Digital Cameras Unravelled
Camera Components

Things to know and consider before buying a digital camera
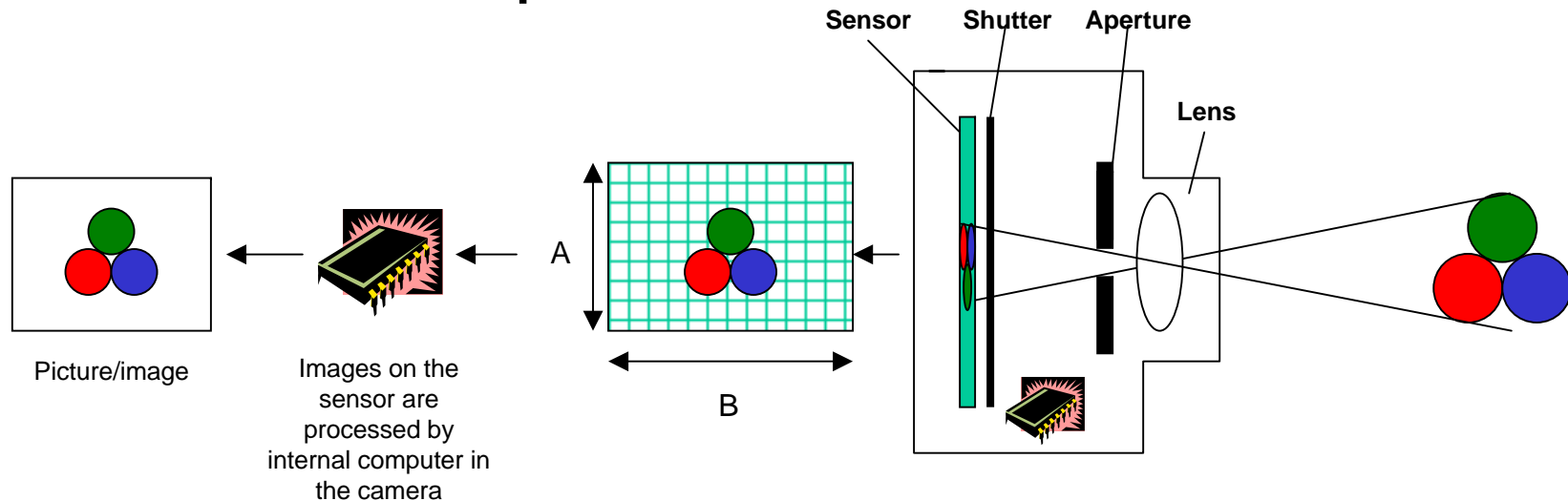
It's Only a Camera….

- "After 40 years of ingesting every aspect of photographic science and composition, I still find the camera to be an endlessly intriguing partner that challenges my imagination and knowledge.
- All that with only 3 variables of:
  – Shutter speed,
  – Aperture [and]
  – Focal length"

    - (Ralph Auletta)

Camera Components

Sensor   **Shutter**   **Aperture**

Lens

A

B

Picture/image

Images on the sensor are processed by internal computer in the camera

- A digital camera has all the same components as film cameras, except the film is replaced by an electronic sensor, made up of millions of photosensitive cells called 'pixels' (**PI**cture **EI**ements) laid in linear rows on a silicon (CCD or CMOS) chip
- The camera also has an internal mini-computer chip to process the data on the sensor chip into an image viewable by the human eye
  - *The number of pixels along A x pixels along B is the number of pixels in the sensor; the number is large so it is quoted in MEGAPIXELS, i.e.*
   - 5 megapixels means there are 5 million pixels

Sensor Resolution
Breaking the Megapixel Myth!

- Pixel density means how many pixels there are in one inch on the sensor
- The more pixels per inch the greater the resolution (sharpness)
- Photographs are usually printed at 300ppi

Pixel array	Photo size @ 300ppi
4000x3000 (12mp)	13x10in
3000x2000 (6mp)	10x7in
2000x1500 (3mp)	6x5in
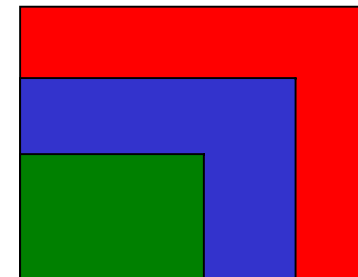
- Therefore a 12MP camera is **NOT** twice as good as a 6MP camera!

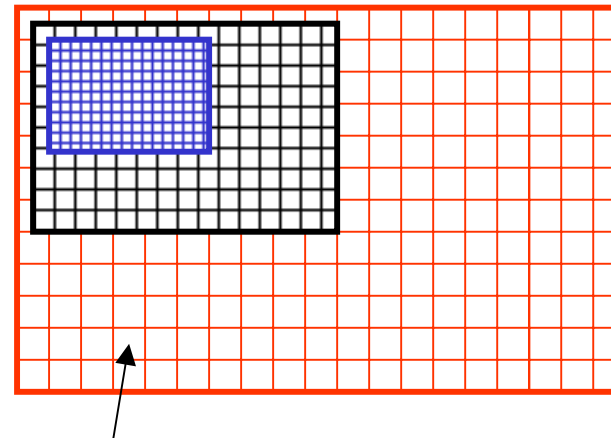Visit my website at www.dhcphotography.co.uk

Sensor Quality
Breaking the Megapixel Myth!

- But picture quality also depends on how big the sensor is
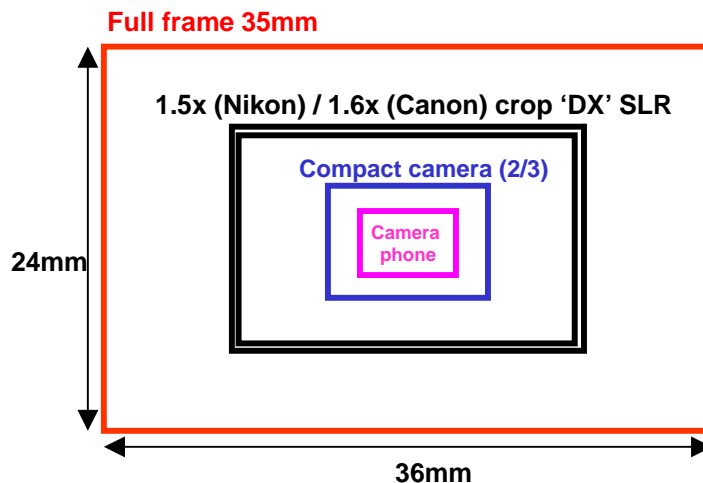
All these chips could be rated 12MP, but the pixel size reduces dramatically

Full frame 35mm

1.5x (Nikon) / 1.6x (Canon) crop 'DX' SLR

Compact camera (2/3)

Camera phone

24mm

36mm

The larger the pixel size, the more light can fall in the sensor, more accurate the light measurement, less diffraction (which causes blur), less dynamic range, etc etc

Choice No 1 – How many Megapixels for me?

Consider: output medium and print-size #1

How do you want to see your pictures?	Recommended Megapixel Range (assuming 300ppi camera output)
I want to view my images on my computer or e-mail them to family & friends.	**1-3 MP** The pc screen resolution is only 1076 x 768 / 72dpi so high megapixel images won't be seen any sharper than lower ones; cameras with lower than 2MP (e.g. camera-phone) will be generally low quality resolution (small chip/lens) if printed, but may be adequate on a 72dpi pc screen
I want to print good quality 6x4 or 7x5 and look at images on the pc/e-mail, etc.	**4 - 6 MP** Will easily accommodate good quality prints of this size and higher providing *Factors Affecting Image Quality* in further section are considered; remember the first consumer SLRs were only 6MP and marketed as high-end digital imaging. When out with the family I turn down my high-end SLR to 5.6MP setting because I will look that them more on the pc; and I can still crop.
I want to print high quality images to hang on the wall up to 10x7 or crop images in photo editing software to get selective images	**7-10 MP** This is the range that most compacts are currently being sold at; to me this is a **megapixel-myth** marketing tool to make you think the image quality is increasing. You really don't need this much for printing up to 7x5 or using a digi-screen. Higher megapixel = higher file size = larger memory card = more hard-disc size = **higher peripheral spend for no real increase in quality**. Make sure your megapixel mammoth can take lower MP rates for day-to-day photography. *If you genuinely use photo-imaging software and crop, or print 10x7 or higher then 7-10MP is an advantage.*

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Choice No 1 – How many Megapixels for me?

Consider: output medium and print-size #2

How do you want to see your pictures?	Recommended Megapixel Range (assuming 300ppi camera output)
I want to print high quality images to hang on the wall up to 12 x 8 (@A4), or crop images in photo editing software to get selective images. I want to use photo-imaging software to change colours, clone, etc. (digital darkroom).	**10 -12 MP +** See *Factors Affecting Image Quality* in further section to ensure your camera is capable of sharp images at this print size. Do you really need a compact with small sensor to have this many megapixels if you don't print above 7x5? Serious photographers will benefit from this size - raw seriously recommended for digital darkroom maximum capability
I want to print high quality images greater than 20x16 (@A3) and/or use serious digital darkroom software	**Use photo-stitching or photo interpolation software** **Or buy a 21MP Canon 1Ds Mark III @£6,000** SLR/Prosumer with high quality lenses / raw output / high-end photo-imaging software are optimum here (see later)

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There are too many cameras to choose from!

Summarising camera types

Compact

All-in-one with telephoto lens, flash, etc

-ready to go!

Optimum Use
- General
- Family
- Holiday
- Fits in hand-bag easily!
- Often have movie setting
- Live view

Not optimum for
- Sports/action (focus lag)
- Low light
- High zoom
- Creative photography
- Changing settings quickly
- Taking snaps immediately

Prosumer

High-quality built-in zoom lens, high quality sensor & settings (e.g. raw)

- quality without the hassle of lugging other kit

Optimum Use
- General photography + limited specialist
- High quality larger prints
- Creative photography (if has e.g. PSAM/Raw)
- Want an all-in one package without compromising quality
- Often have movie setting
- Live view
- High zoom-factor

Not optimum for
- Ultra wide-angle

Digital Cameras Unravelled

SLR

High quality sensor/multi-settings, interchangeable lenses

- total control, flexibility & future-proofing (esp. lenses)!

Optimum Use
- Specialist / creative (full ISO/PSAM, etc)
- Multi-focal lengths
- Raw
- Sports/action
- Weather protection (high-end)
- Personal lens choice
- Shoot immediately – no lag

Not optimum for
- Concealing in a Gucci handbag!
- Live view (but some now coming through)
- Dust-free sensor

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Factors Affecting Image Quality

- Sensor Size / Resolution
- Lenses – rubbish in – rubbish out!
  - Choose a high-quality lens such as Leica/Canon/Nikon/Carl Zeiss
  - SLR (Zooms)
    - Proprietary kit lens – good quality,
    - Non-proprietary lens - good quality but cheaper than pro-lens
    - Proprietary pro-lens - the biggest quality factor in my opinion but at a price
      - Camera body will be obsolete in 18 months but lenses should last a lifetime (but beware DX life-expectancy)
- Aperture (how much light can get in)
  - F1.8-F2.8 Excellent (Pro & some Prosumer)
  - F2.8-4.5 Good (Some Prosumer)
  - F4-F5.6 - usual range (Kit)
  - F5.6-F8 - avoid as you'll get camera shake
    - Vibration Reduction lenses now affordable

- ISO
  - Equivalent to film speed
    - 100/200 slow light capture but little or no grain
    - 400 faster but usually tolerable grain
    - 800 & above borderline grain with compacts (small sensor more artifacts)
    - 1600+ super fast but tending towards unacceptable grain
    - Most compacts are set on auto-ISO, so watch out in low light for high grain
- Focus Lag
  - Most compacts can take up to 2 seconds to focus, meter & shoot meaning you may either miss the action or the model has walked off!
- DIGITAL ZOOM –
  - The best way to deteriorate a good picture – SWITCH OFF THIS SETTING - PLEEEAASSE
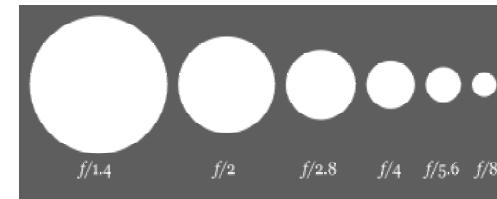
Choice No 2 – Which Camera Type is best for me?

Consider: What you photograph and why #1

When and how do you take photos?	Recommended Camera Type
Occasionally, on the spur of the moment or on holiday to capture the kids/family, or the office Christmas party, etc. I want a nice easy photographic record of what the kids are up to or where I am. I just want to point and shoot and let the camera do the thinking. I don't want the hassle of having to remember to recharge it every night before I take it out.	**Compact** Choose a camera with full auto settings with a good 2-3x plus zoom & flash. You won't benefit from lots of buttons on the back, so keep it simple (chances are you'll never even look at the Settings Menu on the screen). Avoid Alkaline batteries if you can due to high drain; lithium may end up more cost effective long term.
I use my camera regularly to record lots of things, but when I take photo's I want to point and shoot and get a nicely exposed and framed picture without having to remember settings, etc.; I may wish to override the standard setting occasionally. I want to have a good look at the photo after to check it. Movies would be fun.	**Compact** You use this camera a lot so choose a camera that feels good in your hand and has buttons on the back that allow you to change key settings (ISO/Flash/Macro/Night-time) without having to go into the on-screen menu. Lithium rechargeable battery essential. Should have a big bright back screen (2.5 inch +) and good telephoto capability (3-4x plus). Beware 10x zoom on a compact – zoom will stick out more & small lens may just accentuate poor quality. All compact cameras have autofocus-lag and it can take 1-2 seconds for it to focus before the shutter will fire; so not ideal for action. Movie should be 640x320 minimum.

Choice No 2 – Which Camera Type is best for me?

Consider: What you photograph and why #2

When and how do you take photos?	Recommended Camera Type
I use my camera regularly and like to get high quality images with good zoom and possibly action/sports where I need a camera that can take fast photos without having to wait for the autofocus to lag. I'd like to be able to do creative photography and override the auto function (e.g sunsets/backlighting). I don't want to carry a huge camera case loaded with accessories.	**Prosumer** Prosumers can be as fast as consumer SLRs with little or no focus lag due to faster lenses (f2.8-4), better autofocus systems & big zoom ranges up to 10x. They are oriented at the one-stop-shop high-end consumer. Most do allow accessories such as flashgun, remote controls etc. Some Prosumers have Raw. Should have PSAM, histograms, etc. Some have movie & live-view
I want to take total control and know photography well enough to use PSAM, etc. I would like to have a digital-dark room. I want to take a range of subjects from landscape to sports/action, macro to portrait, so will need to have different focal lengths & choose a lens to suit the subject (e.g. wide angle for landscapes, telephoto for sports/action, macro for flowers/insects)	**SLR** The most flexible kit, naturally. Invest more in the lens than the body (and it is recommended to get the proprietary lenses – they make their lenses to suit their cameras); the former will last forever, the latter will be out of date in a year. Remember, all makes have different lens mounts so once you've chosen a brand you'll have to stay with it or sell the whole set. If you change ISO/image quality/white balance, etc regularly then choose one that has buttons on camera-back – otherwise you'll quickly get frustrated having to use the on-screen menu

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Choice No 3 – Which Camera Type is best for me?

Consider: Age Considerations # 1

Target Age Range	Recommended Camera Type
Children under 10 Children in this age bracket **generally** *click in front of a subject without framing it. They like to see instant replay of what they've taken. Short attention span, generally satisfied after 2-3 photos or will take dozens of random photos quickly, but may not wish to review them all in detail after. Most likely you'll get blurred photos due to camera shake in low light	**Don't Do It! *** Strongly advise not to buy them a personal camera *; it will sit on the shelf after 15 minutes and not get used again. Let them use yours which will satisfy them. Use high ISO and high shutter speed if possible to avoid camera shake. Turn off auto-flash in case they blind the cat… ** To test this hypothesis let them use your camera for a week and see if they are serious photographers or not; you'll soon get a feeling and my experience shows >90% of kids will give up in 10 mins*
Children 11-14 Children in this age bracket may want to have their own camera & enjoy having a photo record of a holiday/event. Will want to see instant replay of each photo in turn. Will take hundreds of photos of same thing. May not have the patience to upload & filter on a pc.	**Compact** Fully auto camera & 3x zoom plus. No sticky-out buttons or pop up flash as they'll be broken off . Big back-screen will get scratched; glass viewfinder redundant. LITHIUM BATTERY due to high battery drain. Look for easy buttons that change from camera to playback & flash on/off. In-built lens cover recommended to protect lens when off. Get a big memory card at least 1 GB. No need for high megapixel; kids will be satisfied looking at images on camera-screen or on pc, won't be much interested in printing every photo; consider digi-screen above printer. Cheap Compacts are a false economy as the software & lens will not deliver the flexibility & quality.

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Choice No 3 – Which Camera Type is best for me?

Consider: Age Considerations

Target Age Range	Recommended Camera Type
Children 15+ Generally more creative and like to take more social photos, friends/family/holidays. May have own pc & need to upload a lot to view. May have desire to take more creative photography & have specific subject matter in mind linked to hobby/activity	**Compact/SLR** Robust as it will be in their charge, not yours. Special effects may be fun, face-recognition will give good sharp photos of people. Big screen & good pc support software. Entry level SLR may give flexibility esp. subject matter (better zooms & flash). Can build up equipment slowly. Camera bag advisable to keep all contents together & protect.
Senior Citizens Generally want to point & click. May not own a pc. May have difficulty with buttons. Want to have a good record of an event/family/holiday without hassle of having to load onto pc but may want a photograph to show others.	**Auto Compact** Big bright back-screen, big clear buttons. Fully automatic with autoflash; face recognition may be useful so camera always gets faces in focus. Consider cameras that interface directly with personal printer so it's easy to print photos (see printer costs). Why not consider an lcd photo-frame where you put the memory card directly into the frame – no printer costs but great slide-shows; chances are you'll recover the cost through savings on ink!

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Home Printing – The Facts Before You Buy
1 - Cost

Assumptions

- £100 inkjet printer, 2 year shelf life [1]
- A4 Photo Premium Paper 15 sheets [2] £11
  - Cost per sheet 73.3p
- Black ink cartridge £25
- Colour ink cartridge £25

- 33.3 pages per ink cartridge [1]
- Consumables £74.42 / 33.3 sheets
  - £2.23 per A4

Photos/year	A4 sheets/month	Refills/yr	Consumables/yr	2yr Cons. + printer	Cost Per Print A4	6x4	Comparison A4	6x4
100	8	3	223.48	£546.97	**£2.73**	**£0.68**	**Highstreet**	
200	16	6	446.97	£993.93	**£2.48**	**£0.62**	**£1.50**	**40p**
300	24	9	670.45	£1,440.90	**£2.40**	**£0.60**	**Online**	
400	32	12	893.93	£1,887.87	**£2.36**	**£0.59**	**99p**	**9p**
500	40	15	1,117.42	£2,334.83	**£2.33**	**£0.58**	**PC Screen/e-mail**	
1,000	80	30	2,234.83	£4,569.67	**£2.28**	**£0.57**	**0p**	**0p**

Sensitivity analysis: **25 pages/cartridge: £3.00 A4 / £0.75 6x4**
Cost of Ownership: @30p A4 / 9p 6x4 for each print

[1] Article -The true cost of inkjet printers - computeractive.co.uk, quotes between 31-38 pages per refill depending on printer type; ave. shelf life of a printer 18mth-2yrs
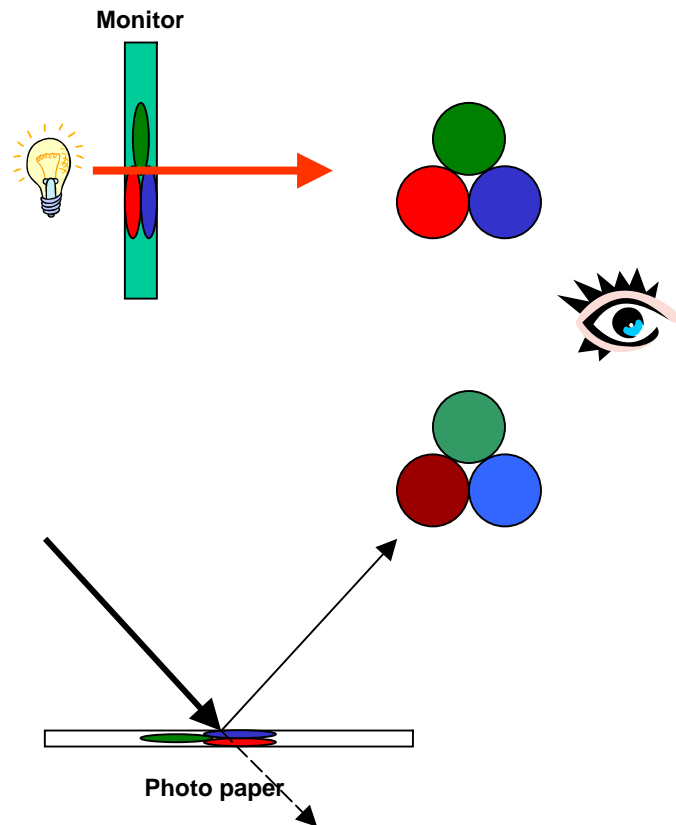- http://www.computeractive.co.uk/computeractive/features/2014003/true-cost-inkjet-printers
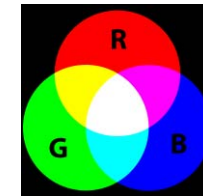[2] Jessops Christmas Buyers Guide 2007

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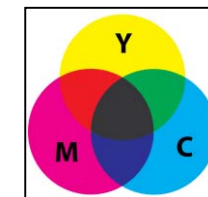
Home Printing – The Facts Before You Buy
2 – Exactly what colour is that?

Monitor

Digital equipment uses Red, Green and Blue (RGB) light in an additive mode – the colours add together to make a new one. The light is transmitted out to the viewer so the image is bright

Photo paper

Inkjet printers use Cyan, Magenta, Yellow & Black (CMYK) subtractive mode - pigments or dyes in the ink block out other colours. The light reflects off the paper to the viewer and some of this is absorbed by the ink/paper; so you lose some brightness depending on the light you're viewing it in

Prints may fade in time depending on stability of dye/pigment, exposure to light, etc

Home Printing – The Facts Before You Buy
3 - Colour Space

- The human eye has almost an infinite spectrum of colours
- An 8-bit computer can only mathematically calculate 2^8 (i.e. 256) colours*
  - *16-bit chips can show 2^{16} or 64,000 colours
- So, computers have to make a compromise as to which range of colours it will use – called GAMUT
- sRGB Colour Space is the standard used across the Internet:

- The computer (sRGB) can only reproduce the colours inside the rigid triangle (shown in black)
- Printers (CMYK) can only reproduce colours inside the rounded triangle (shown in yellow)
- This means when an RGB colour is outside the printer gamut, the printer has to make a 'best guess' of the nearest colour. This is why inkjet prints often do not match the colour & brightness seen on the computer screen

CMYK space
sRGB space
GAMUT Mismatch
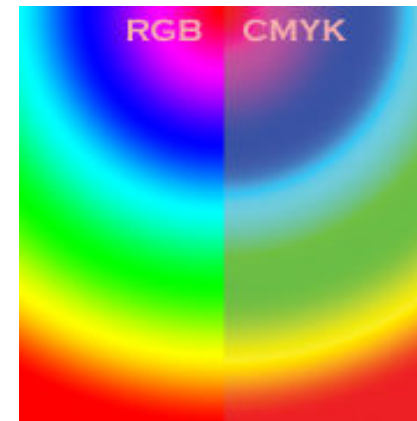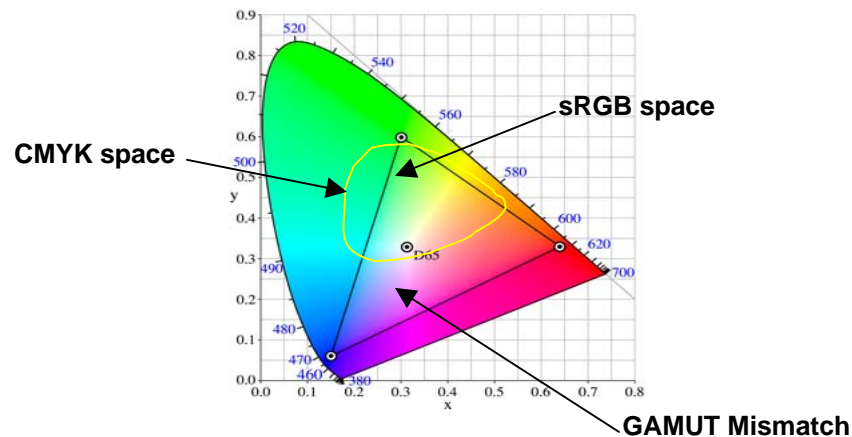
The Printing Solution?
1   Use the Same Colour Workflow

- Commercial digital printers use sRGB colour space using projected laser light
  - They use photographic paper (e.g. Fuji Crystal paper rated 150yrs stable)
- Compacts are usually set at sRGB
- On your SLR use sRGB Colour Space
  - Adobe RGB is wider gamut but only for commercial (journalism/magazines)
- Colour calibrate your pc screen
- Use an ICC profile
  - You are using the actual gamut of the end printer
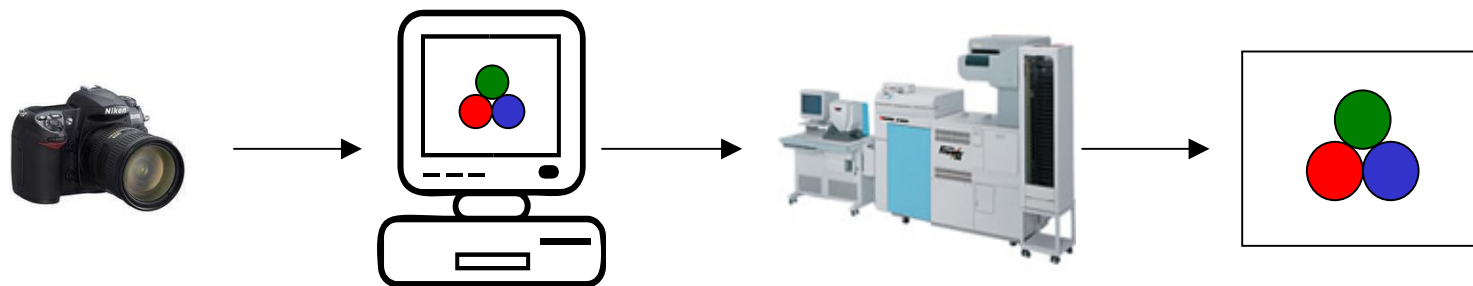
The Printing Solution?

2 Shop around for printer consumables

- Premium / Professional Photo Glossy Inkjet Paper

  - **Buy my e-shop Professional Glossy Paper A4 - £24.50 for 125 sheets**
    - **That's 19.6p per sheet compared with 73.3p per sheet high-street [2]**

- Proprietary Cartridges?
  - The debate is still out as to whether reusable or non-proprietary cartridges are as good as / worse
    - But more re-usable are obviously (more) environmentally friendly

- Printer Cost
  - Data suggests[1] that low-cost printers don't stay low-cost for long due to higher per-print ink cartridge costs & efficiency
    - If you don't use a printer often you could waste up to 2 A4 pages of ink due to head-cleaning alone

- The Final Consideration
  - Do you REALLY need to print it out?
    - Does the camera have a tv view cable?
    - Can you just look at it on the pc or e-mail it?
    - Why not get a digital frame?
  - DO THIS:
    - Find all your printed photos; where are they? Locked away in a cupboard, on a shelf, hidden away?
      - What is this telling you about the value and need to print all your photos?

Digital Workflow
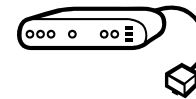## The Hidden Costs

- Memory cards needed for increasing megapixel size
- High battery drain
- Choose Lithium
- Alkaline batteries if not Lithium as rechargeable can't cope with high drain

- Photo-imaging software £50-£500
- Hard-drive space 6-10 GB / year
- (100photos/mth @8mb)

- Innumerable hours at the pc processing & managing

- External hard-drive £100 for archiving

- Printing costs £600/yr +

Digital Workflow
Image File Formats

- **BitMap (.bmp)**
  - Uses the actual pixel file data – very large file-size
- **GIF (.gif)**
  - Used mainly for web-building and website; compressed & can use as animations
- **JPEG (.jpg)**
  - **The Digital Camera Standard File-type**
  - Uses a mathematical algorithm to COMPRESS a photo so the file size is realistic
    - Uses a best-guess of colour based on the surrounding pixels
  - Can set varying qualities to reduce file-size
    - Benefit is that you set the quality to the medium (i.e. website or gallery exhibition print)
  - Processed in-camera
- **RAW (e.g. .NEF, .DNG)**
  - **Essentially a Digital Negative**
  - Records the actual light signal at the pixel only – and does not do any further mathematical processing
  - Benefit is that if you made an incorrect setting (e.g. White-Balance) you re-set it on the Photo-imaging software
    - And the pc has a much greater processing capacity than the camera chip
  - You do not lose any data through compression factors

Digital Workflow

Memory Card Choice

Movie Files Optimum Card size

Image size	128MB	256MB	512MB	1GB	2GB	4GB
2 Megapixel	134	268	552	1119	2245	4494
3 Megapixel	120	240	490	996	2000	4000
4 Megapixel	60	119	245	497	999	1998
5 Megapixel	48	95	195	395	800	1595
6 Megapixel	44	88	180	366	735	1471
7 Megapixel	39	78	161	327	657	1314
8 Megapixel	35	69	143	290	582	1164
10 Megapixel	26	53	109	221	444	887
12 Megapixel	20	40	83	169	339	678

Number of photos per card

Not enough practical memory

- **BEWARE of reported e-Bay Fakes**
  - Estimated 90% of Sandisk cards on eBay are fakes
    - http://reviews.ebay.com/FAKE-SanDisk-Ultra-Secure-Digital-Cards-Exposed_W0QQugidZ10000000001254879

- Only choose high-end Cards e.g.
  - Sandisk Ultra
  - Sandisk Extreme
  - Lexar
- Some generic cards can be slow to transfer data

See my DHC e-shop for the following cards

Sandisk Ultra II 2GB   **£25!**
- Compare with High-street price of **£45**
- **CF or SD**

Sandisk U3 micro USB drive 4GB Compare with High-street price of £**55**!   **£35!**

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Transferring Images to PC

You will need some sort of software to transfer your images to pc

- Software that comes with the camera
  - BEWARE!
    - They come with tons of extras, often aimed at promoting the brand & suite of products; some have hidden extras such as Google Toolbar/Yahoo suite/chat room type interfacing – you have to load this on even if you don't want it
    - Some of the software can be fun, however, with lots of goodies for kids etc., so don't fully discount it, just know what you're loading beforehand
  - **You will need EXTRA software to process RAW files; this doesn't usually come with the camera**
- My Advice
  - Take the memory card out of the camera and let Windows do the transferring
  - Upload one of the very good free transfer softwares around
    - Some have library, cataloguing and basic photo-imaging

Photo-imaging Software
Digital Darkroom

- **Professional**
  - Adobe Photoshop CS3 (@£600)
    - Total image management, layers, etc
  - Adobe Photoshop Lightroom (@£175)
    - Fantastic new product that gives perfect digital photo workflow, uses camera raw, keywording, metadata, picture editing, etc
  - Apple Aperture (@£250)
    - Competitor to Lightroom for Apple/Mac
- **Amateur/Serious Amateur**
  - Adobe Photoshop Elements (latest version 6) (@£75)
    - Lots of the Photoshop tools (but not all) that gives a really cost-effective solution
- **Others**
  - PaintShop Pro

Useful Tips & Hints

File Architecture

```
□ 🖼 My Pictures
   ⊞ 📁 1993
   ⊞ 📁 2002
   ⊞ 📁 2003
   □ 📁 2004
      ⊞ 📁 2004 general
      ⊞ 📁 2004 Holidays
   ⊞ 📁 2005
   □ 📁 2006
      ⊞ 📁 Family & Events
      □ 📁 Holidays
            📁 Arizona Oct 2006
            📁 Australia May 2006
            📁 Cornwall Looe August 2006
            📁 Jersey July 2006
            📁 Kingsbury Water Park 8 April 2006
            📁 Lanzarote April 2006
            📁 New Year Louise & Jons 2006
      ⊞ 📁 House
            📁 Japan Osaka March 2006
   □ 📁 2007
      ⊞ 📁 Family
      ⊞ 📁 Holiday
      ⊞ 📁 House
      ⊞ 📁 Other
```

- Save files as a name using date/event – don't just let the camera/pc save the name as DSC0099 – you'll never find it again
- Using a date/event structure will help you significantly in retrieving photos
- Your memory recalls best to a time and event rather than an image
  - So archiving this way gives you 2 chances of finding a photo
- Products such as Adobe PhotoShop Lightroom have keyword metadata capability
- Also, helps to reduce archiving process as you only have to archive once and not overwrite

Archiving Strategy

- PC hard-drive - master file

- External Hard-drive
  - Monthly backup (but only backup new stuff, no need to fully backup everytime)

- CD-ROM/DVD-ROM

  - 3 copies
    - Home
    - Parent/family
    - Work

  - Again, cumulative backup monthly

- USB memory Stick is great backup if on holiday/trip
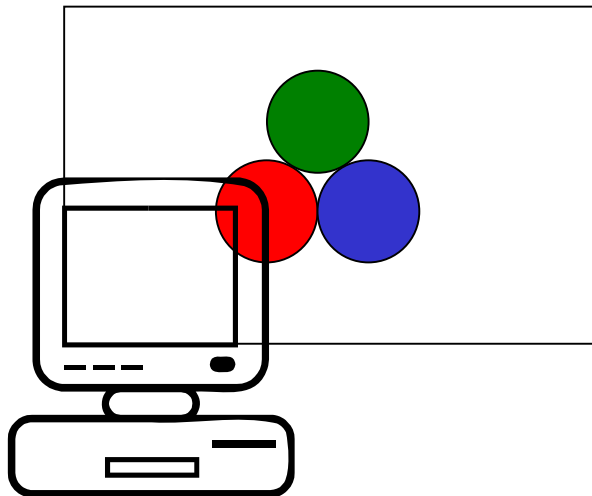
  - e.g. if pc hard disc corrupts

See my DHC e-shop
Sandisk U3 micro USB drive 4GB **£35!**
Compare with High-street price of **£55**!
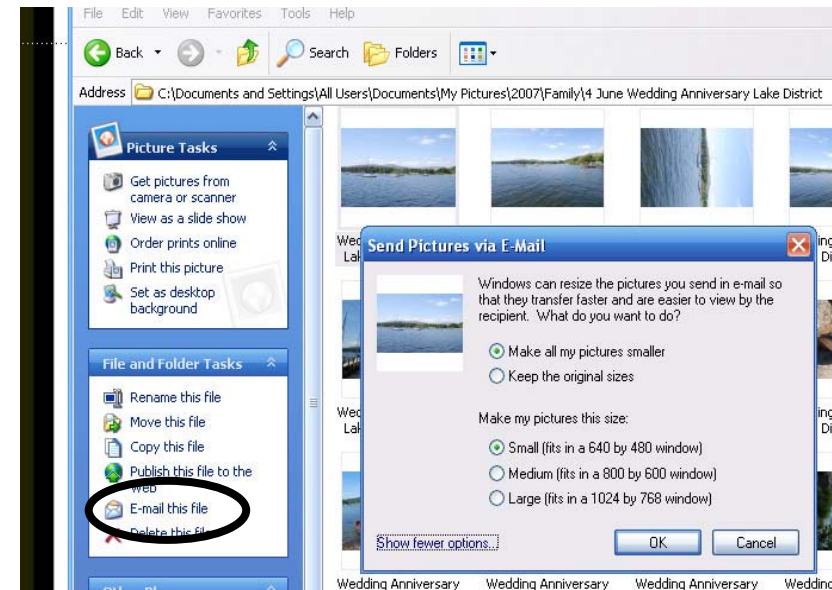
Sending Photos by Email

- Remember a 6MP file is 3000x2000 pixels?
  - But your pc is 1024x768!

- Change the size in Explorer when e-mailing

And Finally…

- *"Buying a Nikon camera doesn't make you a photographer; it makes you a Nikon camera owner"*
  - *Taking Better Pictures is the subject of my next tutorial*

Thank you

- I hope that this presentation helps you make an informed choice & saves you money and that you get a camera that gives you joy, longevity and great pictures
  - If you found my advice beneficial please support me by buying the products on my website & DHC e-shop
    - Photos make great cost effective wall-art and there are some great savings on printer materials, frames & memory cards