



Mastering the Exposure Triangle: Understanding Aperture, Shutter Speed, and ISO in Photography

Key concepts for perfect and creative photo exposure

Overview of presentation

What understanding the exposure triangle will do for your photography.

What do we mean by the exposure triangle?

How to choose the right shutter speed to use?

How to choose the right aperture to use?

How to choose the right ISO to use (and what is it anyway)?

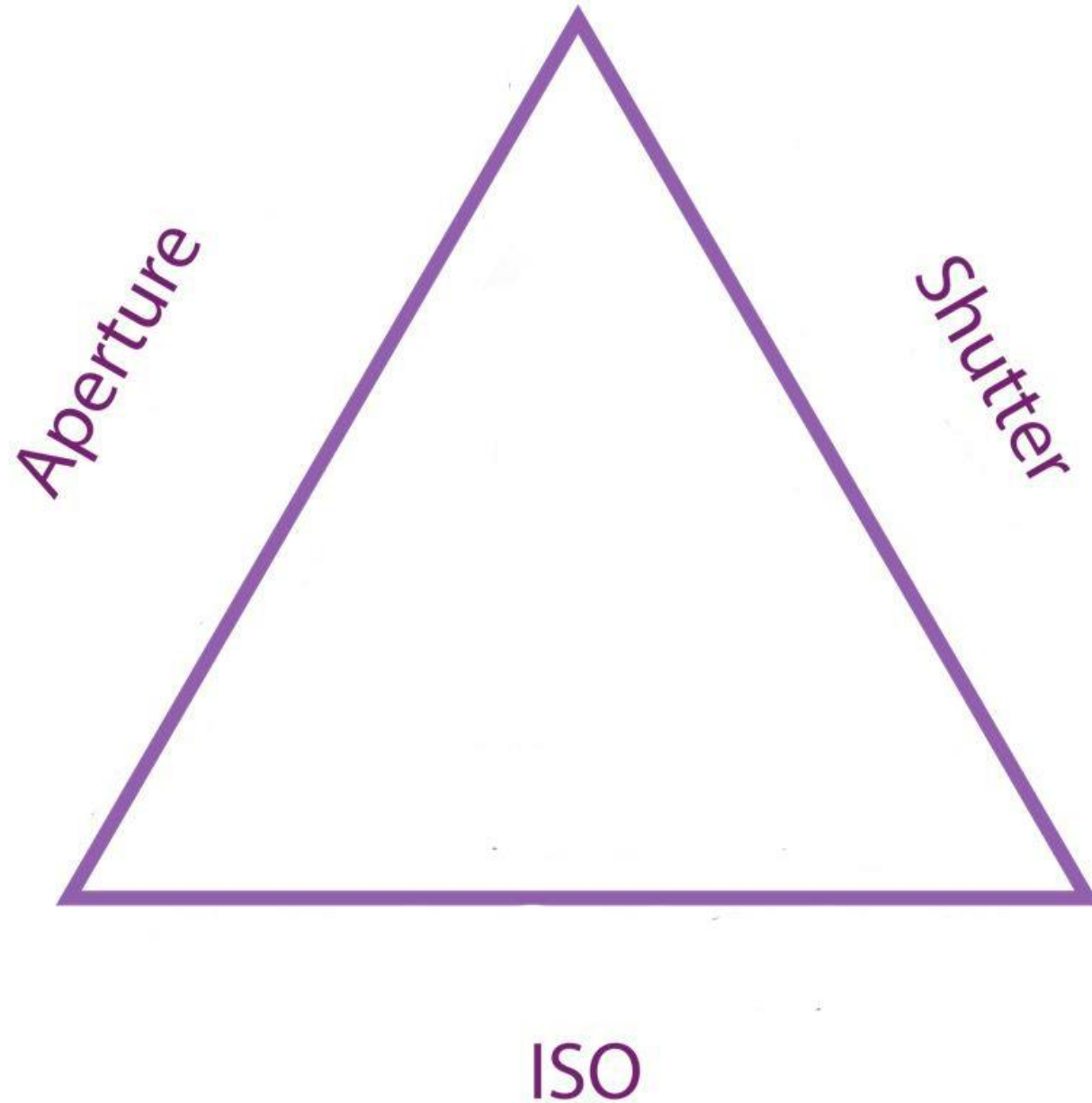
How to balance these controls for different types of photography

Can any of this be applied when using a mobile phone?

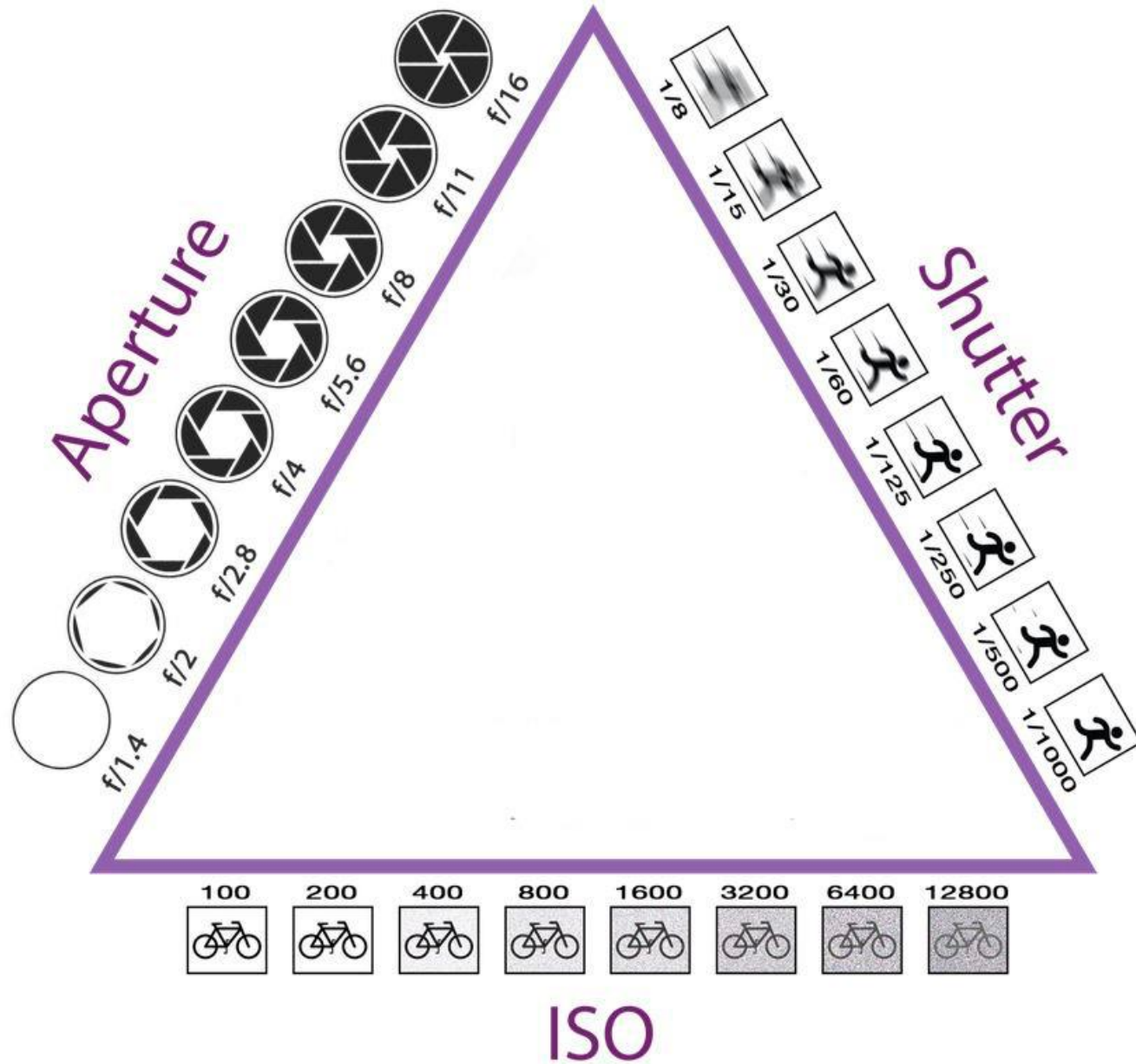
What will understanding the exposure triangle do for your photography?

- By understanding how the exposure controls on your camera interact, help you to get the photographs you want.
- Allow you to improve the creativity of your work
- The exposure controls in question are:
 - Shutter speed
 - Aperture
 - ISO setting

The exposure triang

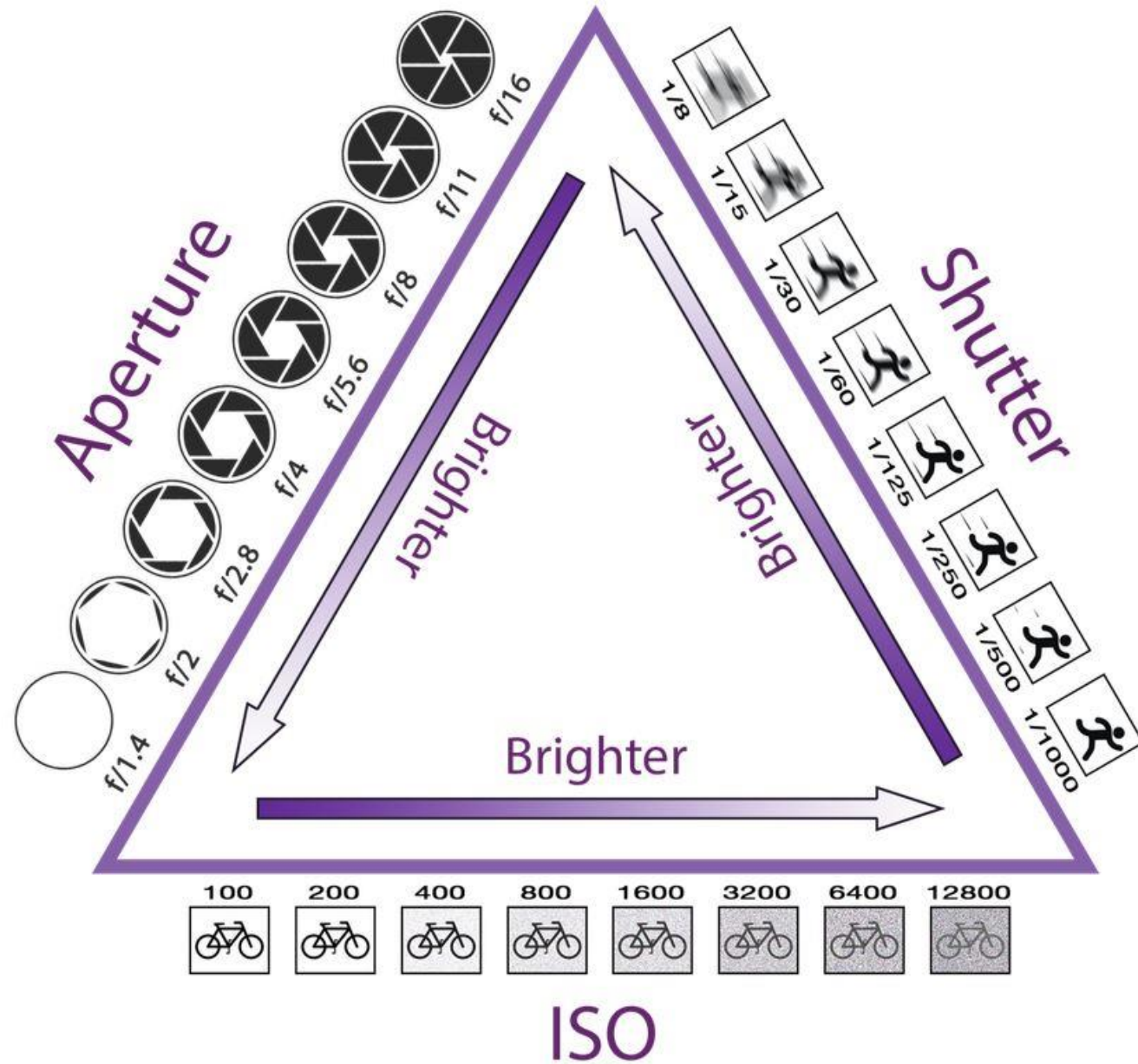


The exposure triangle



From actioncamera.blog

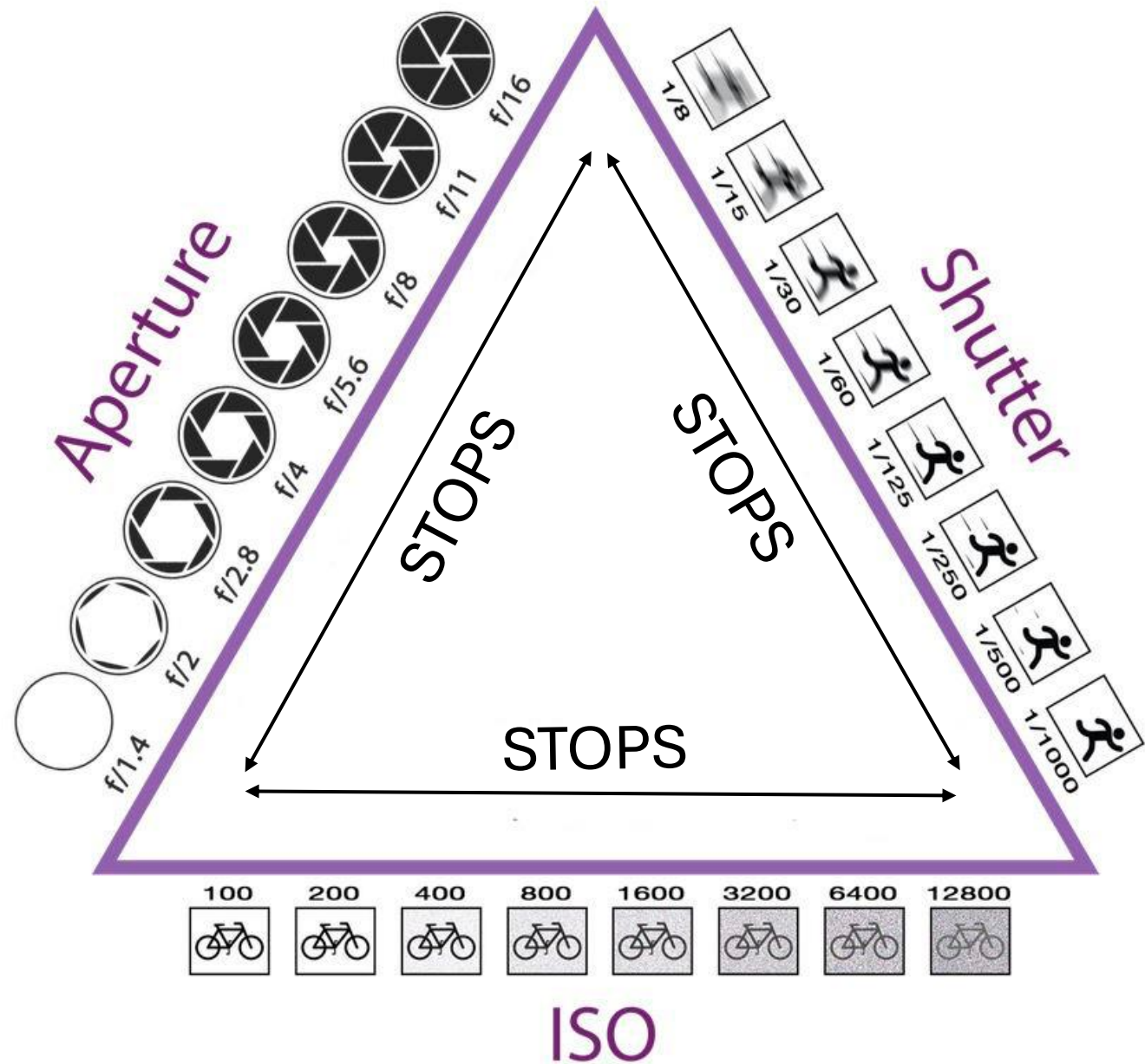
The exposure triangle



From actioncamera.blog

The exposure triangle

A 'Stop' is a unit of measurement that represents a doubling or halving of the amount of light entering the camera, which affects the exposure



Example

The exposure triangle

Three equivalent exposures

1/15s, F/5.6, ISO 6400

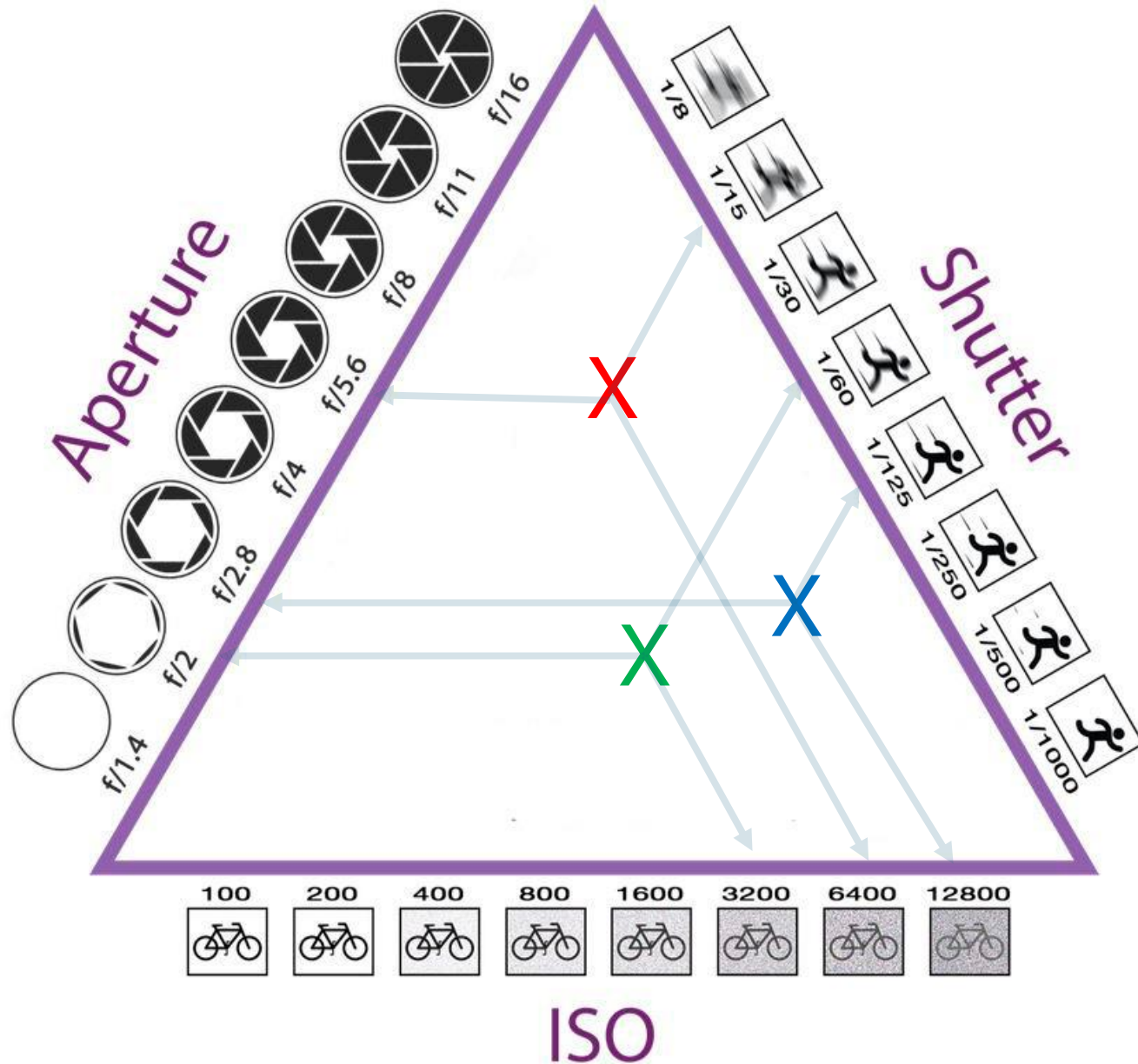
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1/60s, f/2, ISO 3200

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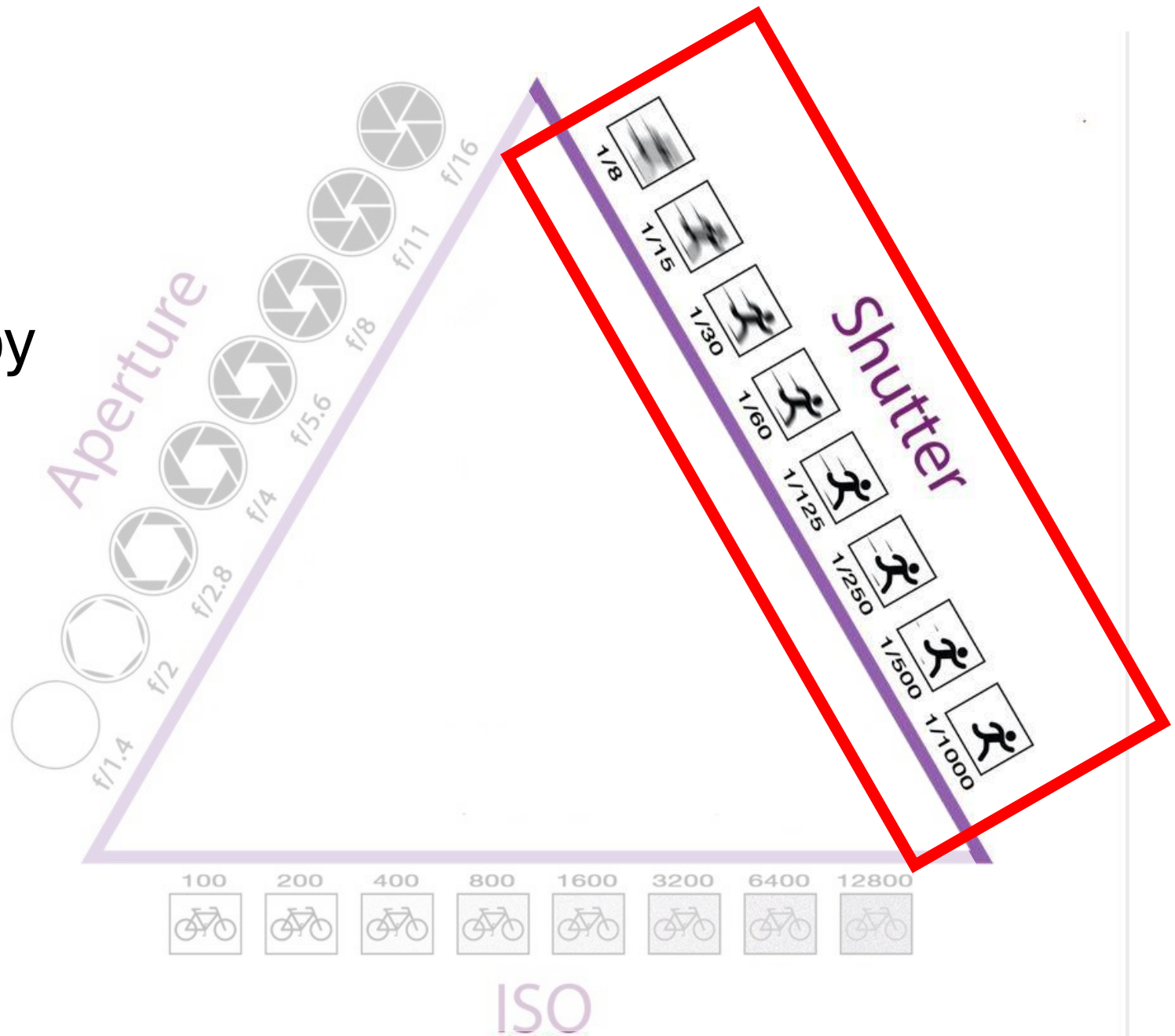
1/125, f/2.8, ISO 12800

*All will give you the correct exposure
But which one is best for what you are
Trying to achieve?*



The exposure triangle

What can we achieve by varying our choice of shutter speed?



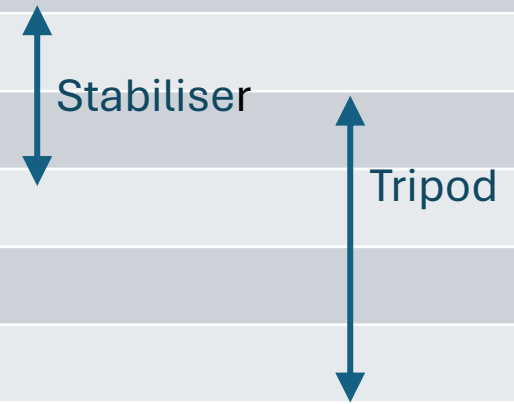
What's a fast and what's a slow shutter speed?

Situation	Shutter speed
Photographing birds	1/2000 s or shorter in flight
Sports action to freeze	1/1000 s
Children playing	1/500 s
Moving people	1/200 s
Still people (portraits), Panning	1/125 s
Limit of handheld (rule of thumb)	1/60 s
Blur effects (water, people)	1/15 s
Blurring water	1s
Night photography, light trails	10s
Star trails	10m and more

These are guide values!

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In camera stabilisation and tripod can help avoid camera shake

Shutter Speed: Pros and Cons of Fast and Slow Shutter Choices

Fast Shutter Speed Benefits

Fast shutter speeds freeze action clearly – good for action photography

Fast speeds eliminate camera shake when doing handheld photography.

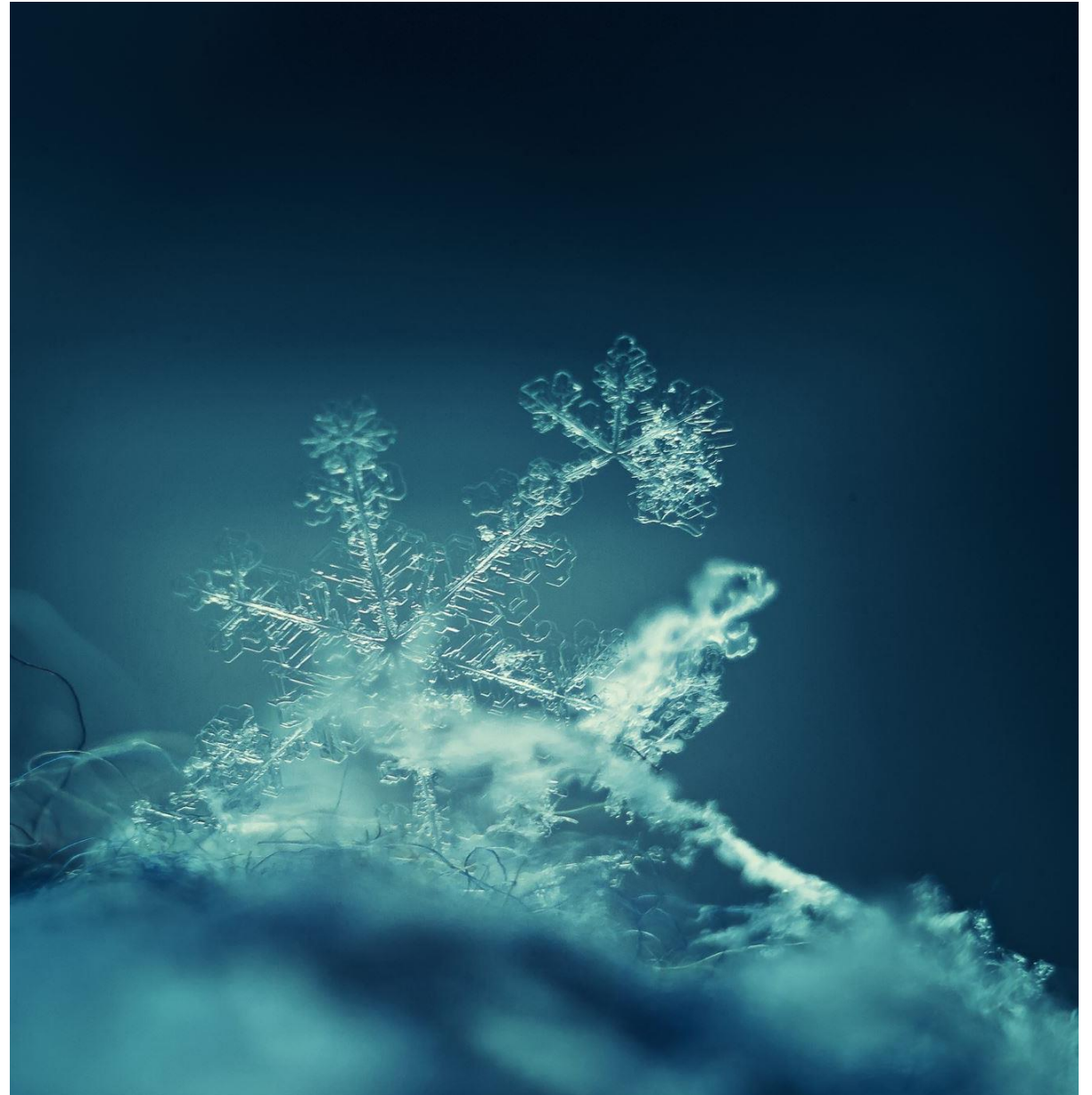
Downside is that they admit less light so you will need a wider aperture and/or a faster ISO

Slow Shutter Speed Benefits

Slow shutter speeds create motion blur effects.

Need a steady hand (image stabilisation helps) or a tripod

Lets more light in so smaller apertures and/or lower ISO possible



Freezing action
fast shutter speed



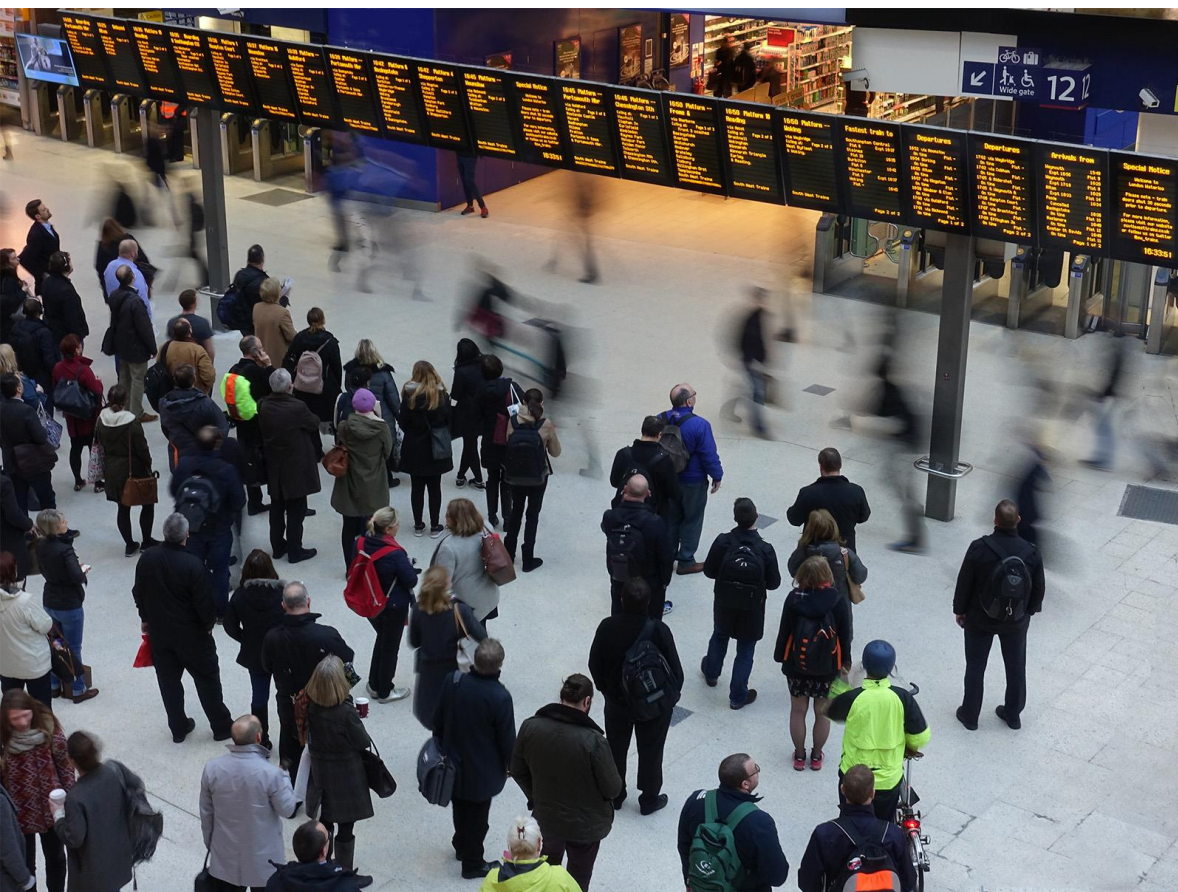
Slower shutter speeds for effect



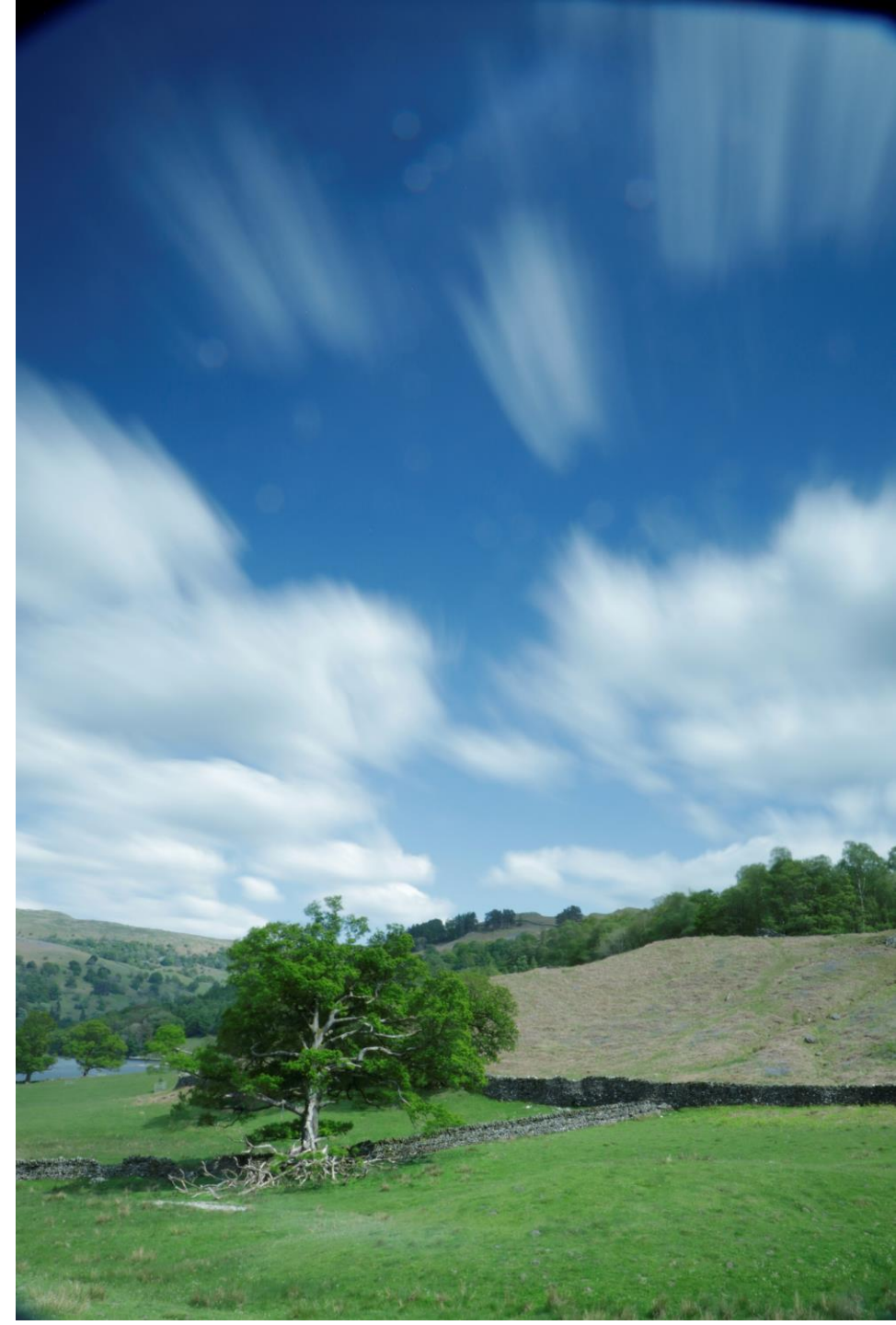
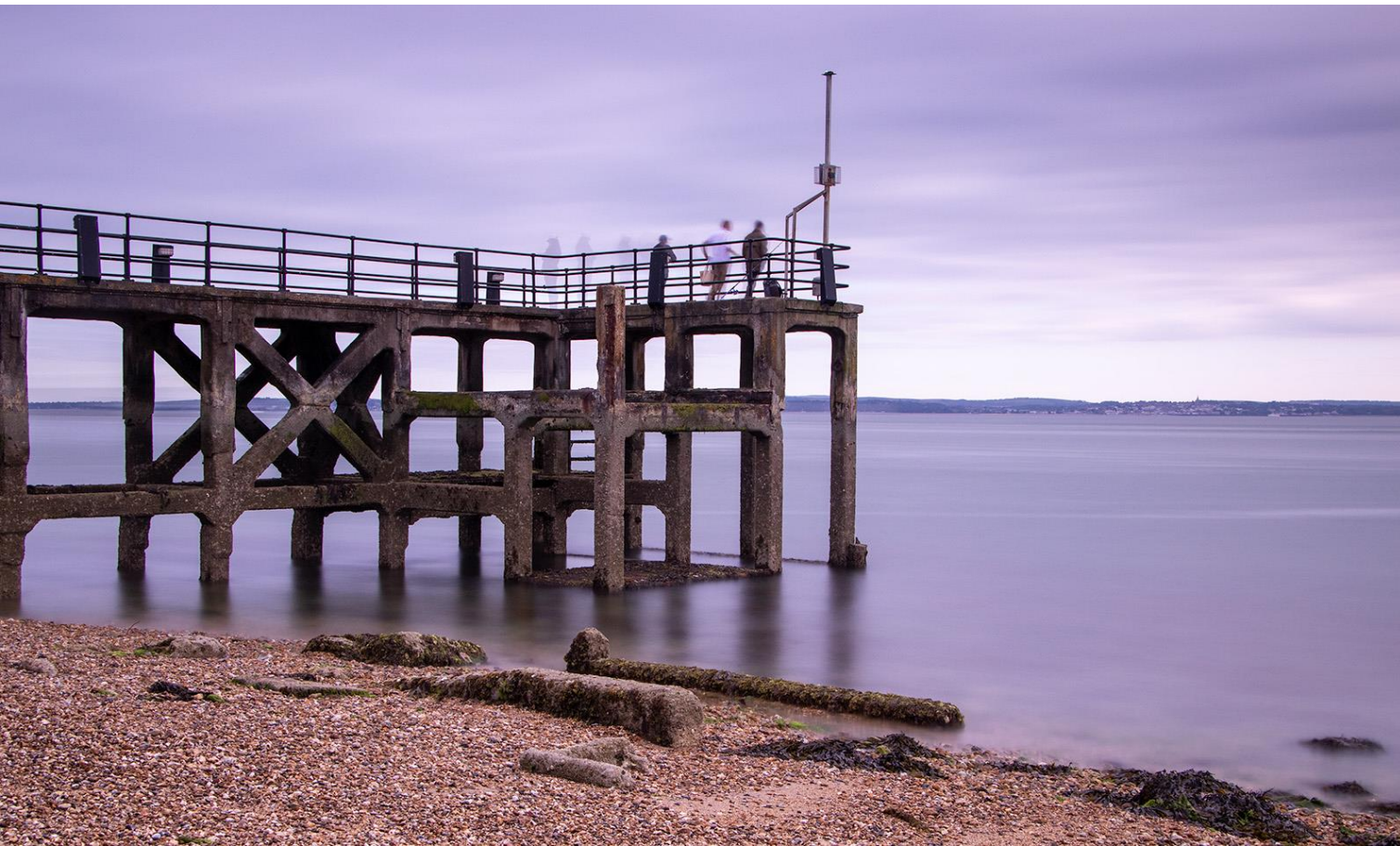
Panning,
Intentional camera movement (ICM),
blurred movement of subject (camera still)



Slow shutter speed for effect



Long exposures for effect
(using neutral density filters)



‘Goldilocks’ shutter speed (not too fast, not too slow)



1/1000 s

1/160 s



Some other stuff about shutters

- Which type to choose? Mechanical or electronic?
- Mechanical
 - Widely found, been around a long time, main type now is focal plane
 - Minimum possible $\sim 1/8,000$ s
 - Can be used with flash but only up to $\sim 1/200$ s
 - Makes a noise!
- Electronic
 - Increasingly found on mirrorless cameras as an option
 - Can go down to $1/50,000$ s
 - Silent
 - Cannot use with flash
 - Can get some odd artefacts photographing moving objects

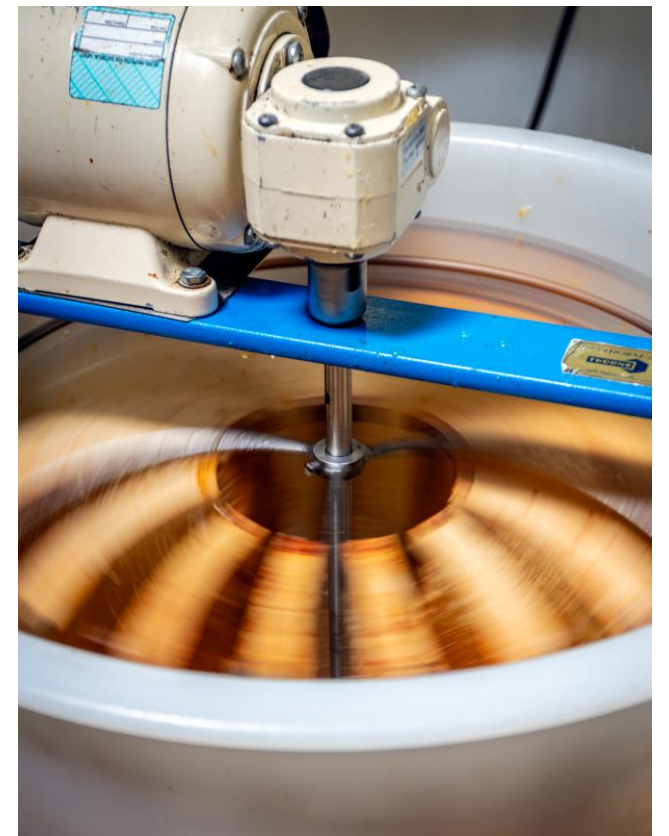


Examples

Rolling shutter effect
with electronic shutter

(Left premiumbeat.com)

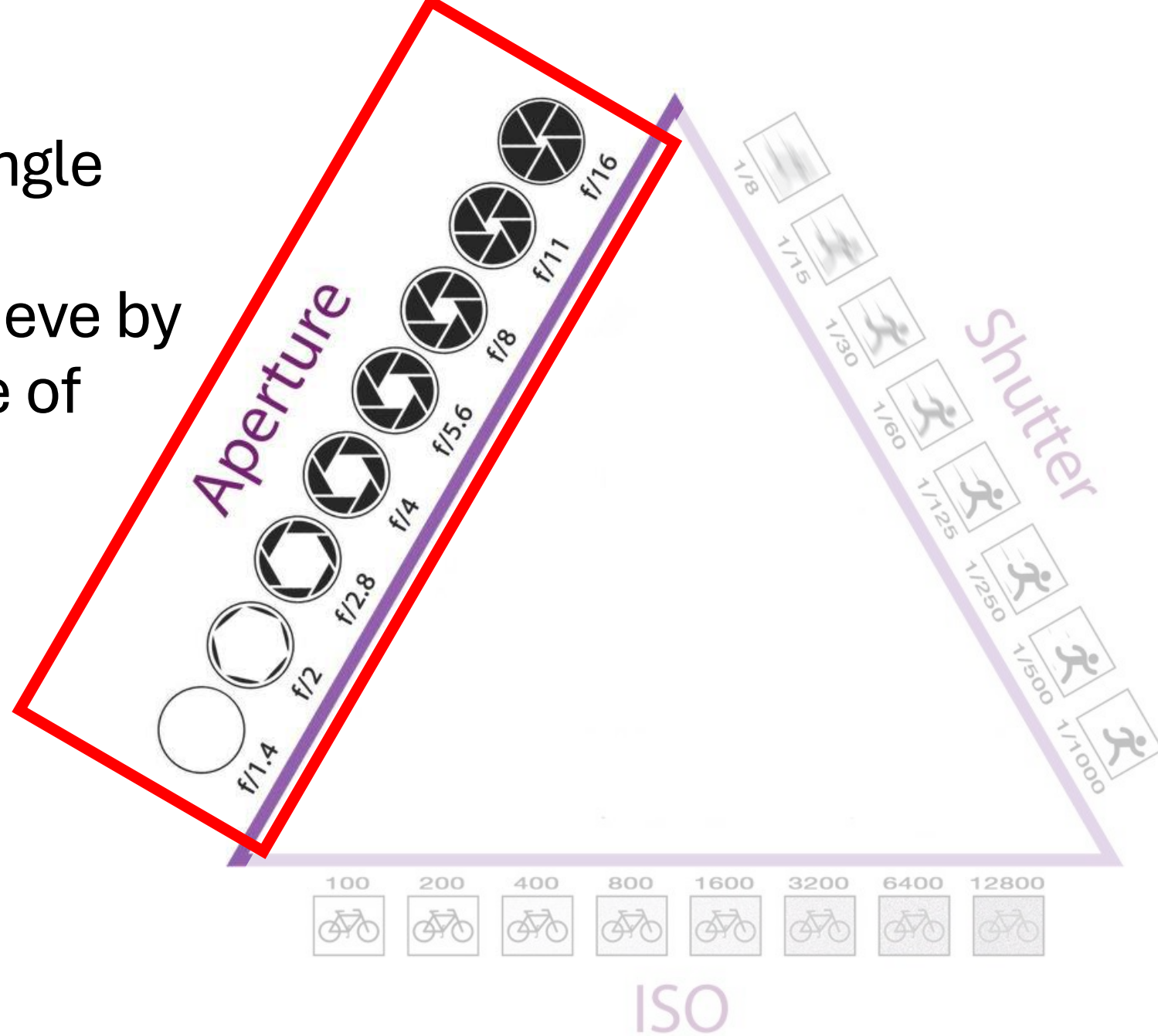
(Right: Ana Peiro-Munoz)



Mechanical shutter: Correct flash synch speed and synch speed too high

The exposure triangle

What can we achieve by varying our choice of aperture?



What is the aperture? According to Google...

- It's the opening within a camera lens that controls the amount of light passing through to the camera sensor.
- It's essentially a (controllable) variable-sized hole in the lens, like the pupil of your eye, that can be adjusted to let in more or less light.
- The size of this opening (measured in f-stops) directly impacts both the brightness (exposure) and the depth of field (how much of the image is in focus) of your photo.

Note that it is normally wide open – the camera only closes it to take the shot then it re-opens

Lens aperture

$f/1.4$



$f/2.0$



$f/2.8$



$f/4.0$



$f/5.6$



$f/8.0$



Lens aperture

$f/1.4$



$f/2.0$



$f/2.8$



$f/4.0$



$f/5.6$



$f/8.0$



What is an ' f number' though?

It's the ratio of the diameter of the aperture hole to the focal length of the lens.

50 mm lens, 25 mm aperture
= $f/2.0$ (diameter of aperture is focal length divided by 2)

Double the number = 2 stops

It means the smaller the aperture hole, the larger the number!

Aperture: Effects, Advantages, and Disadvantages of wide and small aperture Settings

Wide Apertures Characteristics

Allow in more light – faster shutter speeds possible

Shallow depth of field – good for isolating a subject against a busy background

Can create artistic bokeh

Small Apertures Characteristics

Less light falls on sensor – slower shutter speeds required (which might be what you want!)

Greater depth of field

Tiny apertures can suffer diffraction effects that soften the image (below $f/16$) – and can start to show up dirt on sensor!

Shallow depth of field



$f/2.0$



$f/1.4$

Shallow depth of field



$f/1.4$

$f/4.5$



Large depth of field



$f/8$



$f/9$

More depth of field (needed for macro)

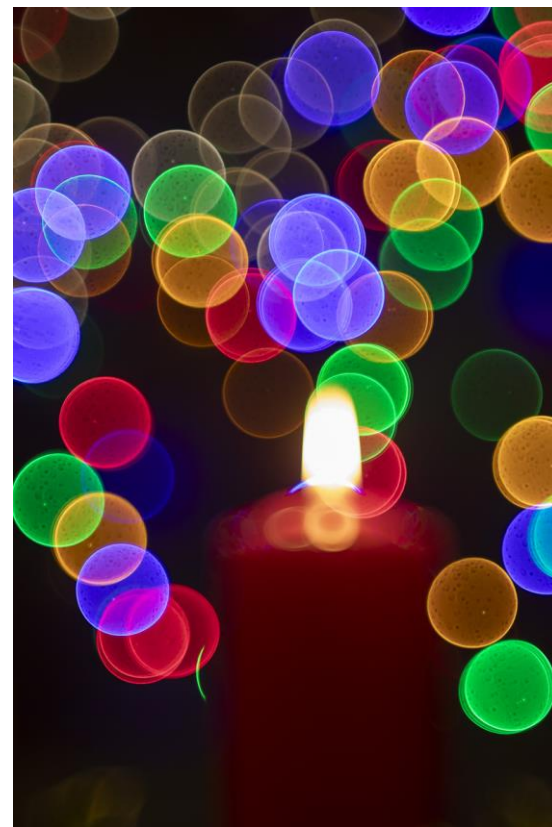


For a given aperture setting, the depth of field decreases:

- With increasing focal length
- The closer you are to the camera

$f/10$

Bokeh effects with shallow depth of field



Bokeh takes on shape of aperture

Some other stuff about apertures

- What's a fast lens?
 - One with a low maximum f number
 - Sometimes can hear the expression 'fast aperture' which means a wide/big aperture or low f number.

- Fast lenses are expensive
 - Prices on Wex for 50 mm Canon prime EF lenses

$f/1.8$	$f/1.4$	$f/1.2$
£129	£409	£1,629

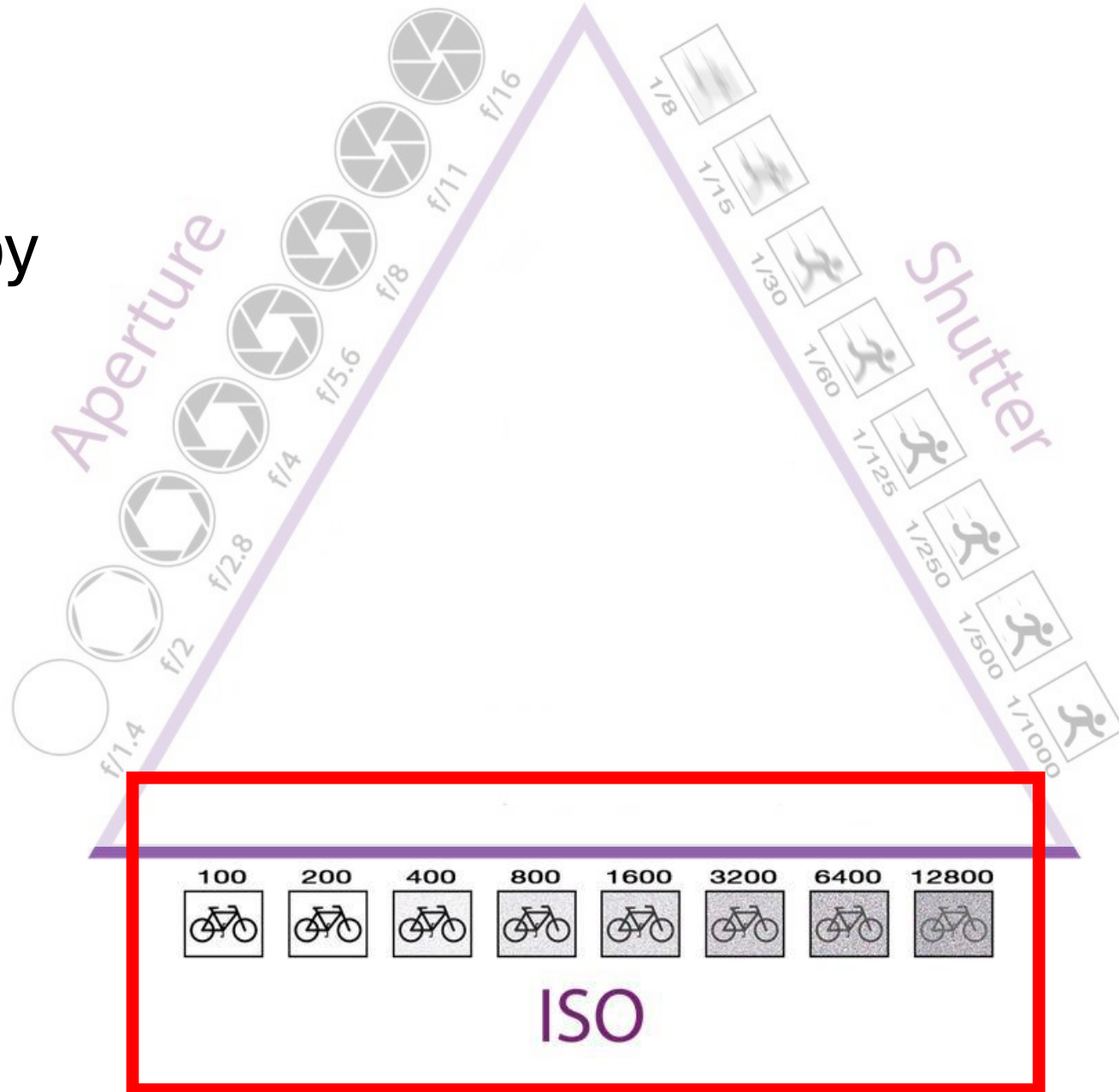
- Long focal length 'fast' lenses can get rather big!



- Most lenses produce their best quality ~3 or 4 stops from wide open but not always the case

The exposure triangle

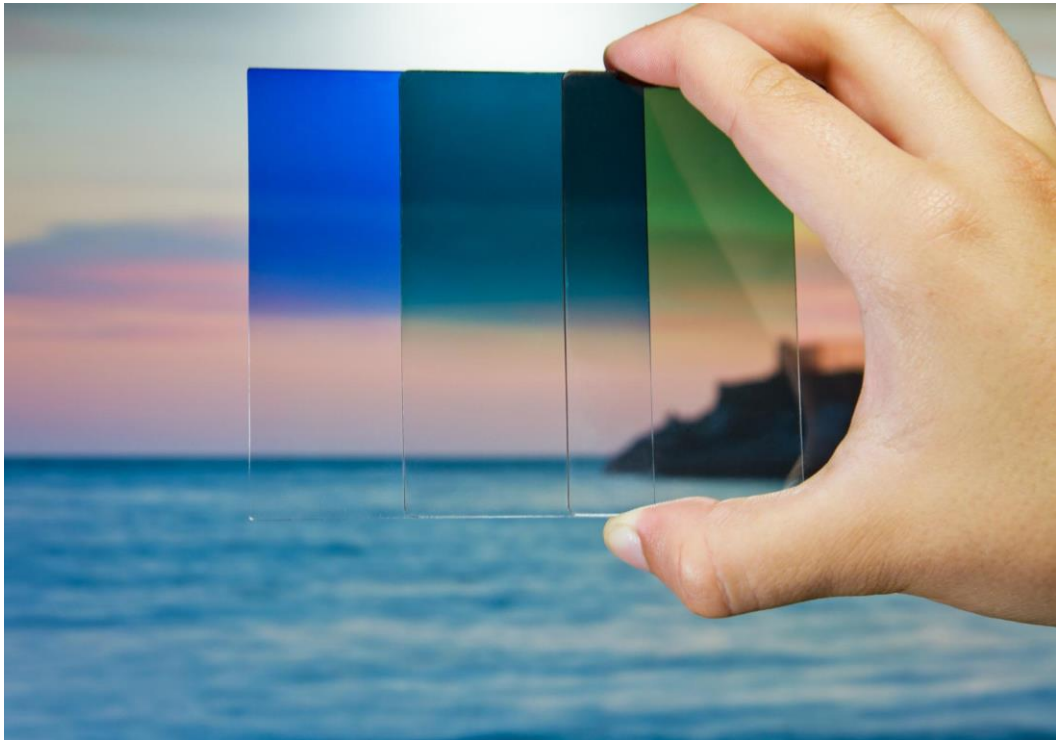
What can we achieve by varying our choice of ISO setting?



‘ISO’ – What are we talking about?

- It's about how sensitive to light we make our recording medium (film or digital sensor)
- Goes back to film days and attempts to standardise the sensitivity of film e.g. between different manufacturers
- Standardised to a single ISO scale in 1974
- Scale is arithmetic, so doubling ISO means twice as sensitive.
Typical values available for film:
 - Kodachrome, 25 & 64 ISO
 - Colour slide, colour print and B&W, typically 100, 200 & 400 ISO
- Same scale adopted to quantify sensitivity of digital sensors
 - Now can see 50 to 128,000 ISO ranges available on cameras!

ISO Sensitivity: Benefits and Drawbacks of High and Low ISO Values



Low ISO Advantages

Low ISO values produce clean images with minimal noise, ideal for well-lit environments.

Low ISO Limitations

Requires more light to capture good images, limiting use in darker conditions.

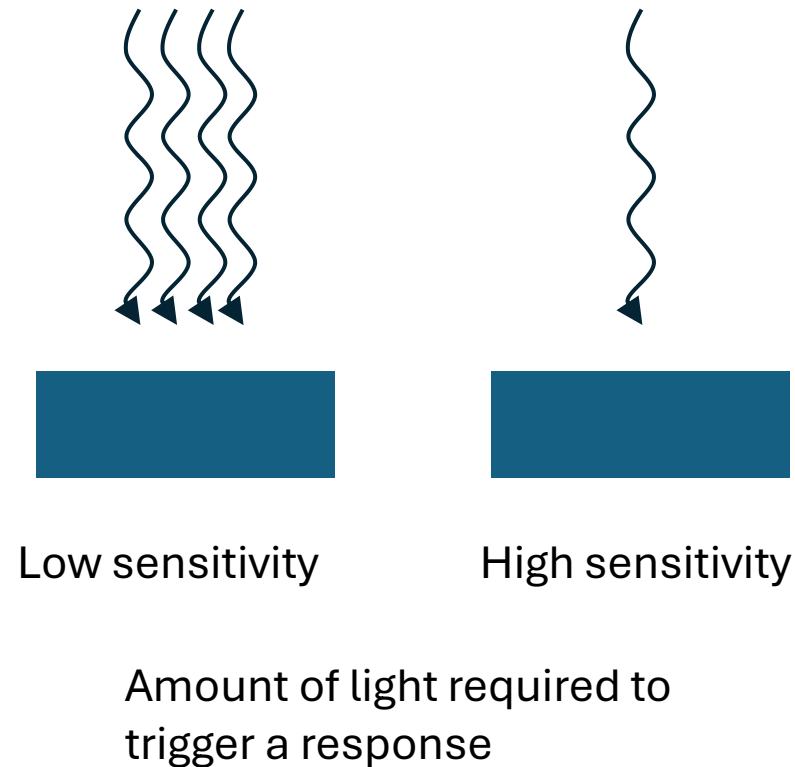
High ISO Benefits

High ISO allows shooting in low light by increasing sensor sensitivity.

High ISO Drawbacks

May introduce grain or noise, reducing overall image quality.

What do we mean by 'noise'?



- The diagram depicts a sensor
- The low sensitivity setting requires a lot of light to trigger a response
- The high sensitivity setting requires much less light to trigger a response
- All electrical systems suffer from random 'noise' (remember the hiss from short wave radio stations!)
- Sometimes the sensor will trigger a random 'false' response which causes noise
- If the sensitivity is high, a 'false' response is more likely to occur.

Types of noise

- Noise can be either in the form of:
 - luminance (brighter or darker than it should be)
 - Colour (speckles of the wrong colour – shades of red/green/blue)
- Usually, it's a mixture of the two.
- The higher the ISO is set, the greater the risk of noise degrading the quality of an image
- Note that 'noise' is not the same thing as 'grain'
 - 'Grain' only correctly used to describe effects seen with film
 - Grain can have aesthetic appeal – noise never does!

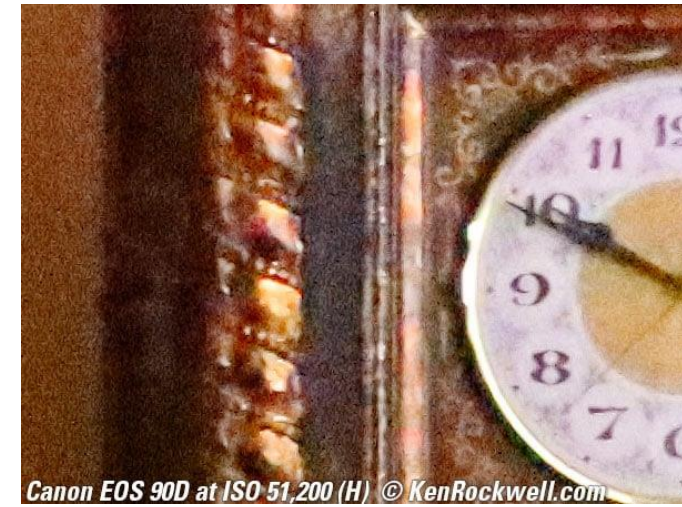
Canon 7D mk2 @ ISO 5000



Canon 80D @ ISO 800
(~3.5 stops less sensitive)



Images from Ken Rockwell's website



Consequences

- High ISO images don't have the same degree of detail in them.
- Noise most apparent in large areas of similar tone or colour
 - Can get colour noise which shows as random speckles
- But, don't be afraid to push the ISO up if it would otherwise mean missing a picture!
 - There are post-processing excellent tools available to reduce noise
- Creative choice?
 - Normally try to go for as low ISO as your preferred shutter and aperture choices will allow.

Example of noise reduction

Original



NR Processed



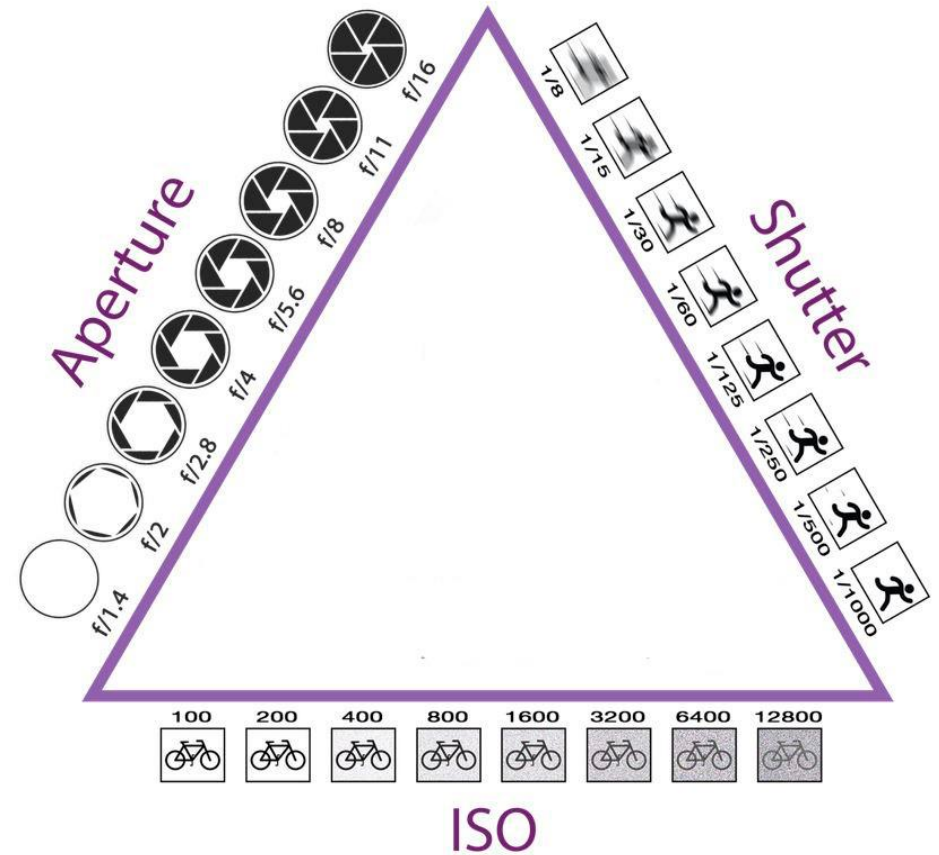
So how do you decide what settings to use?



Programme mode



Auto ISO



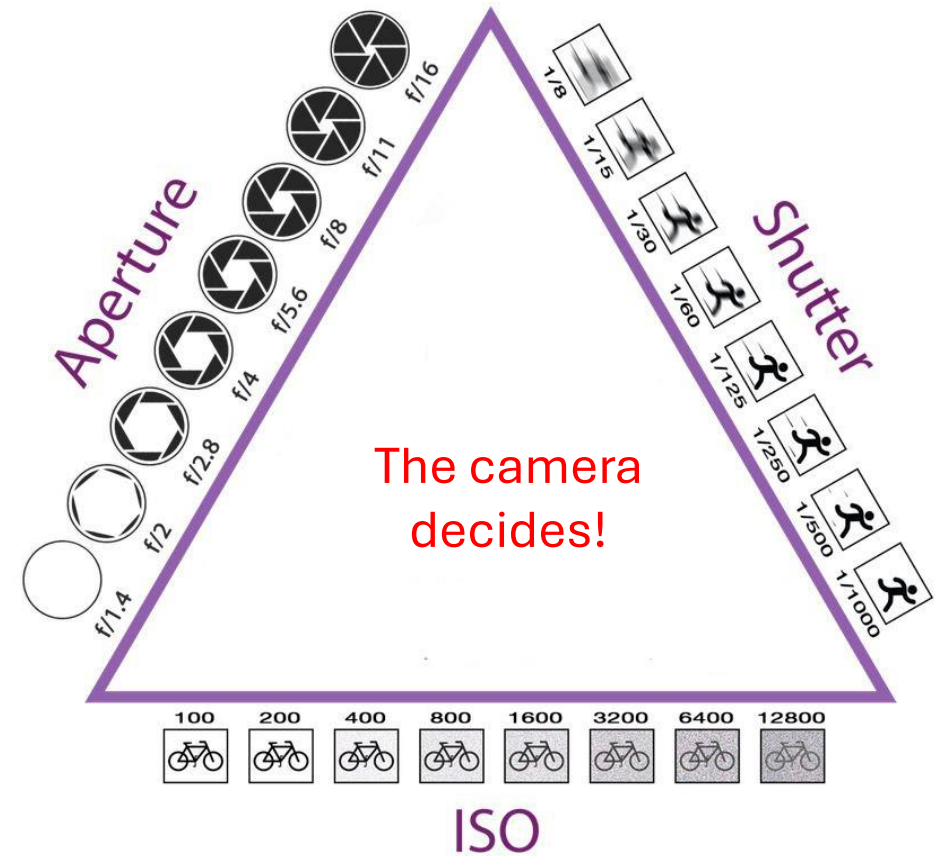
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Programme mode



Auto ISO



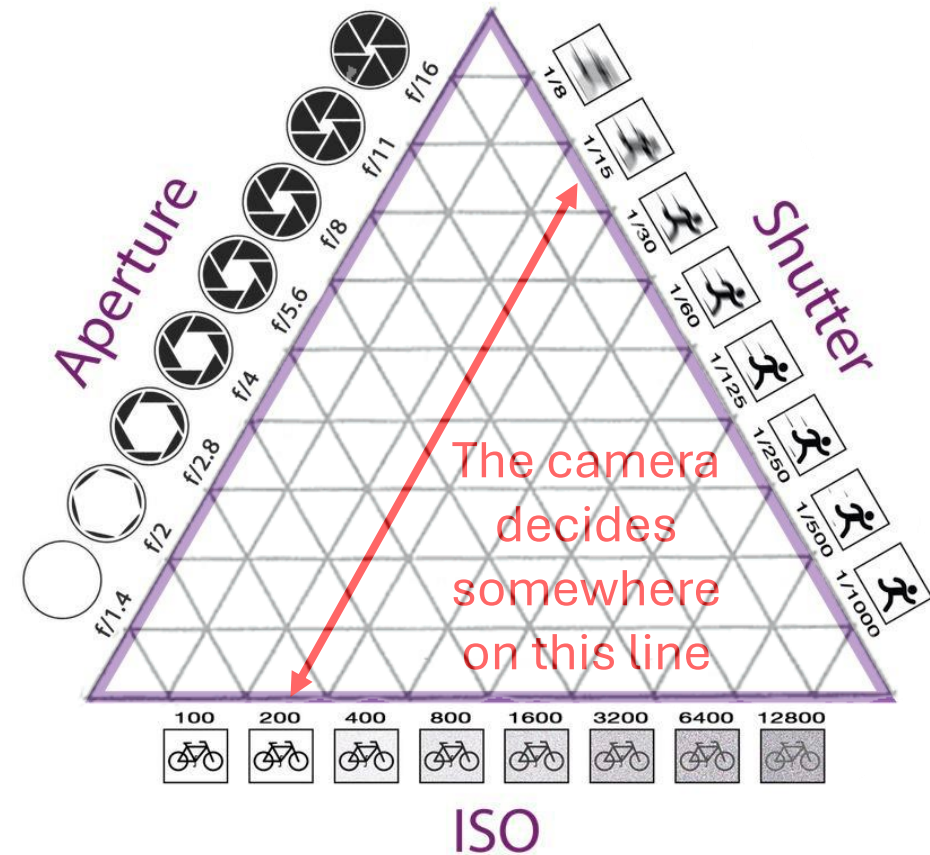
So how do you decide what settings to use?



Programme mode



ISO 200



In this example, anywhere between
1/1000 @ f2 and 1/15 @ F16

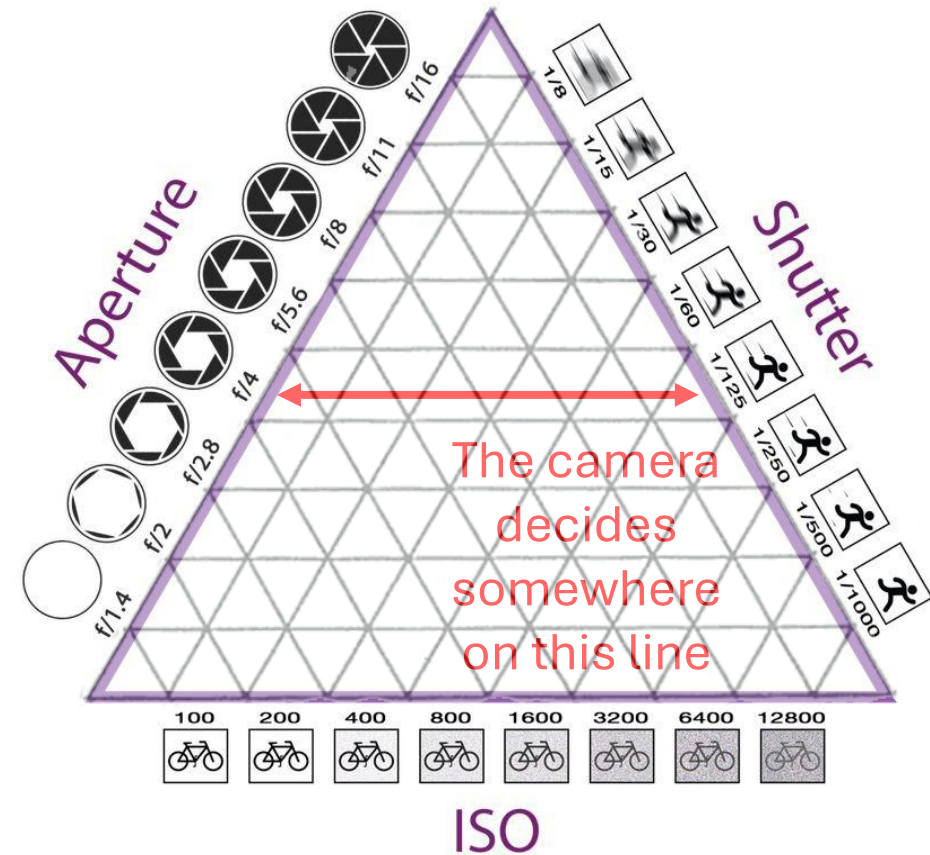
So how do you decide what settings to use?



Shutter priority
(1/125 s)



Auto ISO



In this example, anywhere between
f5.6 @ ISO 100 and f16 @ ISO 800

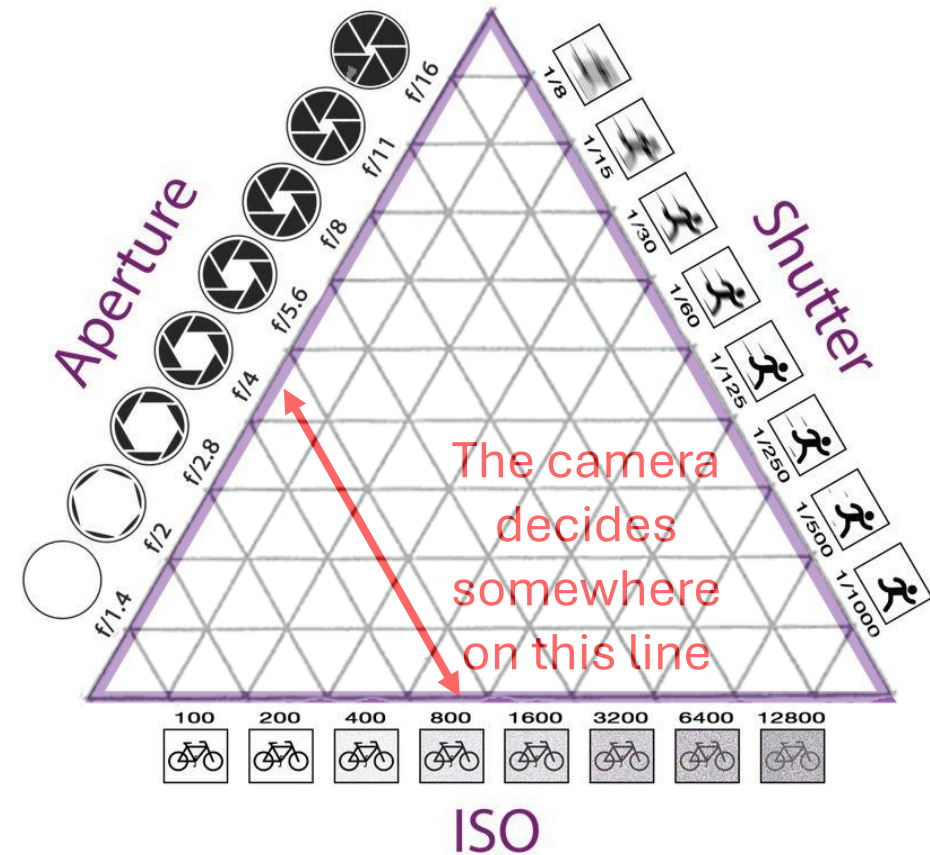
So how do you decide what settings to use?



Aperture priority
(f 4)



Auto ISO



In this example, anywhere between
1/125 @ ISO 100 and 1/1000 @ ISO 800

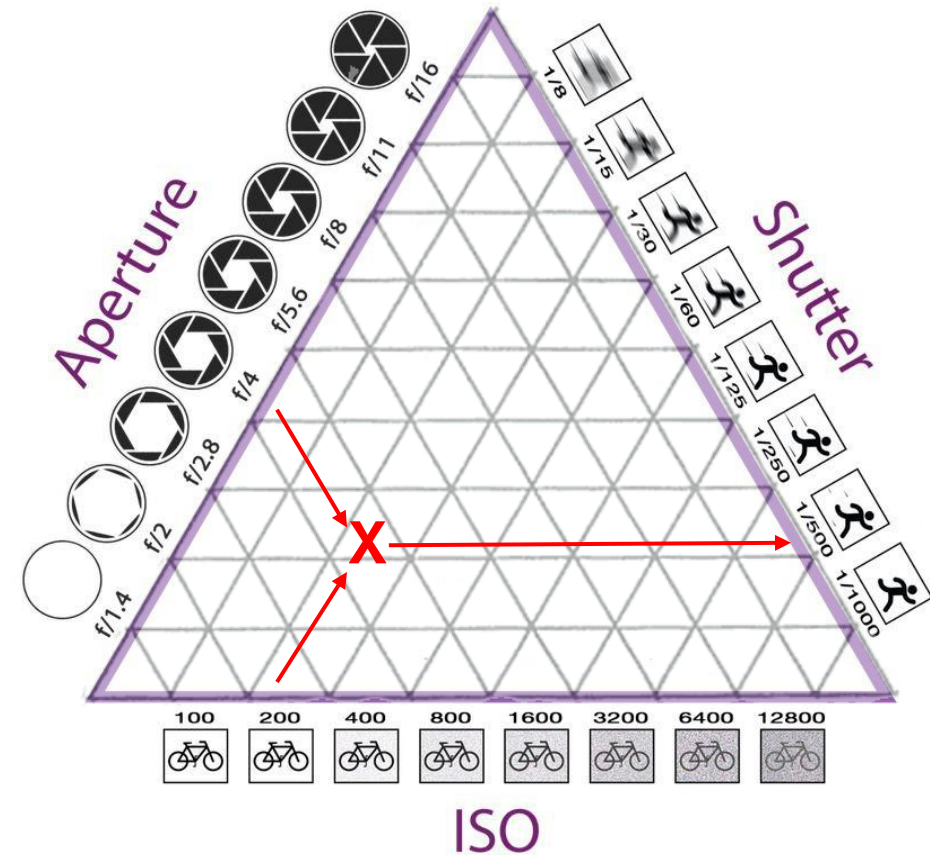
So how do you decide what settings to use?



Aperture priority
(f 4)



ISO 200

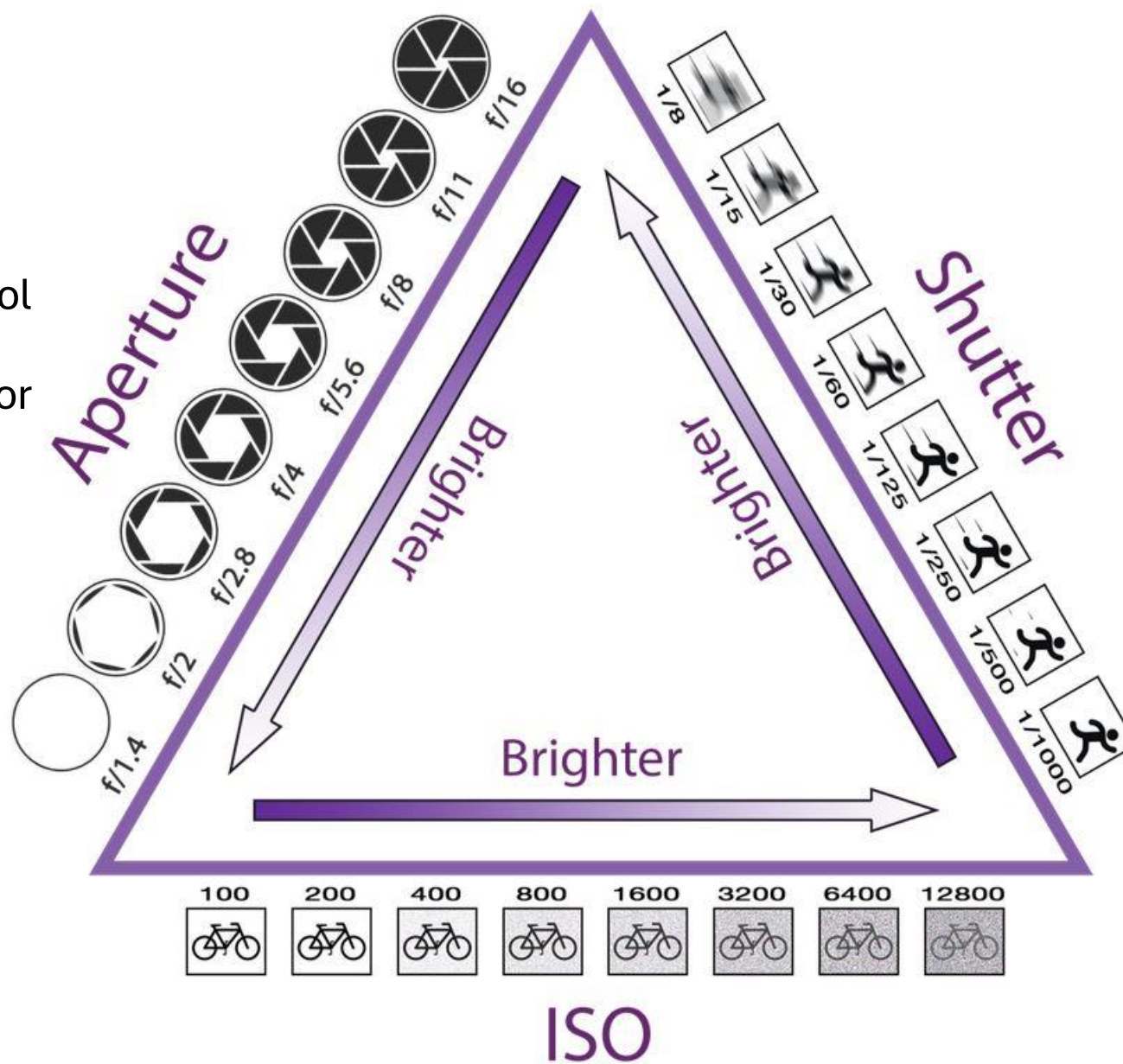


Camera then only has one choice to set shutter speed (in this example 1/500 s) to match the light level and produce the correct exposure .

The exposure triangle

-Recap

- Three interdependent settings control exposure
- Can leave camera to decide on one or more, but you may not get what you want
- You making choices on any one or more can help with creative control



Some typical scenarios and settings to prioritise

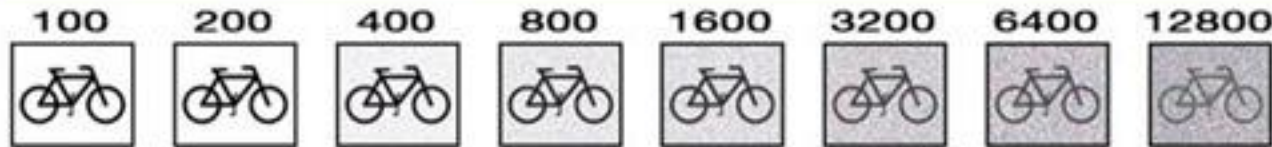
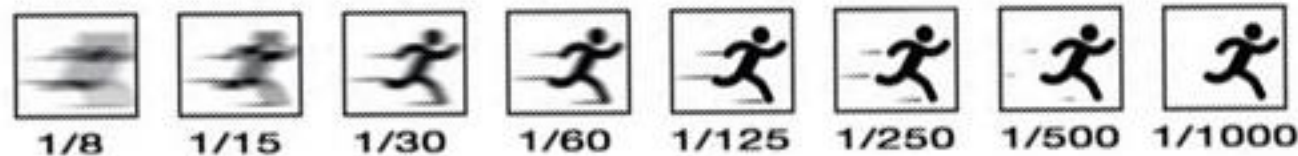
Type of photography	Aperture	Shutter speed	ISO
Landscape	Control (mid to Small)	Auto OK (but may need a tripod)	Control (low as poss.)
Portrait	Control (large to mid)	Auto OK (but may need a tripod)	Control (low as poss.)
Wildlife	Auto (but usually large)	Control (fast)	Auto (but keep as low as possible)
Sports	Auto (but usually large)	Control (fast unless panning)	Auto (but keep low to mid)
Close up	Control (small)	Auto OK (probably need a tripod)	Auto (but keep low to mid)
Street photography	Auto	Control	Auto

You decide!

Mobile phone

- Does the exposure triangle apply?
- Unfortunately not, as phone do not have controllable apertures
- It becomes an 'exposure line'! It does allow some creative control

Shutter



ISO

Conclusion

Exposure Triangle Components

Aperture, shutter speed, and ISO work together to control light for optimal exposure in photography.

Creative Exposure Control

Mastering the exposure triangle enables creative control over image brightness and artistic effects.

Adaptation to Lighting

Balancing exposure settings is essential for capturing stunning photos in diverse lighting conditions.

According to Microsoft Copilot!