

# Going Digital!

- **What is Digital Photography?**
- **How Do Digital Cameras Work?**
- **About Image Quality** (Megapixels, Compression, etc)
- **Fundamentals of the Digital Image**
- **Digital Pros & Cons**
- **Digital Thru-Hiking**

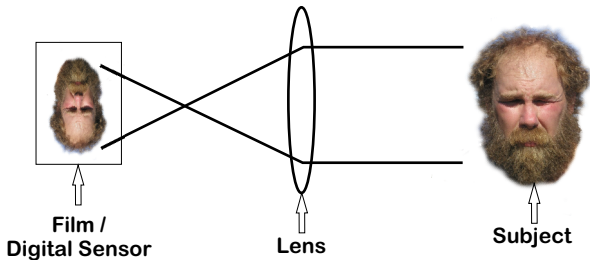
**By: Jonathan Ley**

**[www.phlumf.com](http://www.phlumf.com)**

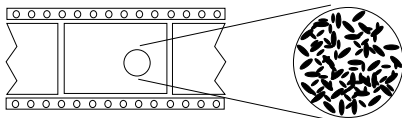
**Updated for ALHDA-west Gathering**

**October 2004**

# Digital vs. Film...

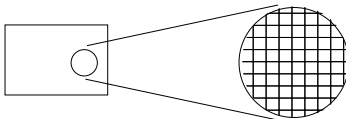


# Digital vs. Film...



**Film...**

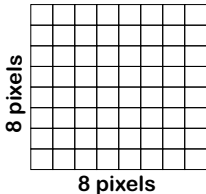
**...is made of grains**



**Digital Sensor...**

**...is made of a grid.**

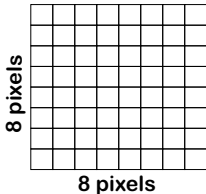
## How does it work?



$8 \text{ pixels} \times 8 \text{ pixels} = 64 \text{ pixels}$

Each square in the grid can sense  
one point of light, or “pixel”

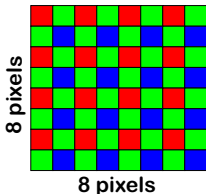
# How does it work?



$8 \text{ pixels} \times 8 \text{ pixels} = 64 \text{ pixels}$

Each square in the grid can sense  
one color

## How does it work?

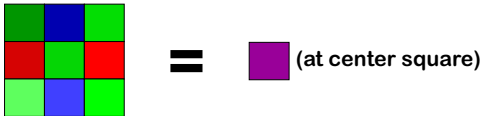


8 pixels x 8 pixels = 64 pixels

Each square contains a color filter.

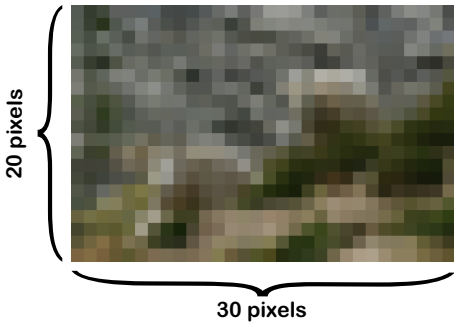
The colors are arranged in a special pattern...  
(bayer filter pattern)

## How does it work?



The camera mixes the colors from neighboring pixels to determine the “actual color” for each pixel.

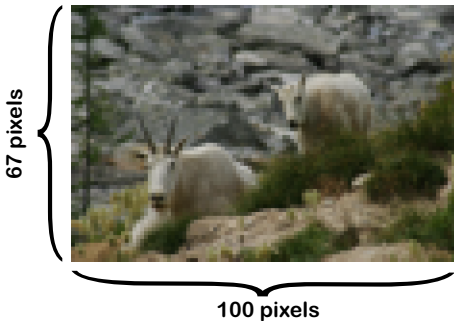
**More pixels give a clearer image**



$$20 \times 30 = 600 \text{ pixels}$$

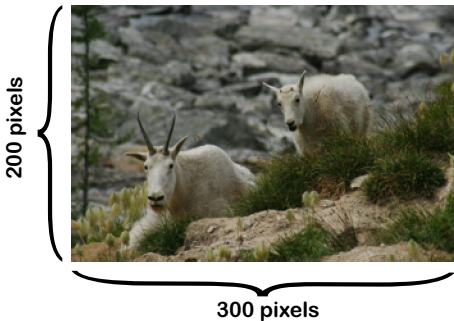


## More pixels give a clearer image



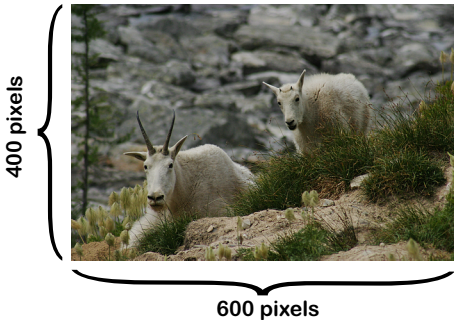
$$100 \times 67 = 6,700 \text{ pixels}$$

## More pixels give a clearer image



$$200 \times 300 = 60,000 \text{ pixels}$$

# More pixels give a clearer image



$$400 \times 600 = 240,000 \text{ pixels}$$

## How clear is clear? (a rough guide!)

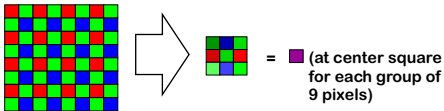
| Vertical | Horizontal | Pixels  |                      |
|----------|------------|---------|----------------------|
| 480      | 640        | 307,200 | ← OK for e-mail      |
| 768      | 1024       | 786,432 | ← This projector!    |
| 1200     | 1600       | 1.9M    |                      |
| 1500     | 1950       | 2.9M    |                      |
| 1600     | 2100       | 3.4M    | ← Point & shoot film |
| 1704     | 2272       | 3.9M    |                      |
| 2000     | 2600       | 5.2M    | ← Good 35mm print    |
| 2048     | 3072       | 6.3M    | ← Good 35mm slide    |
| 2400     | 3600       | 8.6M    |                      |
| 2800     | 4200       | 11.8M   |                      |
| 3200     | 4800       | 15.3M   | ← Medium format 6x7  |
| 4000     | 6000       | 24M     |                      |
| 5000     | 7500       | 37.5M   |                      |

- “Equivalent Clarity” is very subjective  
& a matter of **MUCH** debate!!!

# “Ideal Resolution” vs. “True Resolution”

Other factors can help determine your “true resolution”

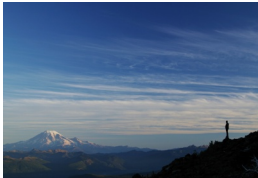
- Quality of the lens
- Quality of the sensor (“Noise”, etc.)
- Quality of the photographer
- Shutter speed & camera “shake”
- Remember this...?



# Data compression...

- Image files are usually “compressed” (.jpg is most common)
- More compression = smaller file size
- More compression = lower “quality”

Uncompressed 6.3 Megapixel Image = 13.8 Mb



Low Compression = 0.85 Mb

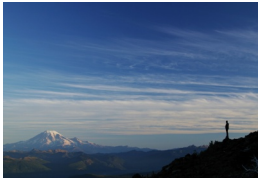


High Compression = 0.16 Mb

# Data compression...

- Compressed file sizes also depend on the “complexity” of the image

Low Compression, 6.3 Megapixel Image...



Simple image = 0.85 Mb



Complex image = 3 Mb

# Storage...

- Photos are stored as digital files on infinitely re-usable memory cards.
- Memory cards can be removed, re-inserted into the camera.
- Memory comes in many types / sizes
- Connect your camera (or a memory card reader) to your computer with a cable (USB, etc.)
- You can then print the image, e-mail it, put it on the www...



# How much memory is enough?

- How many photos can you fit on a memory card?...
- Low compression... Average complexity...
- Actual results may vary!

|               |      | Memory card size |      |       |       |       |
|---------------|------|------------------|------|-------|-------|-------|
| Camera pixels |      | 32Mb             | 64Mb | 128Mb | 256Mb | 512Mb |
|               | 1.9M | 42               | 85   | 170   | 340   | 679   |
|               | 2.9M | 28               | 56   | 111   | 222   | 445   |
|               | 3.4M | 24               | 47   | 95    | 190   | 379   |
|               | 3.9M | 21               | 41   | 83    | 165   | 331   |
|               | 5.2M | 16               | 31   | 62    | 124   | 248   |
|               | 6.3M | 13               | 26   | 51    | 102   | 205   |
|               | 8.6M | 9                | 19   | 37    | 75    | 150   |

...Number of photos

# Going Digital... Pros & Cons.

- + **Experimentation** (no added cost for many more photos)
- + **Immediate Feedback** (photos displayed on Camera's LCD panel)
- + **Long-Term Storage** (no degradation)
- + **The "Digital Darkroom"** (big plus!)
  
- +/- **Traveling Flexibility** (improving every year)
- +/- **Cost** (cheaper "per shot", but computer, memory, batteries, camera, printer, etc. add up!)
  
- **Batteries** (only a problem on a long hike)
- **Slide shows...** (expensive digital projector)
- **Color resolution & funky aberrations...**

# Other Digital Considerations

- **Adjustable White Balance Settings.** (for shadows, clouds, indoor)



Indoor Lighting



Corrected

- **Greater Contrast Range With Some Digital Cameras**



Digital



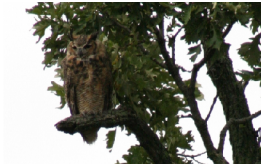
Film

# Other Digital Considerations

- Digital Color gradients



- High-contrast “bleeding”



# Other Digital Considerations

- On-the-fly ISO adjustments for low-light / fast shutter.

ISO 100

ISO 400

ISO 1600

- Moire

# Other Digital Considerations

- Aspect ratio on many digital cameras is different than 35mm



35mm Film 4 x 6

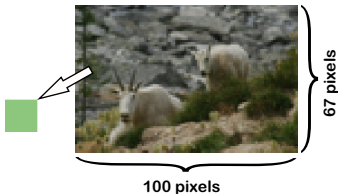


Digital 3 x 4

- “Grain” looks different than film
- Learning curve getting easier all the time...  
...but new features are being added too!
- Whatever you buy will be old technology tomorrow!

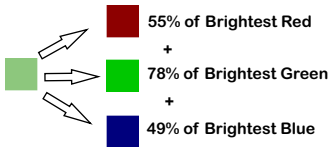
# Intro to Digital Images

- Digital images are made of pixels
- Each pixel is one solid color



# Intro to Digital Images

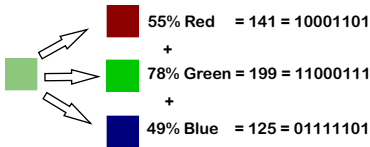
- A color is made from its primary components or “channels”
- Any color can be made from a combo of Red + Green + Blue
- That color is represented by a code of 1’s & 0’s or “bits”
- More bits = more precise color





# Intro to Digital Images

- 8-bit / channel color (also called 24-bit color)
- 256 possible colors for each channel
- Supported by most major formats (.jpg, .tif, etc.)
- Very smooth color transitions possible.

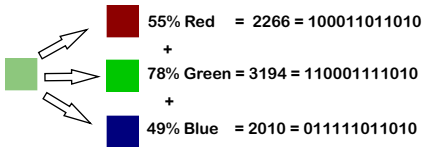


100011011100011101111101 = 24-bit color = 16 Million possible colors

24 "bits" for each pixel

# Intro to Digital Images

- 12-bit / channel color (also called 36-bit color)
- 4,096 possible colors for each channel
- Used by many higher-end digital cameras (RAW formats)
- Gives a wider range of editing possibilities

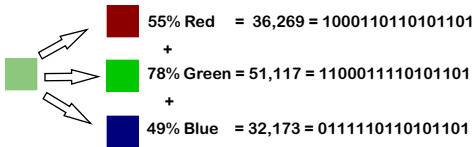


10001101101011000111101001111101 = 36-bit color = 68 Billion colors

36 "bits" for each pixel

# Intro to Digital Images

- 16-bit / channel color (also called 48-bit color)
- 65,536 possible colors for each channel
- Used in some scanning & high-end publishing, etc.
- Extremely large file sizes



100011011010110111000111101011010111110110101101 = 48-bit color  
= 281 Trillion colors

48 "bits" for each pixel

# All about DPI

- A pixel = A “Dot”
- **DPI = D<sub>ots</sub> P<sub>er</sub> I<sub>nch</sub>**
- DPI defines how “big” you want each pixel to be printed



300 “dots” @ 100 dpi = 3 inches horizontal

200 “dots” @ 100 dpi = 2 inches vertical

or

300 “dots” @ 50 dpi = 6 inches horizontal

200 “dots” @ 50 dpi = 4 inches vertical

or

300 “dots” @ 300 dpi = 1 inch horizontal

200 “dots” @ 300 dpi = 0.66 inches vertical

# All about DPI


- DPI is an arbitrary measurement
- The DPI of an image is totally defined by YOU!
- The DPI of an image can be RE-defined by YOU!
- Higher DPI = Smaller, crisper printed image
- Lower DPI = Larger, fuzzier printed image
- With more pixels, you can print a larger, crisper image


# How much DPI is enough?

- 72 dpi = most computer monitors
- 150 dpi = newsprint
- 300 dpi = fine photos / magazines, etc.
- The human eye can not easily perceive more than 300 dots per inch...

# DPI, a rough guide...

| Vertical |   | Horizontal |   | Pixels  | 100 dpi     | 200 dpi     | 300 dpi     |
|----------|---|------------|---|---------|-------------|-------------|-------------|
| 480      | x | 640        | = | 307,200 | 4.8 x 6.4   | 2.4 x 3.2   | 1.6 x 2.1   |
| 768      | x | 1024       | = | 786,432 | 7.7 x 10.2  | 3.8 x 5.1   | 2.6 x 3.4   |
| 1200     | x | 1600       | = | 1.9M    | 12.0 x 16.0 | 6.0 x 8.0   | 4.0 x 5.3   |
| 1500     | x | 1950       | = | 2.9M    | 15.0 x 19.5 | 7.5 x 9.8   | 5.0 x 6.5   |
| 1600     | x | 2100       | = | 3.4M    | 16.0 x 21.0 | 8.0 x 10.5  | 5.3 x 7.0   |
| 1704     | x | 2272       | = | 3.9M    | 17.0 x 22.7 | 8.5 x 11.4  | 5.7 x 7.6   |
| 2000     | x | 2600       | = | 5.2M    | 20.0 x 26.0 | 10.0 x 13.0 | 6.7 x 8.7   |
| 2048     | x | 3072       | = | 6.3M    | 20.5 x 30.7 | 10.2 x 15.4 | 6.8 x 10.2  |
| 2400     | x | 3600       | = | 8.6M    | 24.0 x 36.0 | 12.0 x 18.0 | 8.0 x 12.0  |
| 2800     | x | 4200       | = | 11.8M   | 28.0 x 42.0 | 14.0 x 21.0 | 9.3 x 14.0  |
| 3200     | x | 4800       | = | 15.3M   | 32.0 x 48.0 | 16.0 x 24.0 | 10.7 x 16.0 |
| 4000     | x | 6000       | = | 24M     | 40.0 x 60.0 | 20.0 x 30.0 | 13.3 x 20.0 |
| 5000     | x | 7500       | = | 37.5M   | 50.0 x 75.0 | 25.0 x 37.5 | 16.7 x 25.0 |

Size of camera's sensor (pixels)

Size of printed image (inches)

# Considerations for a long hike

- Weight, batteries, memory cards, logistics
- How many photos do you plan to take?
- What will you do with your photos when you're done?
  - Web site
  - Slide show
  - Photo album/scrapbook
  - e-mail / regular mail to family & friends
  - Make postcards? etc...



# Digital Thru-hike Strategies

All plans:

- Battery Charger in a drift box.

Plan “A”

- Buy tons of memory cards & treat like film - ration your photos per section or per day.
- Sell the memory on “e-bay” when you get done.

Plan “B”

- Mass-Storage device in your drift box
- 40G+ Dedicated Mass-Storage ~\$200?
- Quickly becoming one of the best options.

# Digital Thru-hike Strategies

## Plan “C”

- Buy 3 to 4 cards.
- When you fill up a card, mail it home.
- Person at home downloads photos to computer & mails cards to your next stop so you can re-use them.
- Person at home must be computer savvy & committed!

## Plan “D”

- Burn your photos to CD-ROM's en-route when you get to a big town, or “trail angel”
- Maybe more feasible in coming years.

# Digital Thru-hike Strategies

## Plan “E”

- e-mail your photos home as you go.
- Probably a BAD PLAN for the next 5-10 years!!!

## Plan “F”

- Go “half-digital” - digital till you run out of memory & then switch to film.

## Plan “X”

- Be creative! mix it up!

# Digital Thru-hike Tips

- Minimize use of LCD panel to save batteries
- Beware of bad weather!
- Change quality/size settings for the quality of the shot:
  - Funny trail sign = low quality/size
  - Hiking buddies = medium quality/size
  - View from Forester Pass = High quality/size
- Erase / Edit “bad” photos when you get to town & have batteries/power to spare.

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