Focus on Fundamentals

2.1

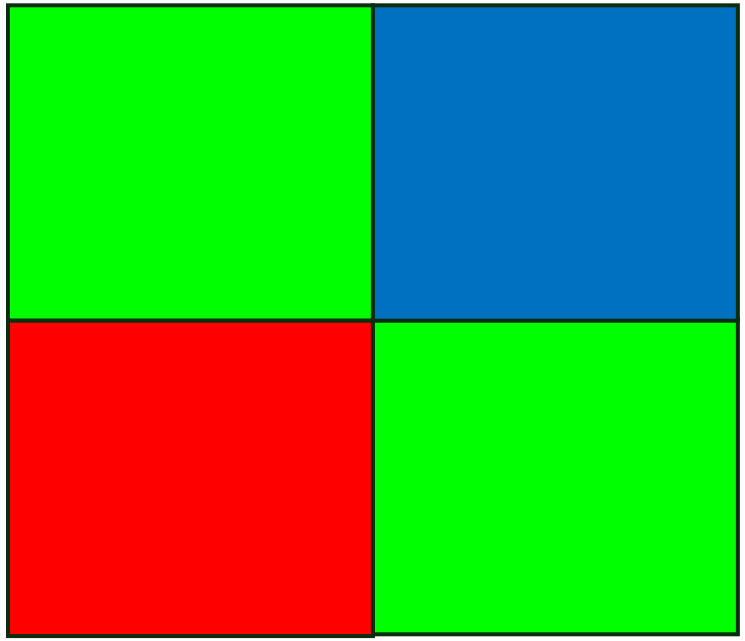
Camera Language

Part 1

Pixel

How the camera collects light

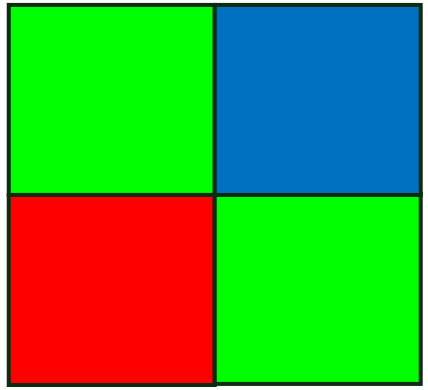
- Our eyes sense only red, green, and blue (RGB) light, and our brains interpret that light into more colors.
- Likewise, digital camera sensors measure RGB light using a grid pattern of microscopic dots called subpixels, or photosites.
- The data from each photosite is interpreted as a colored square called a PIXEL.
- Each pixel in an image is composed of three primary colors: red, green, and blue.
- By combining different intensities of these three colors, a wide spectrum of colors can be achieved.
- Digital images are mosaics made of millions of pixels MegaPixels

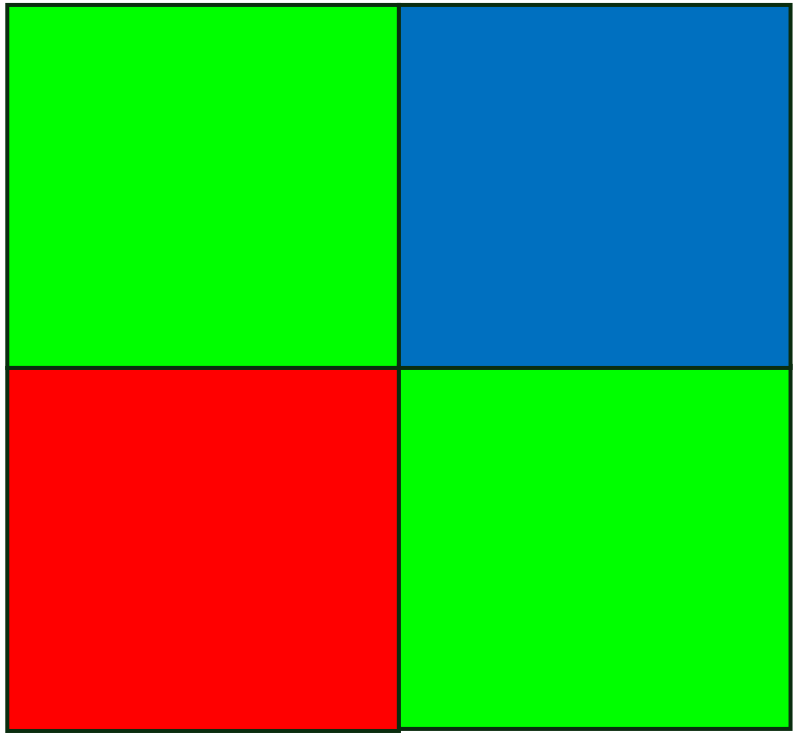


The Bayer Sensor Uses twice as many green elements as red or blue to mimic the physiology of the human eye

Pixels can be different sizes

Each has advantages, and disadvantages

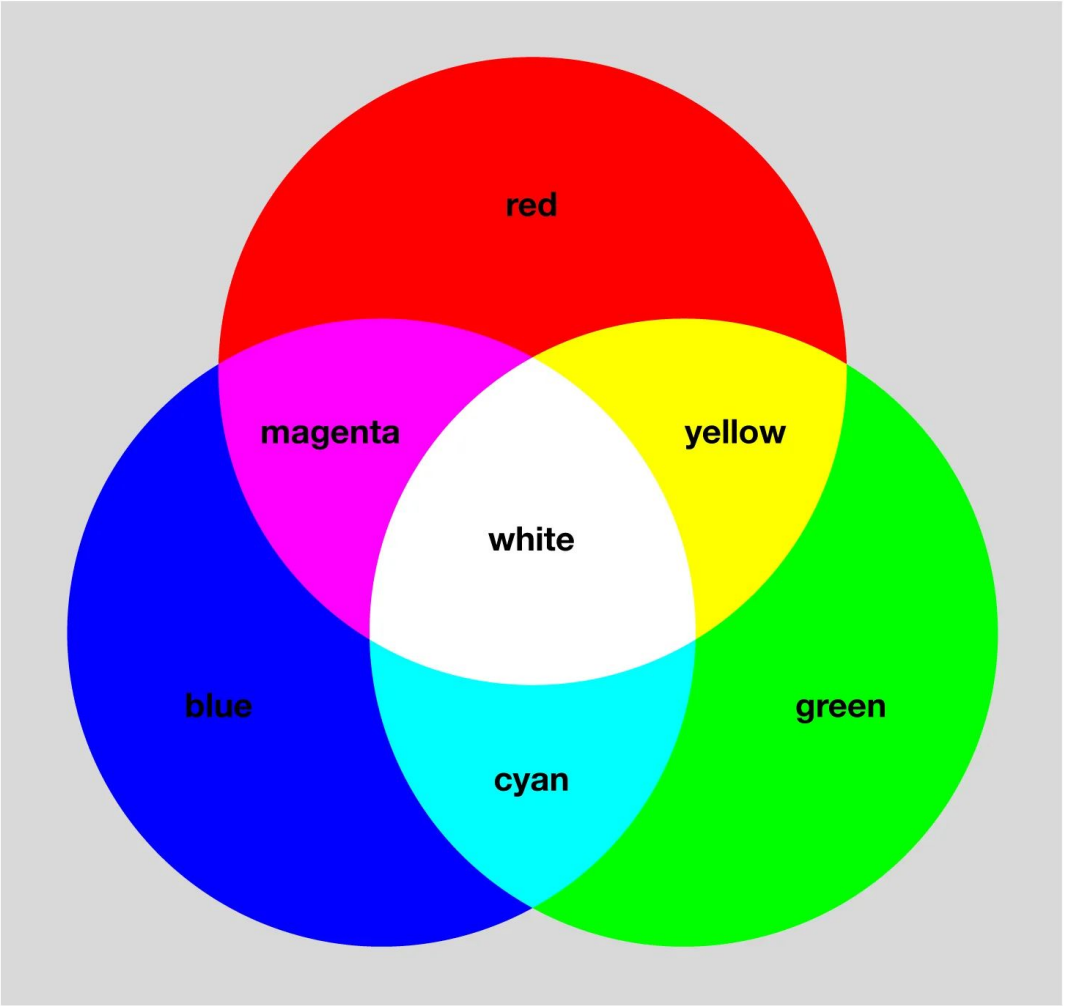




Why Red, Green, Blue Pixels?

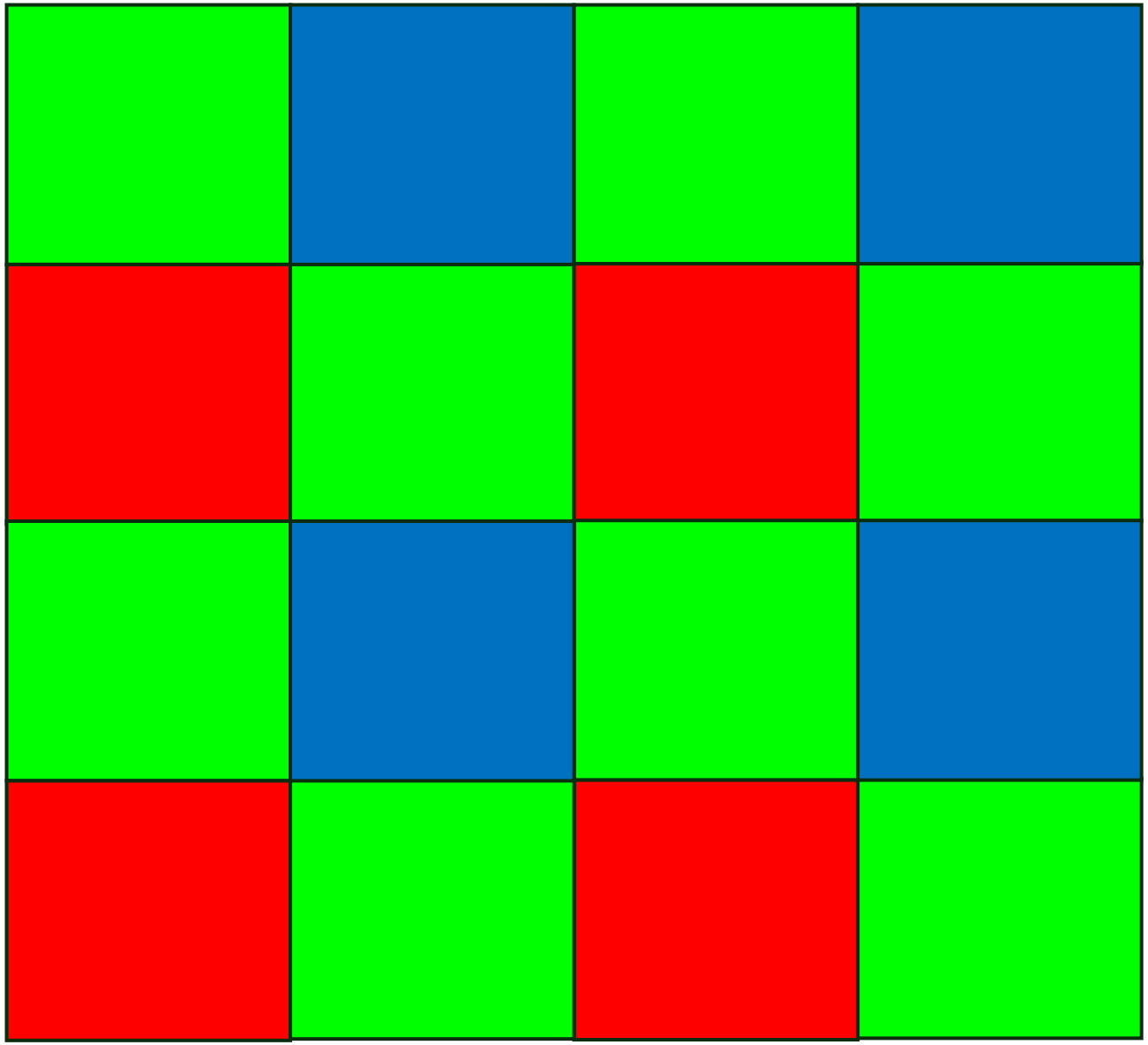
- Our eyes sense only red, green, and blue (RGB) light.
- . Let's call this the "RGB Color Model"
  - Red, Green, Blue
- Primary Colors –
  - Red, Green, Blue
  - No colors overlap
- Secondary Colors –
  - Magenta, Yellow, Cyan
  - Where 2 of the 3 the Primary Colors overlap
- White
  - Where all 3 Primary Colors overlap

RGB colour model



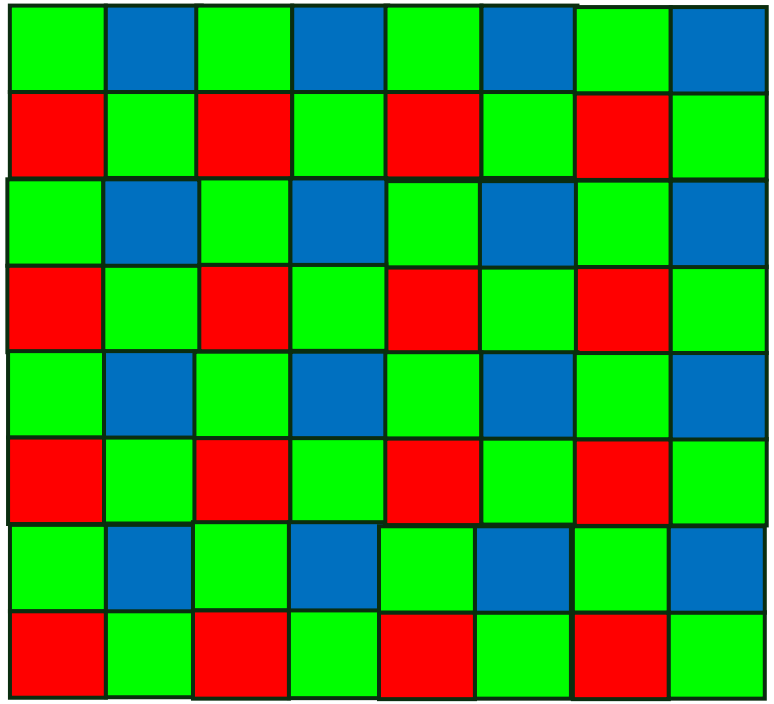
Sensor - A collection of Pixels

- 4 Pixel Sensor



How many pixels can fit on a sensor?

- Depends on
  - The size of the Pixel
  - The size of the Sensor
  - A16-megapixel (16MP) still camera
    - Has an image resolution is 5,312 pixels across; 2,988 down
    - For a total of 15.9 Million Pixels
    - Each pixel containing a red, green and blue color dot (photosite).
  - More Pixels is not always “Better”
    - There are advantages, and disadvantages to sensor size

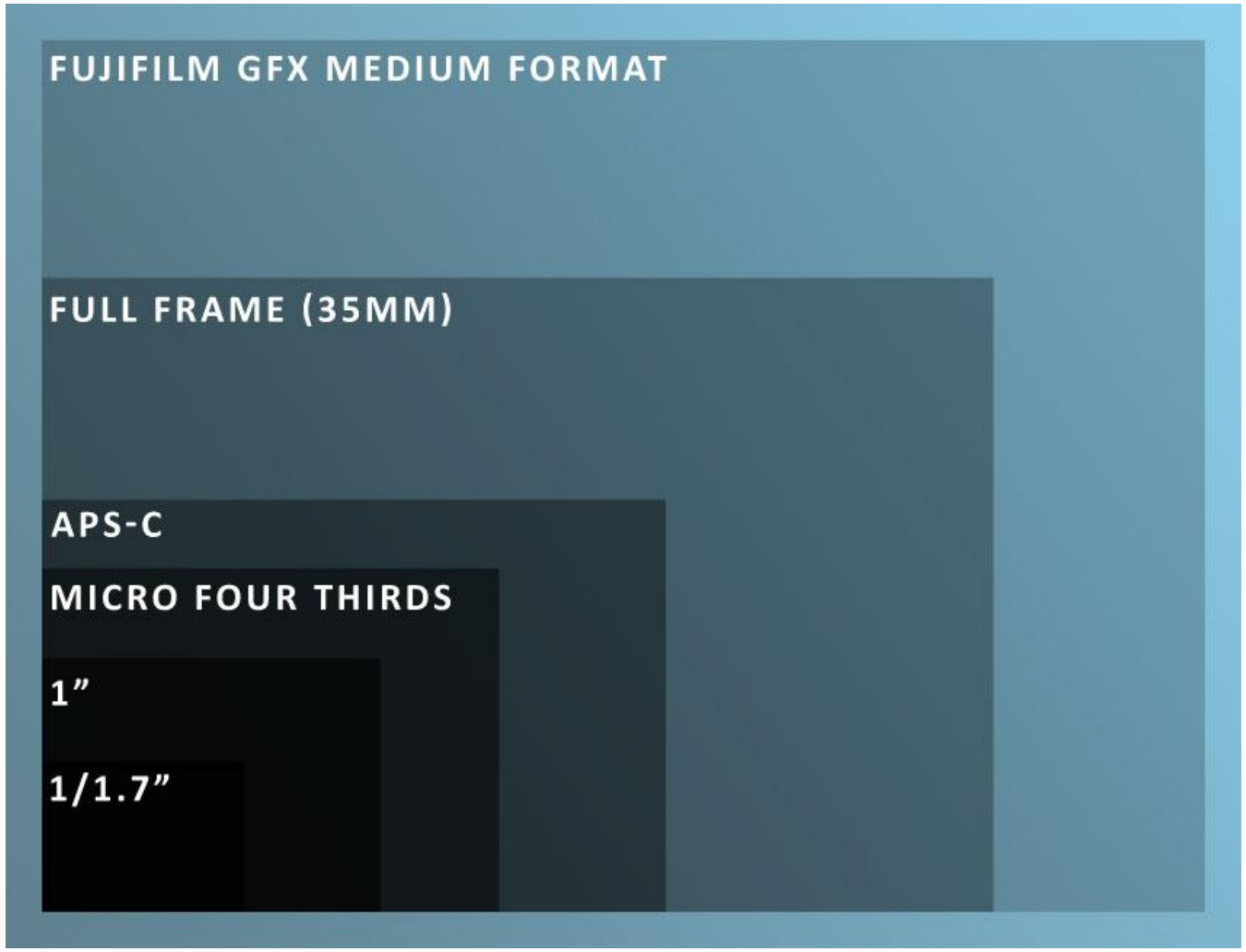


16 pixel sensor

Common Sensor Sizes

- FujiFilm GFX Medium format
  - 44 x 33
- Full Frame
  - 36 x 24
- ASP-C
  - 23.6 x 15.6 (Non Cannon)
- Micro Four Thirds
  - 17.3 x 13.0
- I”
  - 12.8x 9.6
- Smart Phone – ½.3
  - 4.54 x 3.42

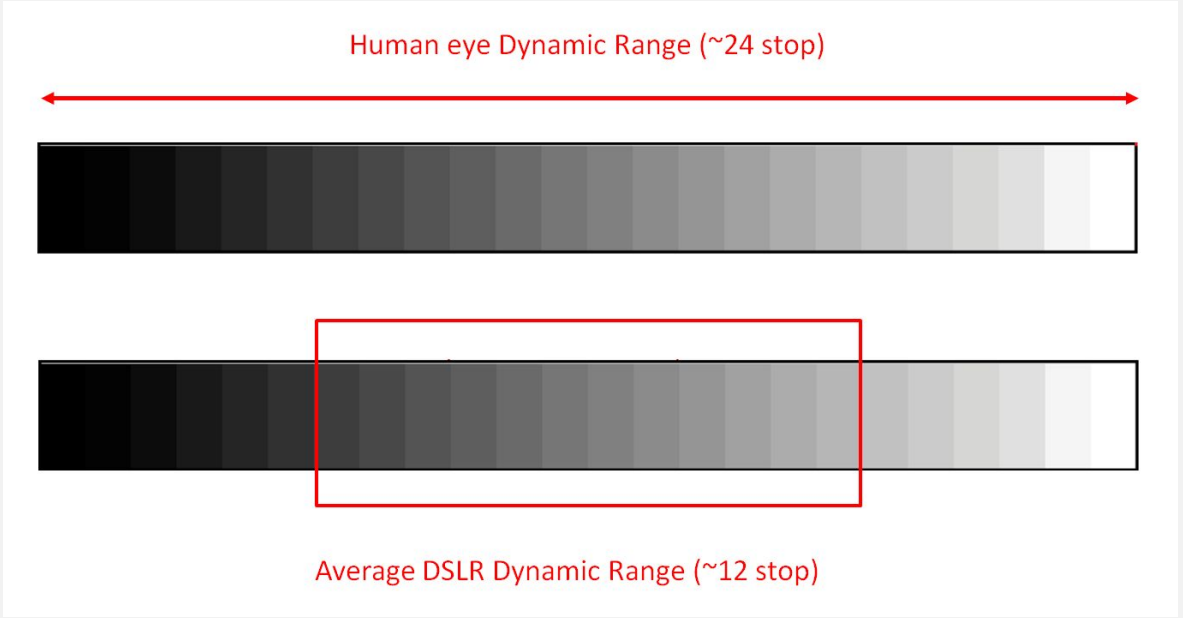
  (All sizes in MM)



Dynamic Range

The Sensor can only capture a limited range of light.

Dynamic Range – The Range of light the sensor can capture without loosing detail



Each change in shade is “1-Stop”

Your Eyes have a Dynamic Range

Can you…

1. Weld without a welding shield?
2. Look directly at the sun without sunglasses?
3. See in a coal mine with no lights?

Humans' vs Canines

1. Hearing
2. Smell
3. Seeing
4. Outdoor Temperature – no coat needed

My dog has better Dynamic Range!

Limitations of Dynamic Range

- The limitations of dynamic range often come into play in bright scenes with a lot of contrast.
  - The brightest areas will turn into white blurs
  - Or the darkest areas will turn a detail-less black
- Exceeding the Dynamic Range
  - Background overexposed
  - Subject underexposed

Example of exceeding the Dynamic Range

Animals in a tree with a bright sky background

Subject in front of a window

How to control the amount of light the Sensor is exposed to?
(Part 1)
(Or, components of the Exposure Triangle)

Shutter

- The door to the camera, (which is always closed)
  - When you press the shutter release button, the shutter opens for a specified length of time, allowing light to hit the sensor and create an image.

Shutter Speed

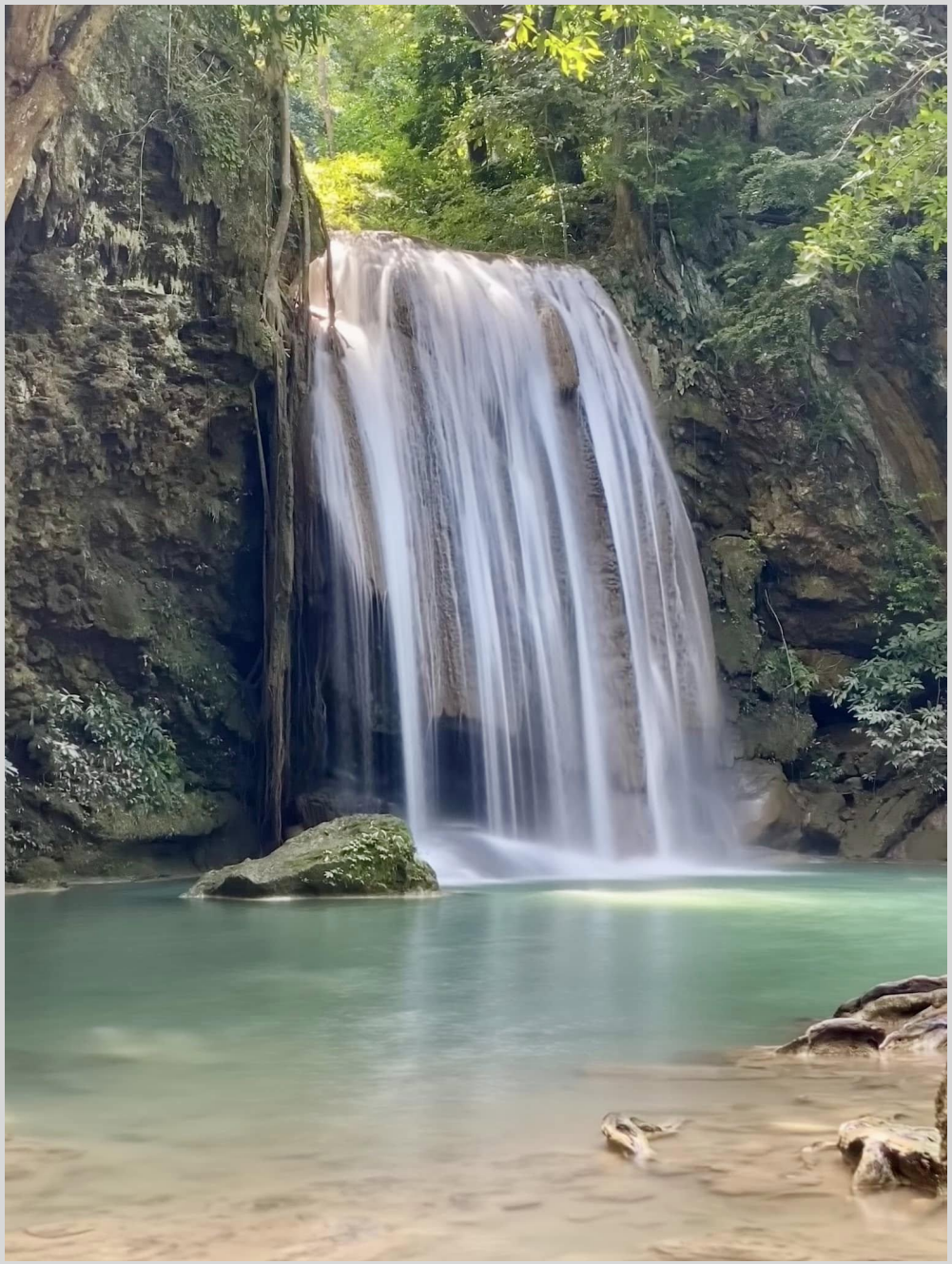
- The duration for which the shutter remains open
  - Usually expressed in sec's - 1/60, 1, 1/1000, 1/30
  - Bulb -The camera's shutter stays open for as long as you hold down the shutter release button
  - Time – program in time

Shutter speed directly impacts how motion is captured in a photograph.

A fast shutter speed freezes motion, making it ideal for photographing fast-moving subjects

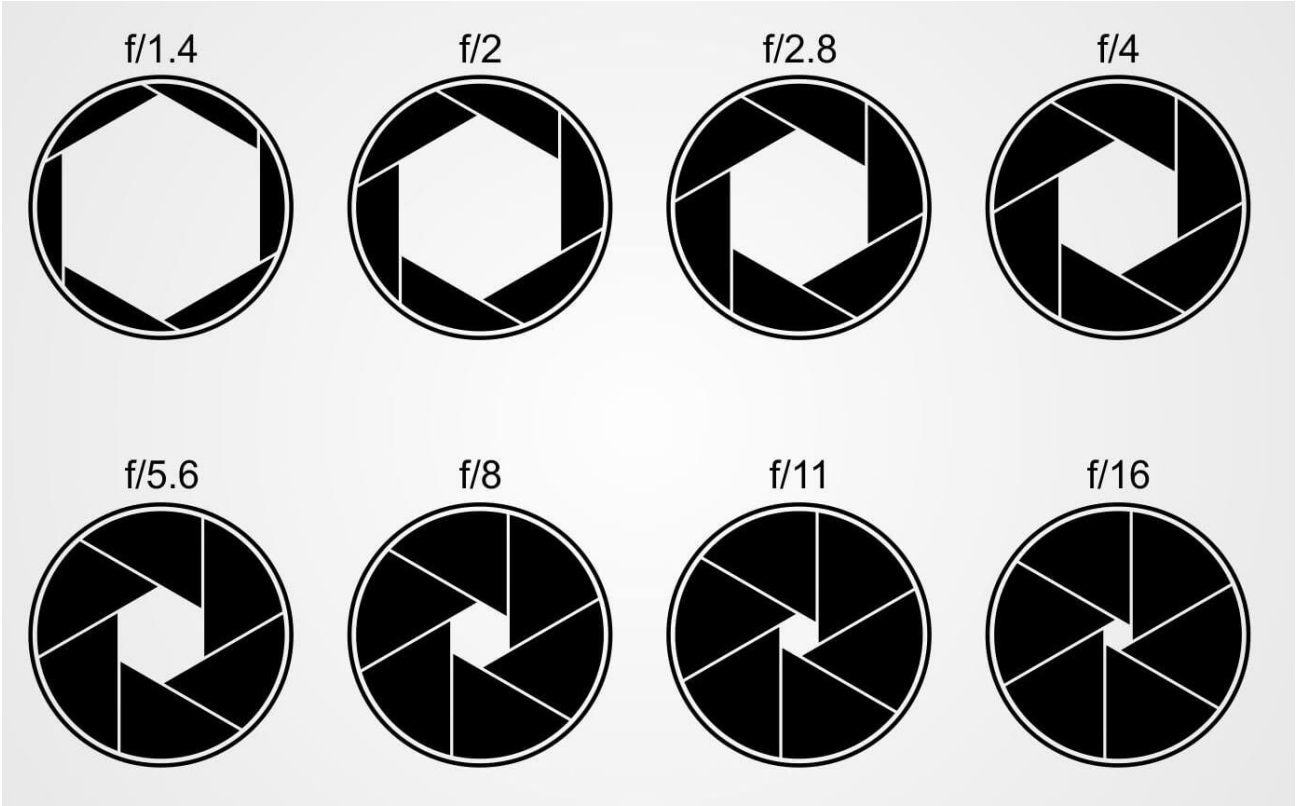
Shutter speed directly impacts how motion is captured in a photograph.

- A slower shutter speed can create a sense of motion blur, which can be used artistically.



How to control the amount of light the Sensor is exposed to? (Part 2)

1. Aperture
   a. The (variable) opening in the lens which light passes through.
   b. The larger the opening, the more light that passes thru
   c. Your eyes do the same - As you move between bright and dark environments, the iris in your eyes either expands or shrinks, controlling the size of your pupil
   d. Aperture also controls Depth of Field – (more later)



Now that we can control the amount of time the shutter is open, and the size of the opening to the shutter…
Can we control the ambient light?

Nope..
But the camera can Amplify the light that hits the sensor!

Let's call this **ISO**

ISO
Controls the camera's ability to amplify or suppress the electronic signal the sensor creates from the absorbed light.

Think of ISO as the volume level on a radio

If the volume is weak (low light), you crank it up. The signal is "Amplified" – High ISO	If the volume level is to strong, you "suppress the signal – Low ISO	the radio signal delivered to the radio does not change

How to control the amount of light the Sensor is exposed to? (Part 3)

ISO

Controls the camera's ability to amplify or suppress the electronic signal the sensor creates from the absorbed light.

Starting at ISO 100…

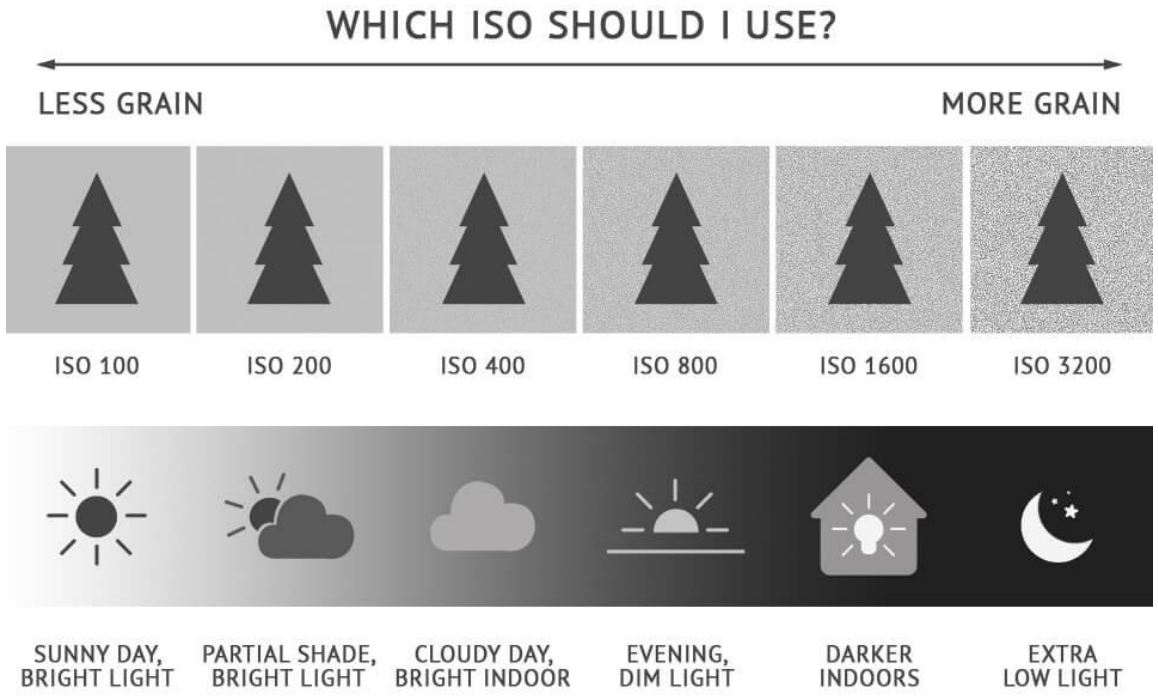
Moving from left to right, each step in the diagram doubles the amplification of the light

Think of ISO as the volume level on a radio

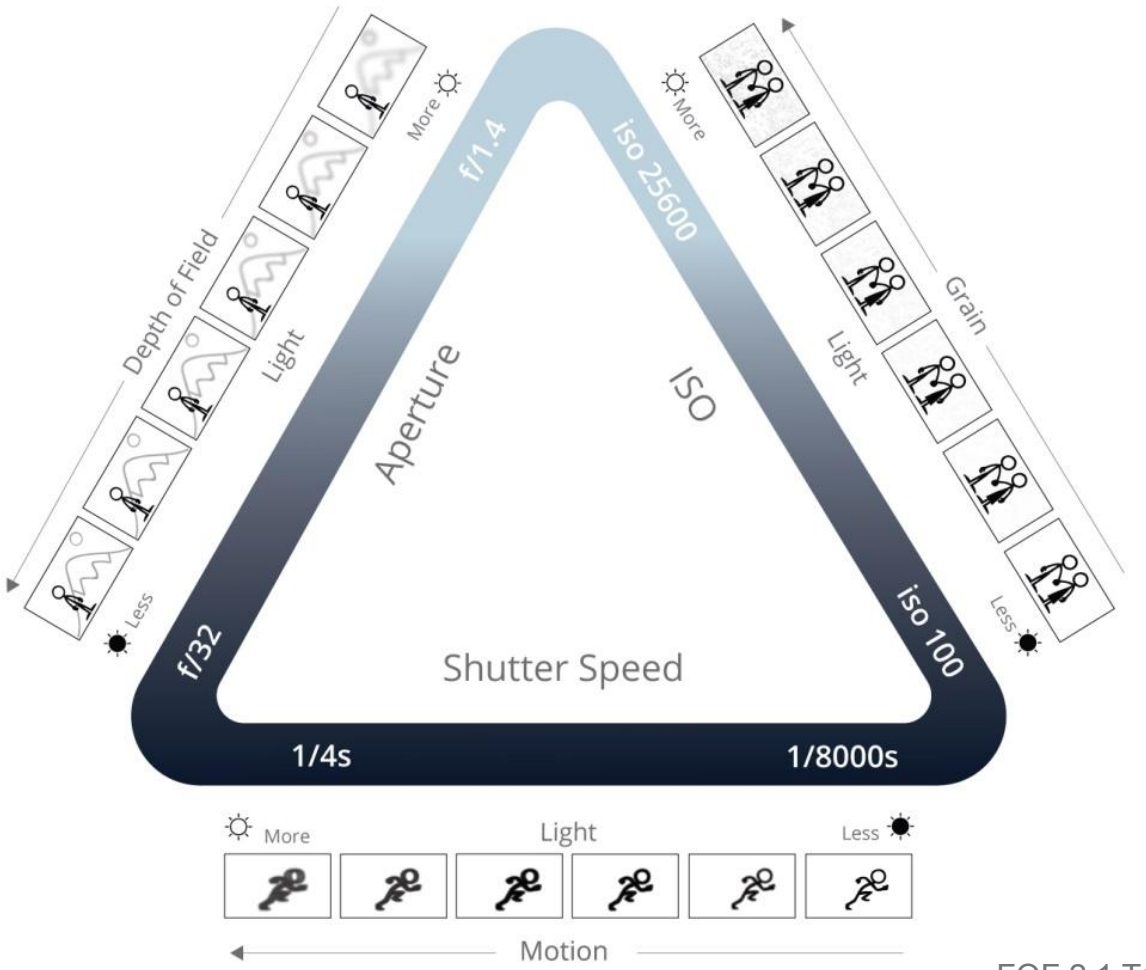
i. If the volume is weak (low light), you crank it up. The signal is "Amplified" – High ISO
ii. The radio signal delivered to the radio does not change

Adjusting the ISO does not

iii. Change sensor sensitivity
iv. Control how much light comes into the sensor
v. Increase the "Noise" (just amplifies the existing "Noise" already present)



Shutter Speed
Aperture
ISO



Components of the

The Exposure Triangle

That control the of amount light the Sensor is exposed to

- Do we need to revisit Exposure Triangle ?

Next Time

Terms

- Focal Length
- Depth of Field
- Field of View
- F-Stop
- Resolution
- Lens – how they affect…everything
  - Zoom or Fixed
  - Field of View
  - MM length
  - F-stop – min, max, variable, fixed
  - Angle of View

The Exposure Triangle