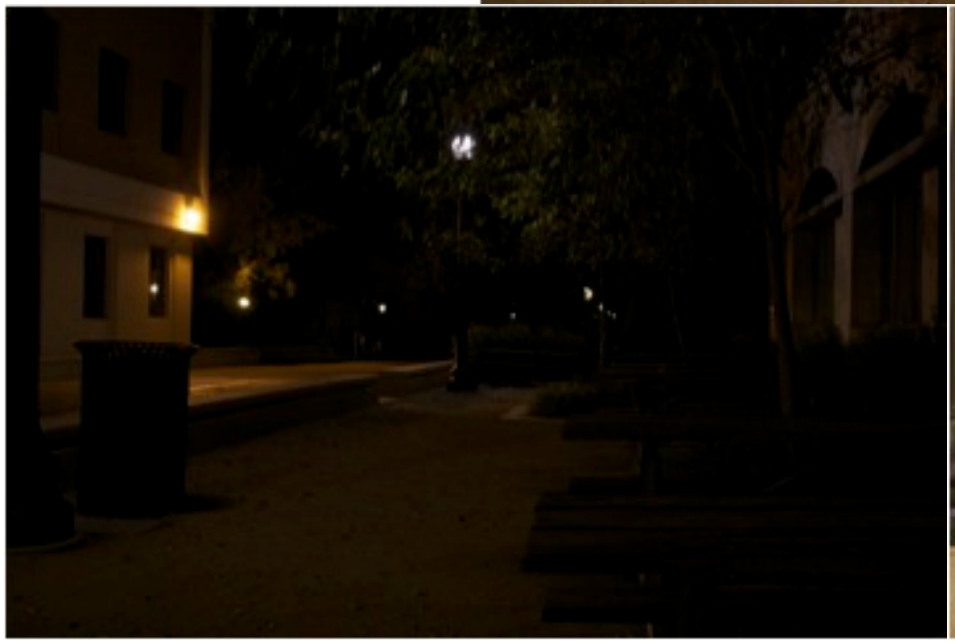
- Check Exposure
- Maximize Range of Camera

Histogram is Subject Dependent

Fix Rainbow

RAW Processing

HDR



HDR

HDR with GIMP

Tips

- Be Still
  - Use a Tripod
  - Shutter Delay
- Take a lot of pictures
- Compose picture
- Always have camera handy

300 pictures taken, 30 decent

Cellphone Camera

PhotoArt

http://www.hawkstudios.net/

Future Tech: Really Cool and Awesome

- Mark Levoy
  - Stanford Professor
  - Teaches Digital Photography CS178 class
- Refocus image after taking it
- Capturing Light Field
- Open Source Camera

http://news.stanford.edu/news/2009/august31/levoy-opensource-camera-090109.html
http://www.graphics.stanford.edu/~levoy/Stanford

Summary

- White Balance
- ISO
- Aperture Size
- Shutter Speed

For More Information

- http://graphics.stanford.edu/courses/cs178-09/