



THE EXPOSURE TRIANGLE

Getting off “Auto” – why you would want to ...



A BAY & BASIN CAMERA CLUB PRESENTATION

Brett Davis - October 2012

Why get off “Auto” ?

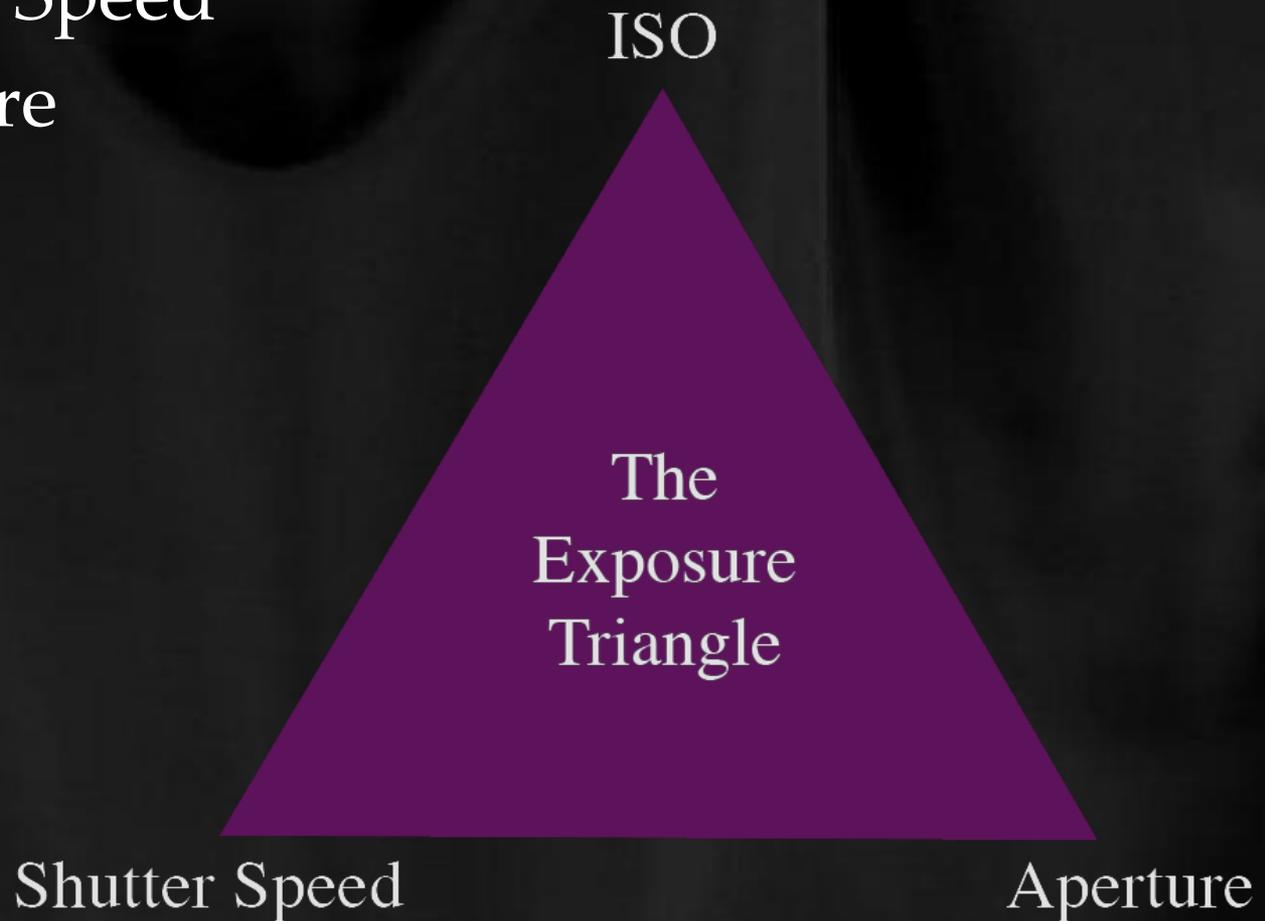
- ▣ because our photos may be better
- ▣ why only “may” be better ... ?
- ▣ because unless you understand the Exposure Triangle, you will not know what to do

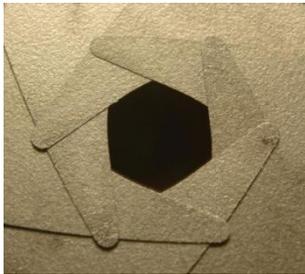
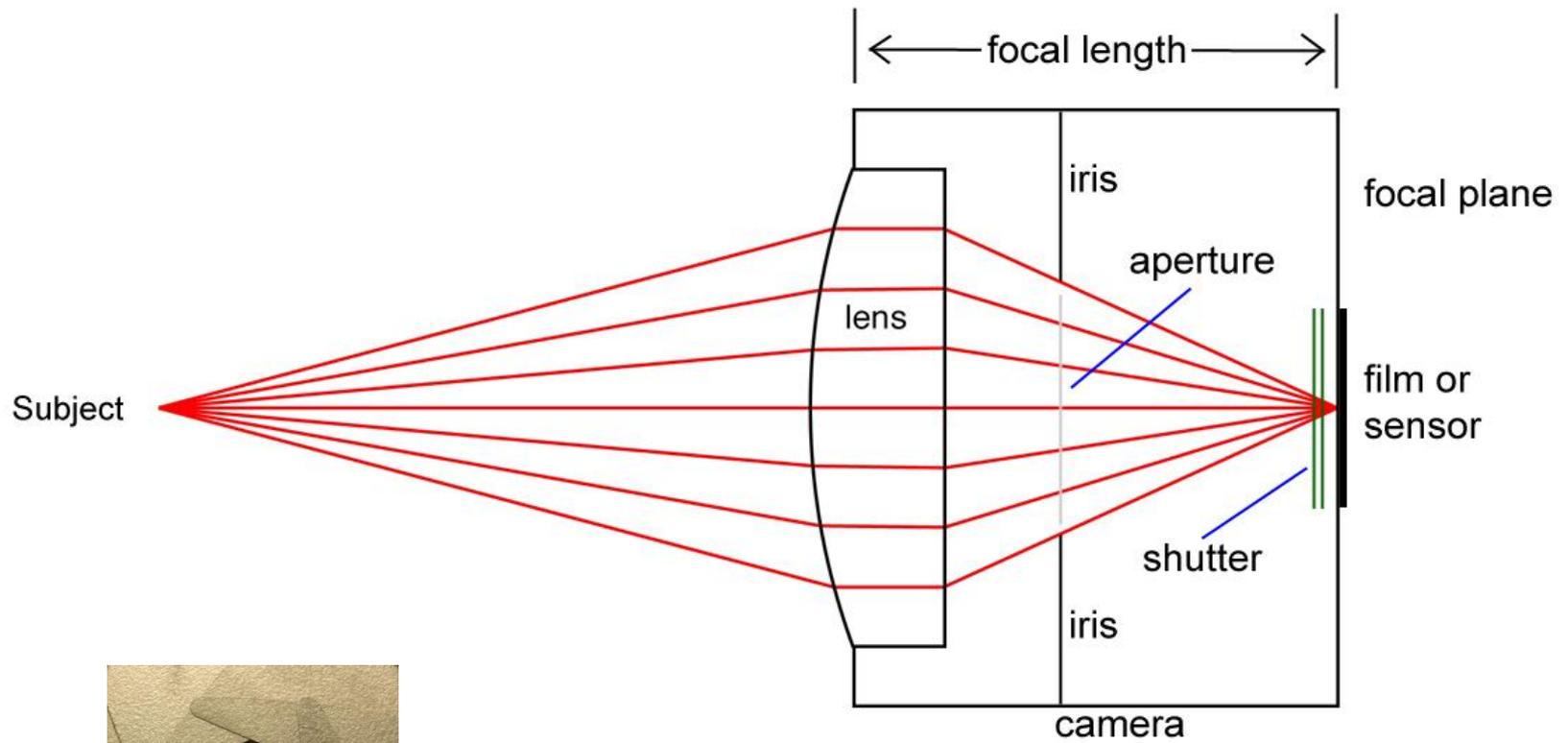
What is the Exposure Triangle?

- ▣ Let us start right from the beginning ...
- ▣ Photography means “painting with light”
- ▣ Every photo needs a certain amount of light
- ▣ Not enough light – photo is too dark
- ▣ Too much light – photo is too light
- ▣ The correct amount of light needed is called the “Exposure Value (EV)”
- ▣ A camera has 3 ways of controlling the EV
- ▣ Those 3 ways are the Exposure Triangle
- ▣ ... and they are interdependent

So what are the 3 ways?

- ▣ Shutter Speed
- ▣ Aperture
- ▣ ISO





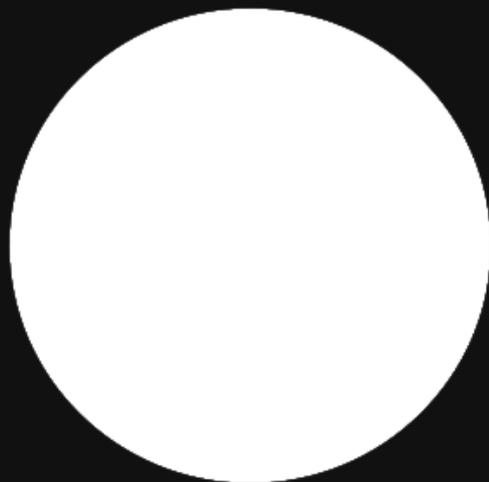
Shutter Speed

- ❑ has nothing to do with the speed of the shutter
- ❑ is the amount of time the shutter stays open
- ❑ is measured in seconds or fractions of a second
- ❑ slower shutter speeds (longer times) let in more light
- ❑ faster shutter speeds (shorter times) let in less light

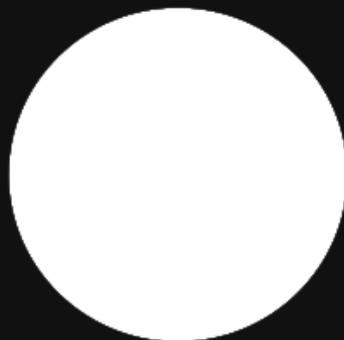
Aperture

- ▣ is the size of the opening in the lens that the light goes through when a picture is taken
- ▣ the bigger the aperture, the more light gets in
- ▣ the smaller the aperture, the less light gets in
- ▣ the area of the opening determines the amount of light that gets in
- ▣ unfortunately, the aperture numbers show the diameter of the opening, not the area ...

Aperture



f/1.4



f/2



f/2.8



f/4

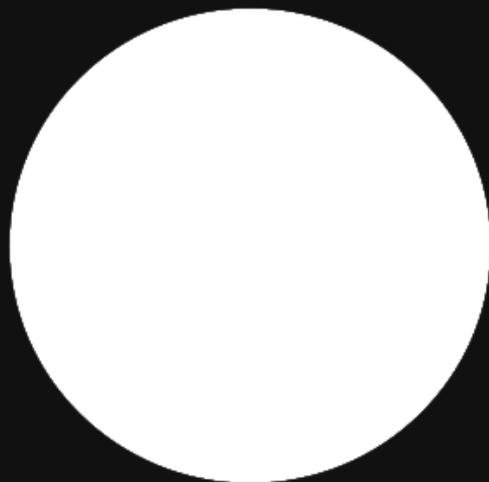


f/5.6

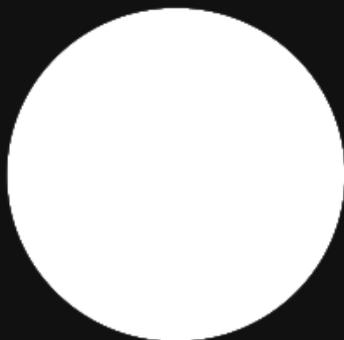


f/8

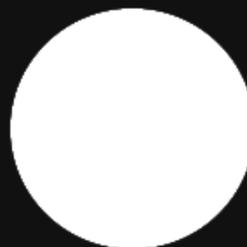
Aperture



f/1.4



f/2



f/2.8



f/4



f/5.6



f/8

(but we will talk more about that later)

ISO

- ❑ unfortunately, is an acronym totally unrelated to what it describes
- ❑ even more unfortunately, it is an acronym that is not even accurate
- ❑ it is an acronym of “International Organisation of Standardisation”
- ❑ ISO is actually a measure of the sensitivity of the image sensor
- ❑ the greater the sensitivity, the less light needed for the photograph

How are shutter speed, aperture and ISO interdependent?

- ▣ for every image there is one correct EV - think of it as the correct amount of light that has to reach the sensor
- ▣ if the ISO stays the same, but we make the aperture smaller (which lets in less light), the shutter speed must be longer so that the amount of light is the same

How are shutter speed, aperture and ISO interdependent?

- ▣ if aperture stays the same, and ISO is increased making the sensor more sensitive to light, then we need to reduce the amount of light by making the shutter speed quicker (shorter)
- ▣ if shutter speed stays the same, but we make the aperture smaller (letting in less light), we have to increase the ISO to increase the sensitivity of the sensor so we let in the correct amount of light



tap handle = shutter



tap size = aperture

water pressure = ISO



A woman in a white bikini is sitting on a beach, holding a white sunscreen bottle with an orange cap. She is applying sunscreen to her leg. The background shows a clear blue sky, the ocean, and a sandy beach. A straw hat and sunglasses are visible on the sand near her feet.

skin sensitivity = ISO

time in sun = shutter speed

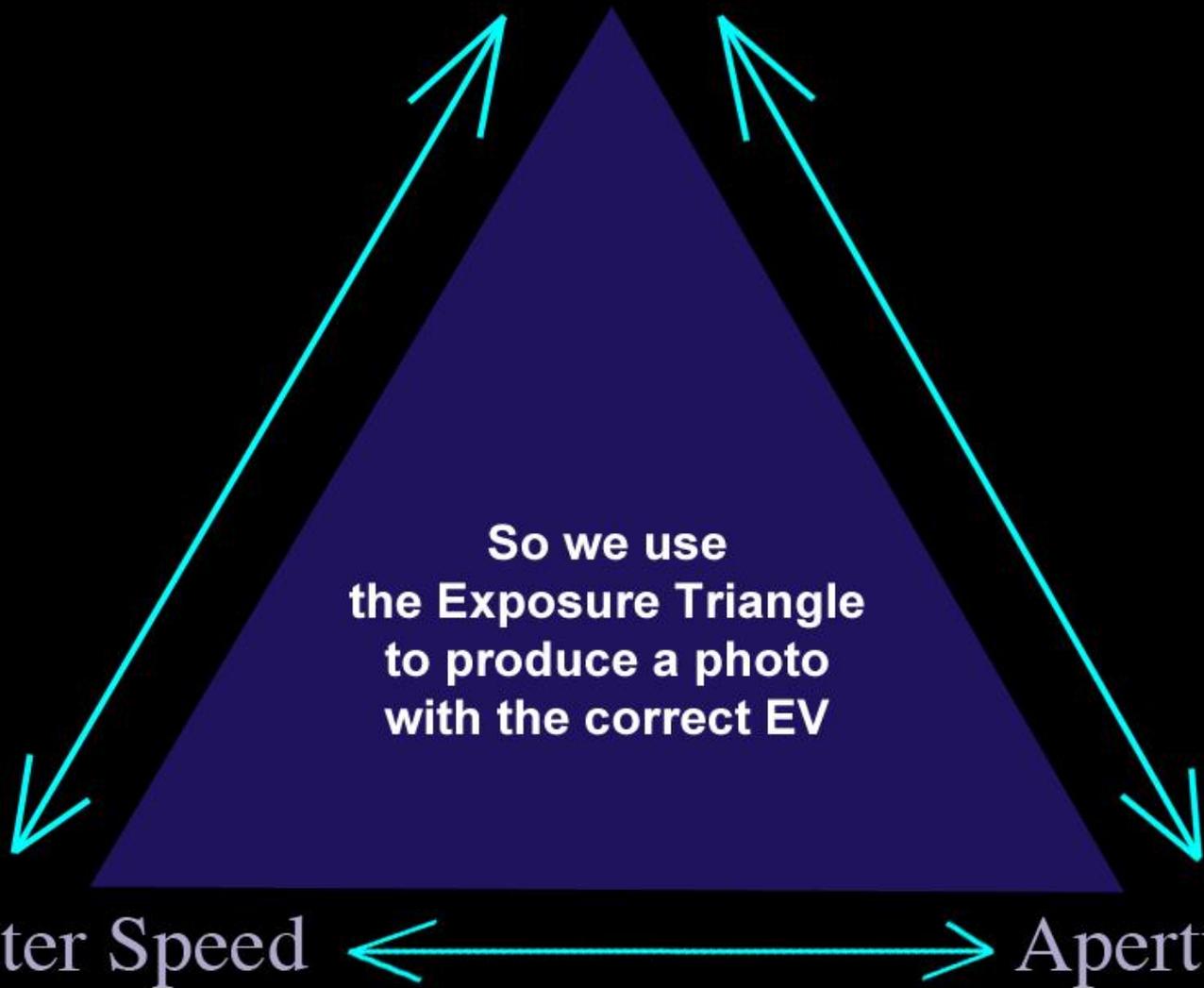
sunscreen = aperture

ISO

So we use
the Exposure Triangle
to produce a photo
with the correct EV

Shutter Speed

Aperture



Numbers

- ▣ shutter speed, aperture and ISO are expressed in different ways – all using numbers
- ▣ shutter speed measures time in seconds, and uses numbers such as 2, 1, $\frac{1}{2}$, $\frac{1}{4}$, etc.
- ▣ aperture measures diameter and uses numbers in the form of f/stops such as f/1.4, f2, f/2.8, f4 etc.
- ▣ ISO measures sensor sensitivity and uses numbers such as 25, 50, 100, 200 etc

So how are the numbers related?

- ▣ in the old days before digital cameras, all the shutter speed settings differed by a factor of 2
- ▣ when you clicked the shutter speed dial up to the next setting, the shutter would be opened up for twice as long
- ▣ if you clicked the shutter speed dial down to the next setting, the shutter would only be opened up for half as long

So how are the numbers related?

- ▣ in the old days before digital cameras, all the aperture settings differed by a factor of 2
- ▣ when you clicked the aperture ring on the lens one click, the amount of light that was let in doubled or halved
- ▣ these days there are a lot more intermediate settings

So how are the numbers related?

- ▣ in the old days before digital cameras, the ISO was determined by the sensitivity (speed) of film that you were using
- ▣ ISO was called ASA
- ▣ but the numbers are basically the same
- ▣ if the ISO number was doubled, the film sensitivity was doubled just like today
- ▣ so ISO 200 is twice as sensitive as ISO 100
- ▣ and each doubling is known as a stop

Stops

- ▣ in the old days, when you turned the aperture dial to the next setting, it would click into place and “stop”
- ▣ when you turned the shutter speed dial to the next setting, it too would click into place and “stop”
- ▣ so any change from one setting to the next - which changed the amount of light by a factor of 2 became known as a stop
- ▣ but f/stops need some further explanation ...

F/stops

- ▣ f/stops - which measure the diameter of the aperture have numbers like $f/1.4$, $f/2$, $f/2.8$, $f/4$ etc.
- ▣ if the focal length of a lens is 100mm and the aperture is set to $f/2$, the diameter of the aperture is $100/2$ which is 50mm
- ▣ an aperture of $f/4$ would have a diameter of 25mm
- ▣ an aperture of $f/8$ would have a diameter of 12.5mm etc.

But ...

- ▣ the amount of light the lens lets into the camera is determined by the area of the aperture , not the diameter
- ▣ the area of a circle is pi times the radius squared and it the “squared” that is important
- ▣ because if we double the diameter we let in 4x as much light
- ▣ so we have to use the square root of the diameter on our aperture scale (about 1.4142)
- ▣ hence apertures of $f/1$, $f/1.4$, $f/2$, $f/2.8$...

So what is the correct EV?

- ▣ a typical scene in bright sunlight at ISO 100 has an EV of 15
- ▣ the same scene in heavy overcast at ISO 100 has an EV of 12
- ▣ bright street scenes at night have an EV of 8
- ▣ distant views of lighted buildings at night have an EV of 2
- ▣ a rural landscape illuminated by starlight has an EV of -6

Now for the good news ...

- ▣ no photographer I know ever uses EVs
- ▣ they all rely on the exposure meters on their cameras to tell them the correct exposure
- ▣ and the correct exposure is not expressed as an EV so you really don't have to worry about EVs at all
- ▣ ... but it is good to know a bit about them

What do we have to worry about?

- ▣ it does not matter what exposure triangle settings you use, it does not matter what shutter speed you use, or what aperture you use, or what ISO you use, as long as that little pointer points to “0” you will produce a photograph with the correct exposure
- ▣ so why do we need to know all that other stuff?
- ▣ because exposure isn't everything ...

Exposure isn't everything?

- ▣ changing the ISO, or the aperture or the shutter speed not only affects the exposure, it also has profound effects on the photograph you take

Different settings – same exposure

ISO	Shutter Speed	Aperture
200	1/8	f/32
200	1/15	f/22
200	1/30	f/16
200	1/60	f/11
200	1/125	f/8.0
200	1/250	f/5.6
200	1/500	f/4.0
200	1/1000	f/2.8
200	1/2000	f/2.0
200	1/4000	f/1.4
200	1/8000	f/1.0

How do we choose our settings?

- ▣ we need to know how changing the ISO will affect our photograph
- ▣ we need to know how changing the aperture will affect our photograph
- ▣ we need to know how changing the shutter speed will affect our photograph
- ▣ and we need to remember that every time we change one setting in the Exposure Triangle, we have to change one of the other settings too

more noise
6400

less noise
100
ISO

shallow focus
f1
APERTURE

more in focus
f22

Exposure Triangle

SHUTTER SPEED

less motion blur

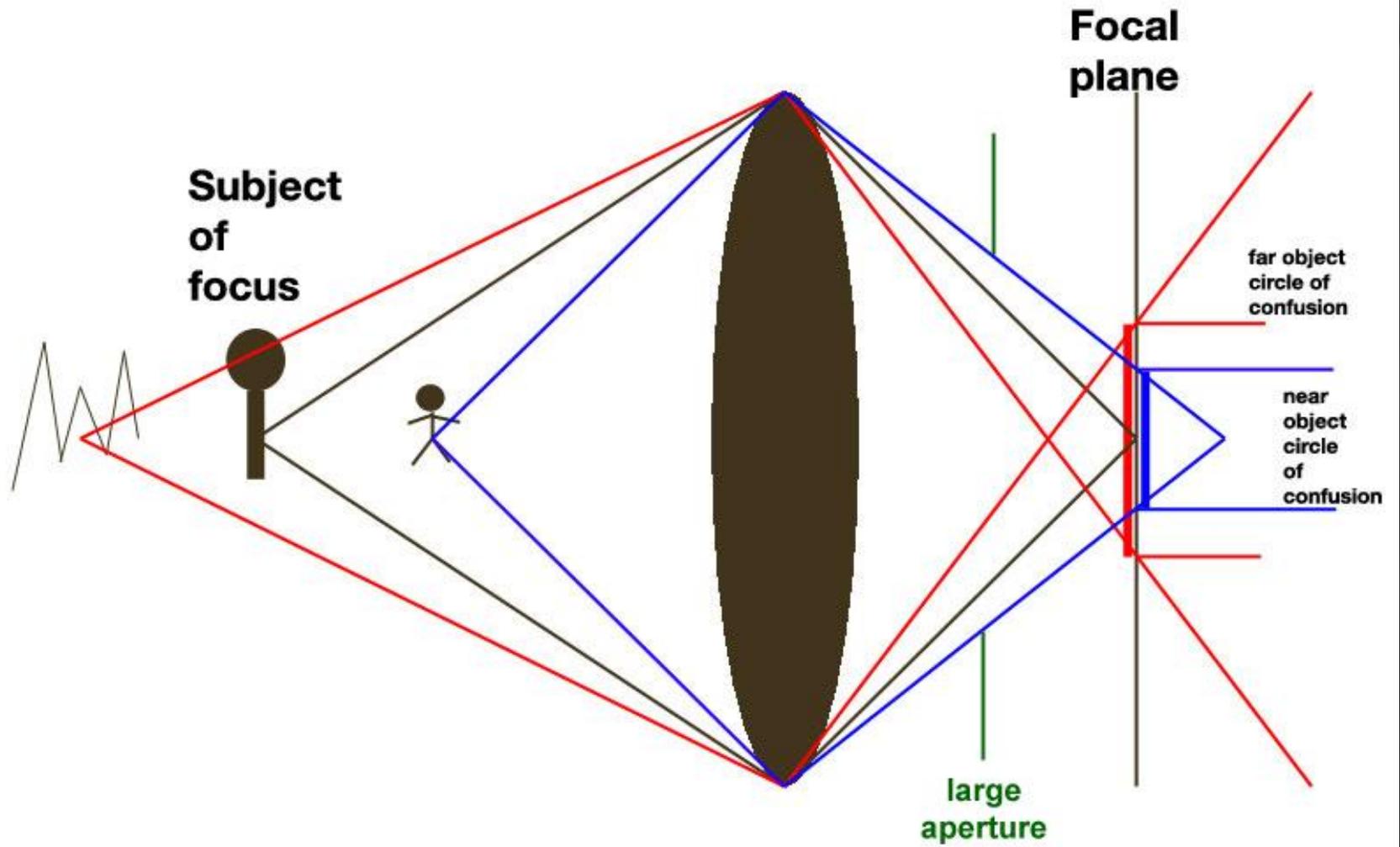
1/4000 sec

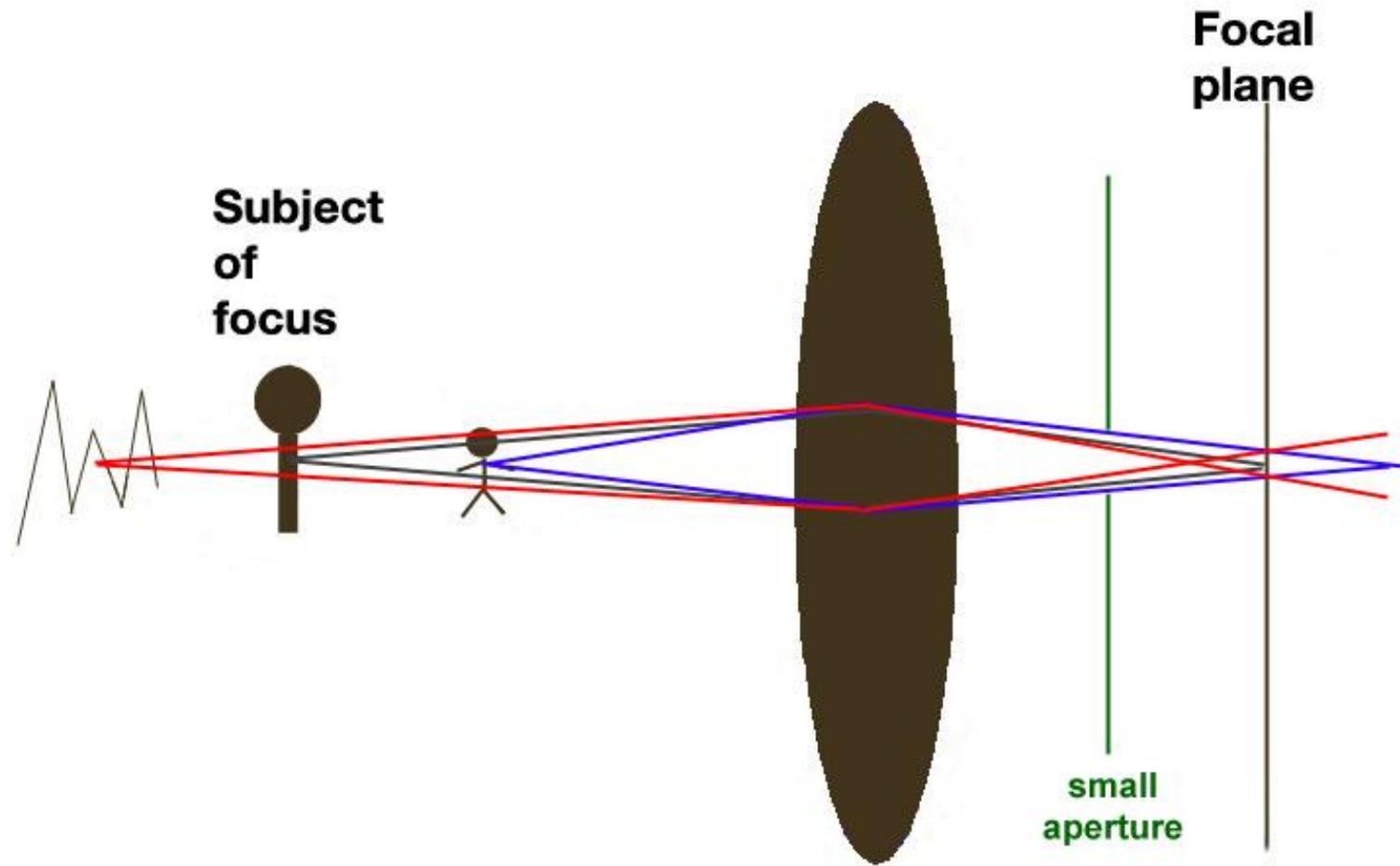
2 sec

more motion blur

Let's start with Aperture

- ▣ aperture affects “depth of field” (DOF)
- ▣ DOF is defined as the distance between the nearest and farthest objects in a scene that appear acceptably sharp in an image.
- ▣ As Robin said yesterday, although a lens can precisely focus at only one distance at a time, the decrease in sharpness is gradual on each side of the focused distance, so that within the DOF, the lack of sharpness is imperceptible under normal viewing conditions.







aperture....f 2
shutter.....1/500
ISO.....100
distance...~3ft



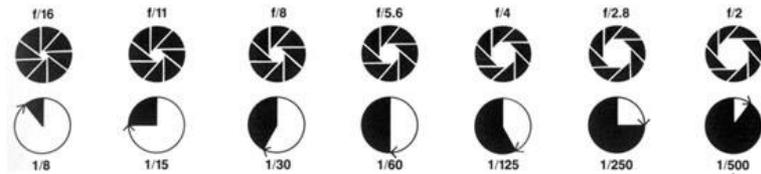
aperture....f 4
shutter.....1/125
ISO.....100
distance...~3ft



aperture....f 8
shutter.....1/30
ISO.....100
distance...~3ft

Shutter Speed

- ▣ fast shutter speeds help to freeze motion
- ▣ but fast shutter speeds need lots of light which require large apertures which reduce DOF
- ▣ slow shutter speeds can result in blurred images due to movement of the subject
- ▣ slow shutter speeds can also result in blurred images due to movement of the camera
- ▣ camera movement can be minimised by a variety of methods such as tripod, monopod, bean bag, holding breath, holding camera firmly



A small aperture ($f/16$) produces great depth of field; in this scene even distant trees are sharp. But to admit enough light, a slow shutter speed ($1/8$ sec) was needed; it was too slow to capture the pigeons in flight.



A medium aperture ($f/4$) and shutter speed ($1/125$ sec) sacrifice some background detail to produce recognizable images of the birds. But the exposure is still too long to freeze the motion of the birds' wings.



A fast shutter speed ($1/500$ sec) stops the motion of the pigeons so completely that the flapping wings are frozen. But the wide aperture ($f/2$) needed gives so little depth of field that the background is now out of focus.

Shutter Speed rule of thumb

- ▣ the rule of thumb when hand-holding a camera is that the shutter speed should not be slower (longer) than $1 / \text{focal length}$
- ▣ so for a 28mm lens always shoot hand-held at $1/30$ of a second or faster
- ▣ and for a 400mm lens always shoot hand-held at $1/500$ of a second or faster

ISO

- ▣ shooting at a high ISO causes an increase in “noise”
- ▣ in the old days “noise” was called “grain”
- ▣ both noise and grain are the result of less light being used for the exposure, but for two very different reasons
- ▣ grain was caused by a chemical process, where noise is caused by an electrical process
- ▣ the results look much the same



ISO 100



ISO 200



ISO 400



ISO 800



ISO 1600



ISO 3200



ISO 6400



ISO 12800 (H1)

Understanding Auto Modes

- ▣ Portrait Mode - your camera will automatically select a large aperture (small number) for a narrow depth of field – ensuring that your subject is in focus and is therefore the centre of attention, while keeping your background blurred to prevent distraction



Understanding Auto Modes

- ▣ **Landscape Mode** is almost the exact opposite of portrait mode in that it sets the camera up with a small aperture (large number – large DOF) to make sure as much of the scene will be in focus as possible.
- ▣ At times your camera might also select a slower shutter speed in this mode (to compensate for the small aperture) so you might want to consider a tripod or other method of ensuring your camera is still.



Understanding Auto Modes

- ▣ **Sports Mode** - photographing moving objects is what sports mode (also called 'action mode' in some cameras) is designed for. Sports mode attempts to freeze the action by increasing the shutter speed.
- ▣ fast shutter speeds may need big apertures or high ISOs, so shallow DOF and noise could sometimes be a problem ...



Understanding Auto Modes

- ▣ **Night Mode** - is for shooting in low light situations and sets your camera to use a longer shutter speed to help capture details of the background but it also fires off a flash to illuminate the foreground (and subject).
- ▣ you may need to use a tripod or your background could be blurred.



Other Auto Modes

- ▣ **Panoramic / Stitch Mode** – for taking shots of a panoramic scene to be joined together later as one image.
- ▣ **Snow Mode** – to help with tricky bright lighting at the snow
- ▣ **Fireworks Mode** - for shooting firework displays
- ▣ **Kids and Pets Mode** – fast moving objects can be tricky – this mode seems to speed up shutter speed and help reduce shutter lag with some pre-focussing
- ▣ **Underwater Mode** – underwater photography has it's own unique set of exposure requirements
- ▣ **Beach Mode** – another bright scene mode
- ▣ **Indoor Mode** – helps with setting shutter speed and white balance
- ▣ **Foliage Mode** - boosts saturation to give nice bold colors

Creative Auto Modes

- ▣ **Aperture Priority Mode (AV)** – is a semi-automatic (or semi-manual) mode where you choose the aperture and your camera chooses the other settings (shutter speed, ISO etc) so as to ensure you have a well balanced exposure.
- ▣ Aperture priority mode is useful when you're looking to control the depth of field in a photo

Creative Auto Modes

- ▣ **Aperture Priority Mode (AV)** – is a semi-automatic (or semi-manual) mode where you choose the aperture and your camera chooses the other settings (shutter speed, ISO etc) so as to ensure you have a well balanced exposure.
- ▣ Aperture priority mode is useful when you're looking to control the depth of field in a photo
- ▣ Choosing a larger number aperture means the aperture is smaller and you'll have a larger DOF and a slower shutter speed.

Creative Auto Modes

- ▣ **Shutter Priority Mode (S or TV)** - you select a shutter speed and the camera then chooses all the other settings.
- ▣ For example when photographing moving subjects you might want to choose a fast shutter speed to freeze the motion, or blur a subject like a waterfall by choosing a slow shutter speed.



Creative Auto Modes

- ▣ **Program Mode (P)** - some digital cameras have this priority mode in addition to auto mode – it is similar to Auto but gives you a little more control over some other features including flash, white balance, ISO etc

Other Auto Modes

- ▣ it is highly unlikely you have all these modes on your camera, and even if you do you will have to remember to check the settings they serve up to you anyhow ...
- ▣ it may be easier to learn the Exposure Triangle and apply it ...
- ▣ but whether you stay with the auto modes, or take the plunge and go fully manual, you will still have to face one problem ...
- ▣ your light meter lies to you

Why and how?

- ▣ the light meter in your camera assumes that everything you photograph is exactly the same general tone
- ▣ if you are photographing a black cat on a black chair, it assumes that you are photographing a grey cat on a grey chair in low light conditions
- ▣ if it is a white cat on a white chair, it still thinks you are photographing a grey cat on a grey chair, but in really bright light conditions



Three cards, f/8, 1/1250 second
Nearly exactly Sunny 16



Black card, f/8 1/200 second (result is not black)
Result is 2.3 stops overexposed, from first one.



White card, f/8 1/5000 second (result is not white)
Result is two stops underexposed, from first one.



18% gray card, f/8 1/800 second
Result is 1/3 stop over first one.

Everything turns out grey

- ▣ it does not matter what auto mode you put your camera on, your cat will always be grey
- ▣ and here is the rub ... even if you go to Full Manual Mode, and line up that little mark properly, you will again end up with a grey cat

Exposure Compensation

- ▣ in auto mode, to make your black cat black and not grey, or your white cat white and not grey, you will have to dial in some exposure compensation
- ▣ this means manually moving that little marker left or right to make the exposure lighter or darker, depending on the colour of your cat
- ▣ so if you are going to have to make adjustments anyhow, it will be easier to do in full manual mode

Alternate Light Metering

- ▣ the light meter in your camera measures reflected light ...
- ▣ if the light around your subject and yourself is the same, you could put your camera into full manual mode, point it at a grey card and adjust your settings to get the correct EV - your exposures will all be perfect
- ▣ or measure the light with an incident light meter
- ▣ or just take the photo and see how it looks

But then there is “Live Preview”

- ▣ most point and shoots don't have viewfinders – they have a “live preview” screen
- ▣ in full auto mode you just use the screen to compose the shot, and then press the button
- ▣ the camera is constantly adjusting the exposure and displaying it on the screen
- ▣ there are two types of “live preview” systems
- ▣ “autogain/framing” or “framing priority”
- ▣ “exposure simulation” or “exposure priority”

But then there is “Live Preview”

- ▣ “autogain/framing” or “framing priority” live preview cameras adjust the preview screen so you can see your subject – in all modes
- ▣ so in manual mode the preview screen looks good no matter what settings you choose
- ▣ you then have to adjust the settings to get the correct exposure

But then there is “Live Preview”

- ▣ “exposure simulation” or “exposure priority” cameras show the exact exposure “look” on the preview screen
- ▣ they are “wysiwyg” in all modes, including manual (what you see is what you get)
- ▣ in manual mode, if your exposure is way too dark you will see a dark screen
- ▣ you can then adjust ISO, shutter speed or aperture until the exposure looks perfect
- ▣ this eliminates reliance on light metering !!!

Going to full manual !

- ▣ when shooting in full manual mode, think like you are using one of the creative auto modes
- ▣ if the shutter speed is a priority, set and forget the shutter speed, and just adjust the aperture values to get the correct EV
- ▣ if you run out of aperture settings, adjust the ISO
- ▣ if you run out of ISO settings, you will have to rethink the shutter speed that you would like to use

Going to full manual !

- ▣ if the aperture is a priority - big aperture (small number) for narrow DOF, or small aperture (big number) for large DOF, set and forget the aperture and just adjust the shutter speed
- ▣ “aperture priority” full manual is arguably the better of the two options, as there are lots more shutter speeds to choose from than apertures
- ▣ if the shutter speeds fall below the reciprocal of the focal length - use a tripod

Summary

- ▣ Shutter speed – big number / big exposure time
- ▣ Aperture - big number / big depth of field
- ▣ ISO – big number / big sensitivity

Sunny 16 Rule

- ▣ On a sunny day set aperture to $f/16$ and shutter speed to the reciprocal of the ISO for a subject in direct sunlight
- ▣ i.e. on a sunny day at ISO 100, set the aperture to $f/16$ and the shutter speed to $1/100$
- ▣ work out all the other setting combinations from there
- ▣ the rule is based on incident light rather than reflected light so very light or very dark subjects are automatically compensated for

Sunny 16 Rule

Aperture	Lighting Conditions	Shadow Detail
<i>f</i> /22	Snow/Sand	edges
<i>f</i> /16	Sunny	Distinct
<i>f</i> /11	Slight Overcast	edges
<i>f</i> /8	Overcast	Barely visible
<i>f</i> /5.6	Heavy Overcast	No shadows
<i>f</i> /4	Open Shade/Sunset	No shadows
Add One Stop	Backlighting	n/a

10 reasons to turn off autofocus

- ▣ 1. When there's not enough light
- ▣ 2. When there's not enough contrast
- ▣ 3. To avoid scaring wildlife
- ▣ 4. When you want a focal point landscapes
- ▣ 5. If you're doing HDR
- ▣ 6. When shooting fast action
- ▣ 7. When shooting through glass
- ▣ 8. With portraits – to get the eyes in focus
- ▣ 9. When doing Macro photograph
- ▣ 10. Compositing with the 'Rule of Thirds'