Basic Digital Photography

Basic Digital Photography Objectives

The primary objective of this class is to help each student to have confidence in his/her ability to get consistent and successful results with a camera, thereby enjoying photography more fully. I hope to achieve these goals by:

- Familiarizing each student with his/her camera and its operation, capabilities, and limitations.
- Acquainting each student with the theories of light and optics as they apply to digital photography.
- Familiarizing each student with the terminology used in digital photography.
- Helping each student to understand which expensive toys he/she really needs and how to find reputable sources of products and information.

PLEASE REMEMBER TO BRING YOUR CAMERA AND ACCESSORIES TO EVERY CLASS

Each class begins with a review of the previous class's shooting assignment, followed by critique and discussion.

The day's topic will be covered through video and Power Point presentation, show and tell, and some hands-on work, followed by discussion.

Classes are based primarily on Q&A and discussion.

Once homework assignments are explained, the floor will open for questions and comments about the equipment used by the students.

A Bit of Photo History…

1915-1935

Musicians Leopold Godowsky and Leopold Mannes

1. Color motion pictures before 1922
2. Kodachrome color movie film-1933
3. April 15, 1935-Kodachrome Color Slide Film
   - **a.** First two-layer film
   - **b.** Agfa in Germany had the first three layer film

1946-Agfa's technology is now public domain;

Ektachrome is born.

1963- Unnamed student at Stanford University builds a camera that captures an image on a computer disk. Technology to print it does not exist yet.

October 17, 1969-George Smith and Willard Boyle design the CCD

1975-Steve Sasson, working for Kodak builds 100x100 CCD Digital camera, weighed 8 lbs., shot in B&W, saved images to cassette, viewed on television, still no printing technology.

Steve Sasson and the first known truly digital camera from 1975

1981-Sony Mavica (Magnetic Video Camera) Still video camera 720,000 pixels on a 2” Floppy. It was not a digital camera, it was an analog electronic camera, a “still video camera.”

The FD-5 was the first digital Mavica in late 1997.

1986-Kodak unveils the first 1.4 million pixel sensor, before the term megapixel was coined.

1987-The Kodak Photo CD

1988-Canon Xapshot, another still video camera. Expensive, bad prints.

1990-Logitech Dycam Model 1: 376x240 Pixel B&W digital image. First fully digital consumer camera. Needed a TV or a computer to view images. Still no good affordable prints.

1991- The Kodak DCS: a Nikon F3 with a 1.3 Mp sensor about $13,000,00. Commercial printers could make bad prints for you, about $25.00 for a bad 3-1/2 x 5.

1994-Apple Quicktake 100: Color digital camera that actually sent 640x480 pixel (.3 Mp) images to a computer. Had a built-in flash. Printers were available for making bad prints. Cost a little under $800.00. The first two models were made by Kodak, the good one was made by Fuji.

Apple Quicktake 100 and 150-Introduced in 1994, built by Kodak

Apple Quicktake 200-Introduced February 1997, built by Fuji. It was actually the Fuji DS-7 and you could use the Fuji software to make images from the Apple camera Windows compatible. Several other manufacturers, including Samsung offered the same camera, made by Fuji!

1994~2000-Many digital cameras of various shapes and sizes were made by nearly every camera, computer, and electronics manufacturer around. None particularly good.

1996-APS Film, APS-Classic (16x24mm) format would become the new standard sensor size for digital cameras.

2002-Canon 1Ds 11.1 Mp Full-Frame 35mm Sensor DSLR

Proved superior to Kodak DCS14, a 14 Mp Full-Frame DSLR released at about the same time.

2003-Canon Digital Rebel was the first affordable DSLR 6Mp, about $1000.00

2004-Canon 1Ds Mk.II 16.7 Mp Full-Frame 35mm Sensor DSLR, about $7000.00

2007-Canon 1Ds Mk.III 21.1 Mp Full-Frame 35mm Sensor DSLR, about $7000.00

2008-Nikon D3x: 24Mp Full-Frame 35mm Sensor DSLR

2009-Everybody's on the full-frame bandwagon, at last: Canon, Nikon, Sony, Leica…

What makes a digital camera go?

1. The central processor runs the camera
2. The lens sends the image to the sensor
3. The sensor captures the image
4. The memory card stores the image

Pretty simple, isn't it?

Sensors and Sensitivities…

With apologies to Jane Austen

A digital camera's sensor is an electronic chip that responds to light by creating an electric signal.

There are two types of sensors used in current digital cameras:

1. CCD 2. CMOS

Each has its own advantages and drawbacks.

CCD

Invented in 1969 by Willard Boyle and George E. Smith at AT&T Bell Labs.

Charge Coupled Device: A CCD is an analog device. When light strikes the chip it is held as a small electrical charge in each photo sensor. The charges are converted to voltage one pixel at a time as they are read from the chip. Additional circuitry in the camera converts the voltage into digital information.

1. Cheapest image sensor
2. Easiest to make

In 2009 Boyle and Smith were posthumously awarded the Nobel Prize in Physics for their contributions and accomplishments with the CCD.

CMOS

Complimentary Metal-Oxide Semi-Conductor: Invented in 1963, patented in 1967 by Frank Wanlass, and designed and built by him while he worked for Fairchild Semiconductor in Ohio; a CMOS chip is a type of active pixel sensor made using the CMOS semiconductor process. Extra circuitry next to each photo sensor converts the light energy to voltage. Additional circuitry on the chip converts the voltage to digital data.

1. Eight times Faster than CCD
2. Uses fewer components than a CCD
3. Uses less energy than a CCD

Sensor Types

Each pixel is represented on your camera's sensor as a **"PHOTOSITE"** Each photosite has a tiny lens in front of it designed to direct light to the photosite as efficiently as possible. The photosites on a sensor are referred to casually as "pixels."

A million pixels is referred to as a "megapixel."

A sensor's resolution is represented by a two-dimensional count of pixels or photosites.

A Nikon D7000 has a resolution of 4,928 x 3,264,

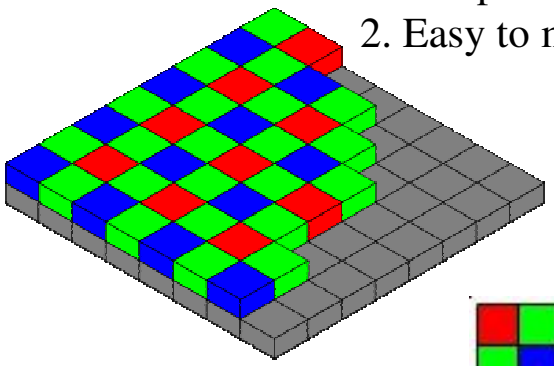
or 16.2 megapixels.

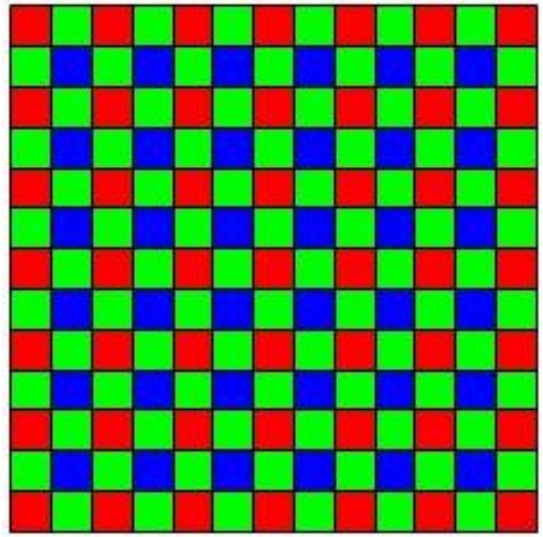
How the photosites are arranged on a sensor determines the type of sensor your camera uses.

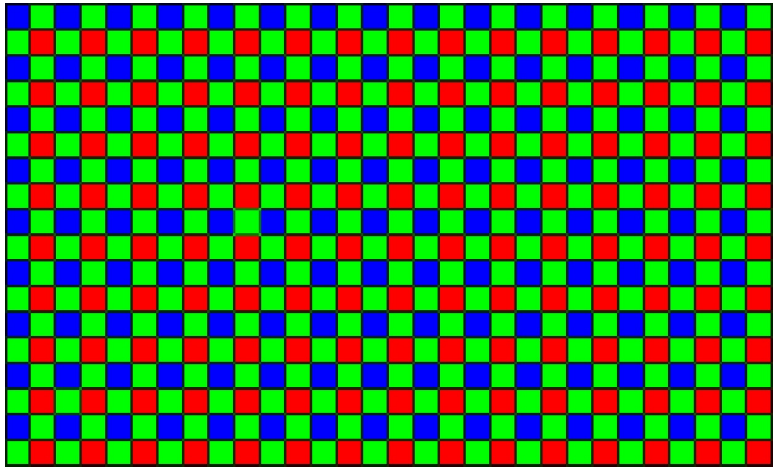
Bayer Filter

A Bayer filter mosaic is a color filter array (CFA) for arranging RGB color filters on a square grid of photo sensors. Its particular arrangement of color filters is used in most single-chip digital image sensors used in digital cameras, camcorders, and scanners to create a color image. The filter pattern is 50% green, 25% red and 25% blue, hence is also called GRGB or other permutation such as RGGB. It is named after its inventor, Dr. Bryce E. Bayer of Eastman Kodak. It was invented in 1975.

1. Not perfectly color accurate, but still very close to the human eye.
2. Easy to make-miniaturizes well



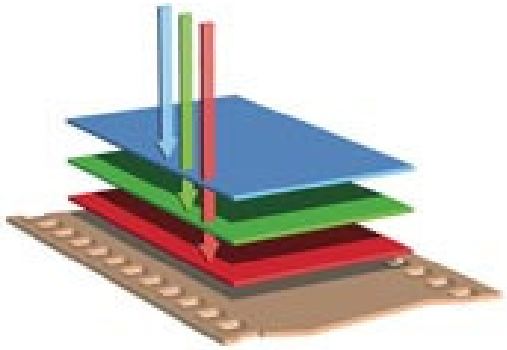




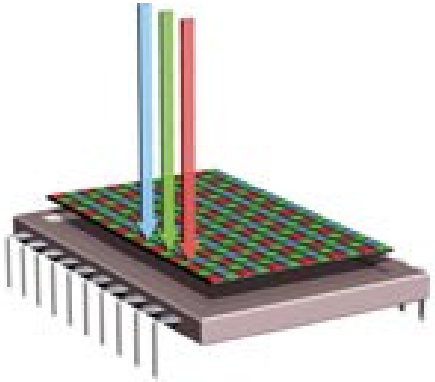
Foveon

The Foveon X3 sensor, Nmed for the Fovea of the eye, is a CMOS image sensor for digital cameras, designed by Foveon, Inc. and manufactured by National Semiconductor and Dongbu Electronics. It uses an array of photosites, each of which consists of three vertically stacked photodiodes, that are organized in a two-dimensional grid. Each of the three stacked photodiodes responds to different wavelengths of light, i.e., each has a different spectral sensitivity curve. This is due to that fact that different wavelengths of light penetrate silicon to different depths. The signals from the three photodiodes are then processed, resulting in data that provides the three additive primary colors, red, green, and blue.

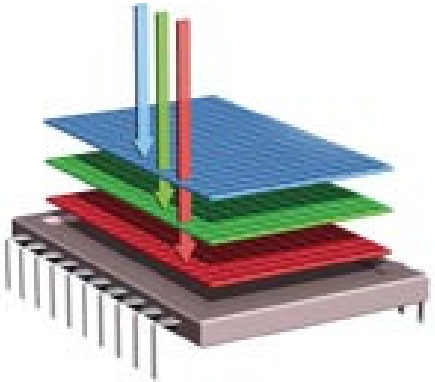
1. More accurate color than CCD or regular CMOS
2. Slower processing than regular CMOS, because there is approximately three times as much to process



COLOR FILM contains three layers of emulsion which directly record red, green, and blue light.



TYPICAL DIGITAL SENSORS have just one layer of pixels and capture only part of the color.



FOVEON X3 direct image sensors have three layers of pixels which directly capture all of the color.

Foveon

Foveon is now owned by Sigma Camera, so Foveon sensors are used exclusively in Sigma DSLR cameras.

Fujifilm Sensors

Fujifilm has pursued different sensor configurations much more than other camera manufacturers.

Dissatisfied with the discernable patterns that can form when using square pixels like all other digital cameras used, Fuifilm created the Super CCD which has hexagonal pixels. The hexagonal pattern was harder for the human eye to accidentally notice and enabled Fuji cameras to get about 35% more resolution out of their pixels.

Fujifilm Sensors

In 2012, with the introduction of the X-Pro 1 camera, Fujifilm introduced yet another type of sensor, the X-Trans CMOS which used irregularly sized and shaped pixels which addressed a number of problems native to conventional sensors and registered nearly twice the resolution of conventional sensors.

Needless to say, to get that technology, you have to buy Fujifilms premium “X Series” cameras.

Sensor Size

Different camera types have sensors of different sizes. This is not to be confused with sensor resolution; it is the physical measurements of the sensor. In general, the larger the sensor, the better the images it can produce.

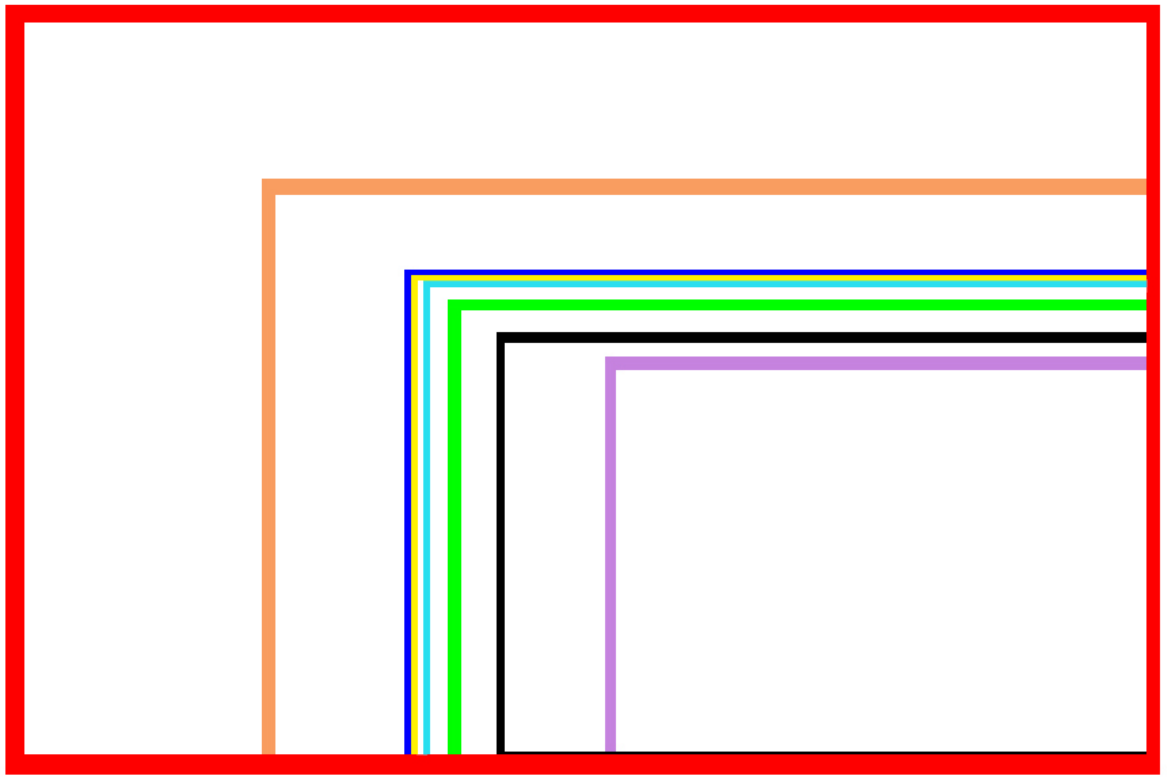
Sensor Size

The larger the sensor, the larger the photosites can be.

The larger the photosite, the lower the incidence of digital noise in an image.

The larger the sensor, the more photosites you can cram onto it.

DSLR Sensor Size



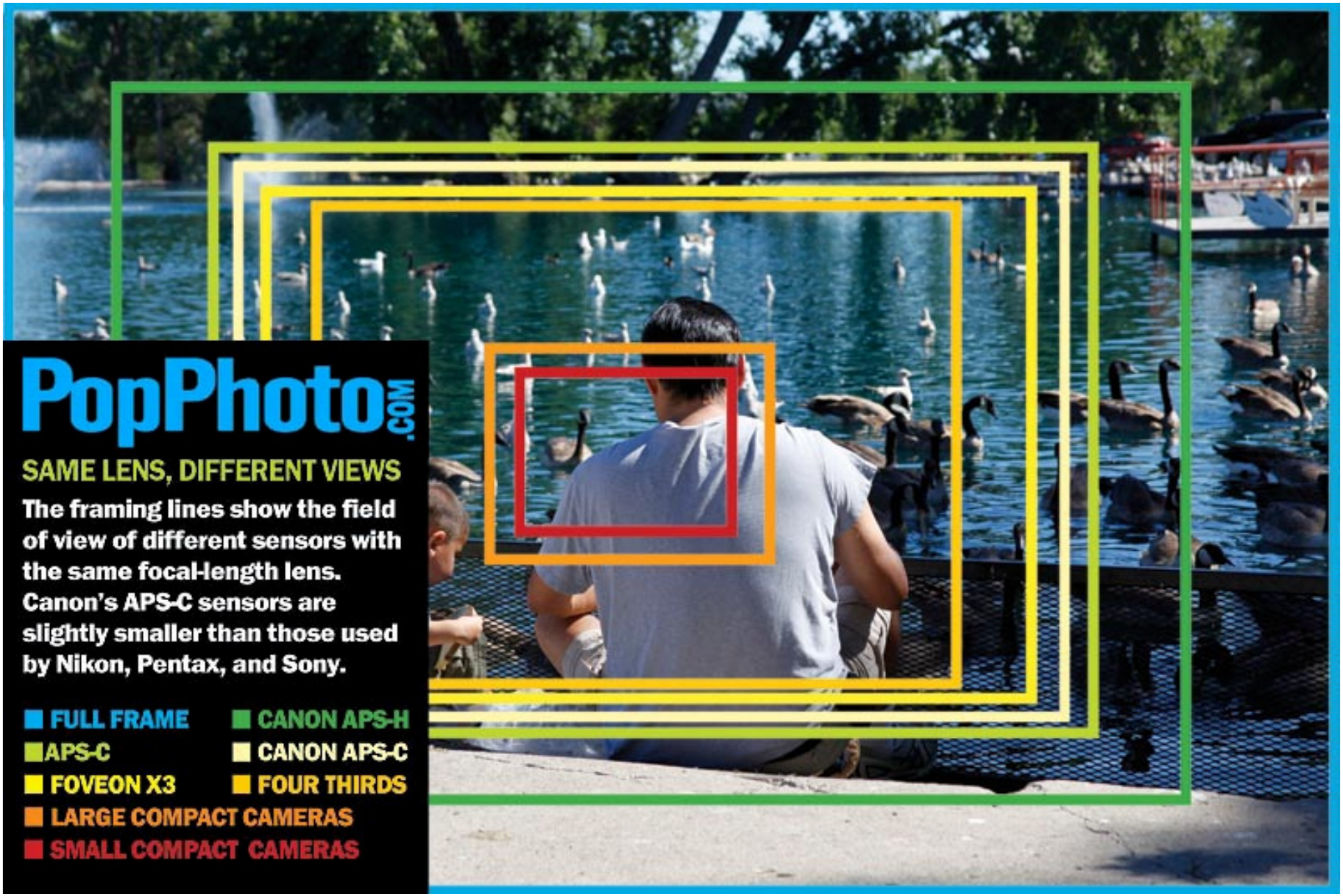
Nikon, Minolta, Sony Canon

Sigma Pentax Olympus

Canon 1D Fuji 35mm

Focal Length Multipliers

When digital cameras first began to blossom, they were always compared to 35mm, usually unfavorably. One of the factors to cause much consternation is the fact that the sensor typical to a digital SLR camera is somewhat smaller than a frame of 35mm film. This meant that the lenses used on 35mm cameras would give a greater magnification when used on a digital camera.


PopPhoto.com
SAME LENS, DIFFERENT VIEWS
The framing lines show the field of view of different sensors with the same focal-length lens. Canon's APS-C sensors are slightly smaller than those used by Nikon, Pentax, and Sony.
FULL FRAME
CANON APS-H
APS-C
CANON APS-C
FOVEON X3
FOUR THIRDS
LARGE COMPACT CAMERAS
SMALL COMPACT CAMERAS

Camera Types

Cameras come in many shapes and sizes from cell phones to big, scary monstrosities. This class is built around the Single Lens Reflex Camera or SLR. Other types of camera that we may address are the Auto-Focus Compact camera and the mirrorless camera.

Auto focus Compact or Point-n-Shoot

1. Usually fairly simple and user friendly
2. Often lacks RAW
3. Often lack manual control or it is difficult to access
4. Convenient and lightweight
5. Still takes good pictures
6. Costs a lot less than a DSLR
7. Some new AFC cameras with larger sensors and greater feature sets are now available.

DSLR-Digital Single Lens Reflex

1. Often not as user friendly
2. Usually makes RAW files
3. Multiple auto to manual shooting modes
4. Larger and heavier than compact cameras
5. Takes far superior pictures
    - **a.** Larger image sensor
    - **b.** Faster processor
    - **c.** Better optics

Mirrorless Camera

A mirrorless camera is usually a camera with both manual and automatic exposure capability that will allow you to change lenses. Mirrorless digital cameras have no optical viewfinder, an LCD is used instead. A mirrorless camera can be much smaller than an SLR and still offer many of the features of an SLR. They are small, lightweight, quick, and quiet. This camera type is growing in popularity quite fast and is well worth watching.

Digital File Types

Digital cameras can process images in several different file types. There are some situations in which some file types may be preferred over others, but in any situation, a RAW file will get the best image, and all other file types can be made from RAW files, but other file types can not be converted to true RAW files.

JPEG-Joint Photographic Experts Group

1. Highly compressible
    - **a.** Highly compressed images lose quality but conserve drive space
    - **b.** Less compressed images take up drive space but print better.
    - **c.** Drive space is cheap these days!
2. Originally intended to be transportable and digitally viewable, not for printing.
3. Newer standards make them printable
4. Ideal for uploading and emailing.

TIFF-Tagged Image File Format

1. Not as compressible as Jpegs
2. Preserve image quality for printing much better than jpegs
3. Use gratuitous drive space

RAW-Ain't been cooked!

1. Almost uncompressed
2. Unprocessed image file
3. Holds tremendous amount of data in a comparatively small file
4. Proprietary to one or two cameras
    - **a.** Requires special software
    - **b.** Must be processed for sharing printing and viewing

DNG- Digital Negative-Adobe version of RAW file

Image Editing Programs

There are innumerable programs available for editing digital images. The prices range from absolutely free to frighteningly expensive.

Here are a few…

Microsoft Paint

1. Slow clunky and limited
2. Built in to Windows-it's free!
3. Does not support RAW or DNG

The Gimp

1. Similar to older versions of Photoshop
2. Free at gimp.org
3. Just as complicated (Almost as powerful) as Photoshop
4. Needs the UFRaw plugin to work with RAW and DNG files, also free at gimp.org.

Adobe Photoshop Elements

1. Older versions sometimes bundled with imaging hardware

   a. Scanners

   b. Printers

   c. Some Cameras

2. As close to Photoshop as you'll get for under $500.00 (Costs under $100.00)

3. Fairly simple to use, but limited

4. Great Inexpensive alternative to Photoshop

Adobe Photoshop Lightroom

1. Similar in functionality to Photoshop Elements
2. Nearly as powerful as Photoshop
3. Requires “cataloguing”
4. Not network friendly and doesn’t like external storage media
5. Uses fewer system resources than Photoshop
6. Under $150.00

Adobe Photoshop

1. Very powerful
2. CS6 can be purchased for about $700 or CC can be “rented” through the Adobe Creative Cloud program which makes it much more affordable
3. Intended for professional use
4. Great for workflow if you need to go into production
5. Not always worth it for the casual shooter.
6. Students get a big, fat, juicy discount.

Your Camera's Software

1. Designed to work specifically with your camera
2. Usually free

a. If you buy a used Digital camera and want its software, make sure it comes with it or that you can download it for free.

b. Often offers access to features of your camera not available through third party software.

3. There is almost always a 30-Day demo that can be downloaded for free. Good for a test-drive.

Canon Software:

Zoom Browser (Image Browser now)-Very simple

Digital Photo Professional-More Advanced

Nikon Software:

View NX2- Fairly simple, with some advanced features.

Olympus:

Camedia Master-Fairly Simple, with some advanced features.

Sony:

Image Data Suite and Picture Motion Browser

RAW File Editing

Fast Stone Viewer-Free at www.faststone.org

Raw Extractor is a fully automatic raw-to-jpeg converter available for free at www.downloads.com

Adobe DNG converter converts RAW files to DNG to edit in Photoshop or Photoshop Elements. Free at www.adobe.com

Next Week…

EXPOSURE AND CAMERA CARE

Make sure you have your camera's owner's manual with you,
I might need it.