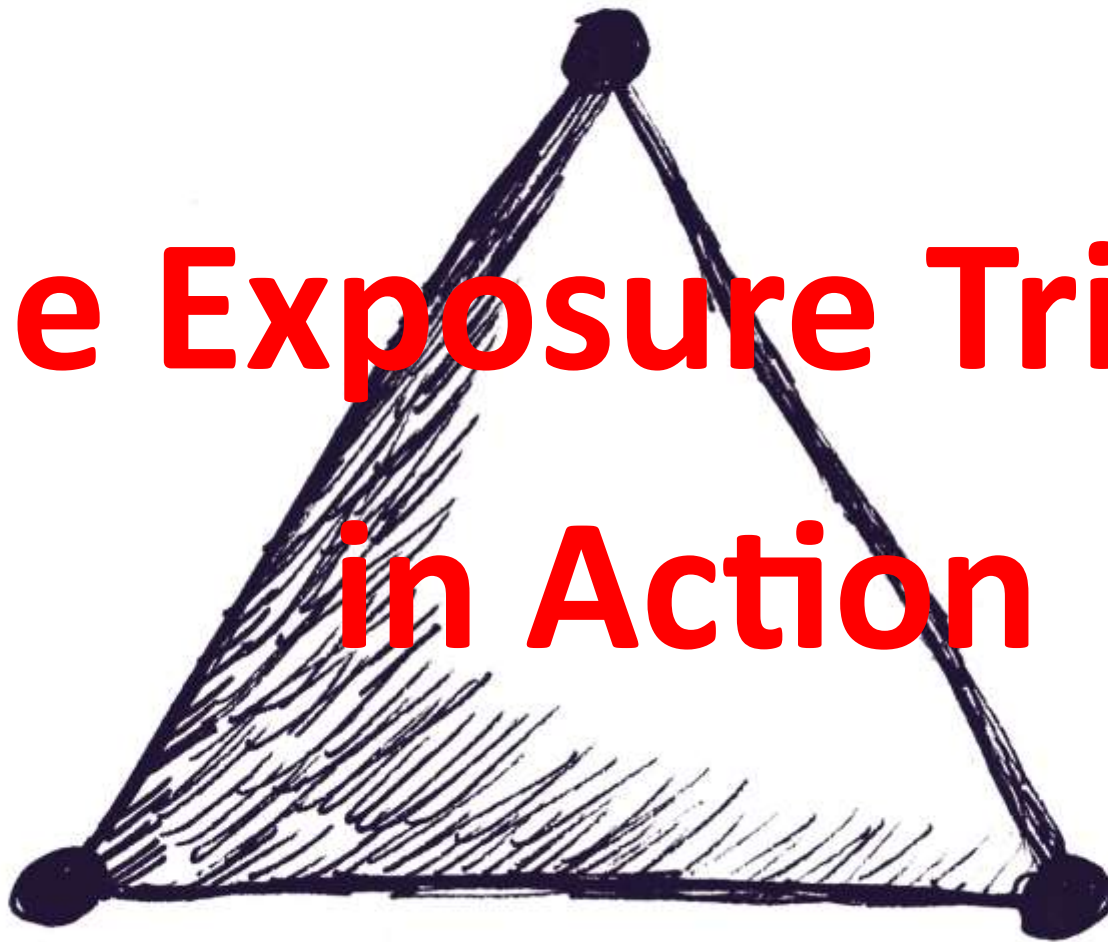


APERTURE

The Exposure Triangle in Action

ISO



SHUTTER
SPEED

Black Canyon of the Gunnison National Park



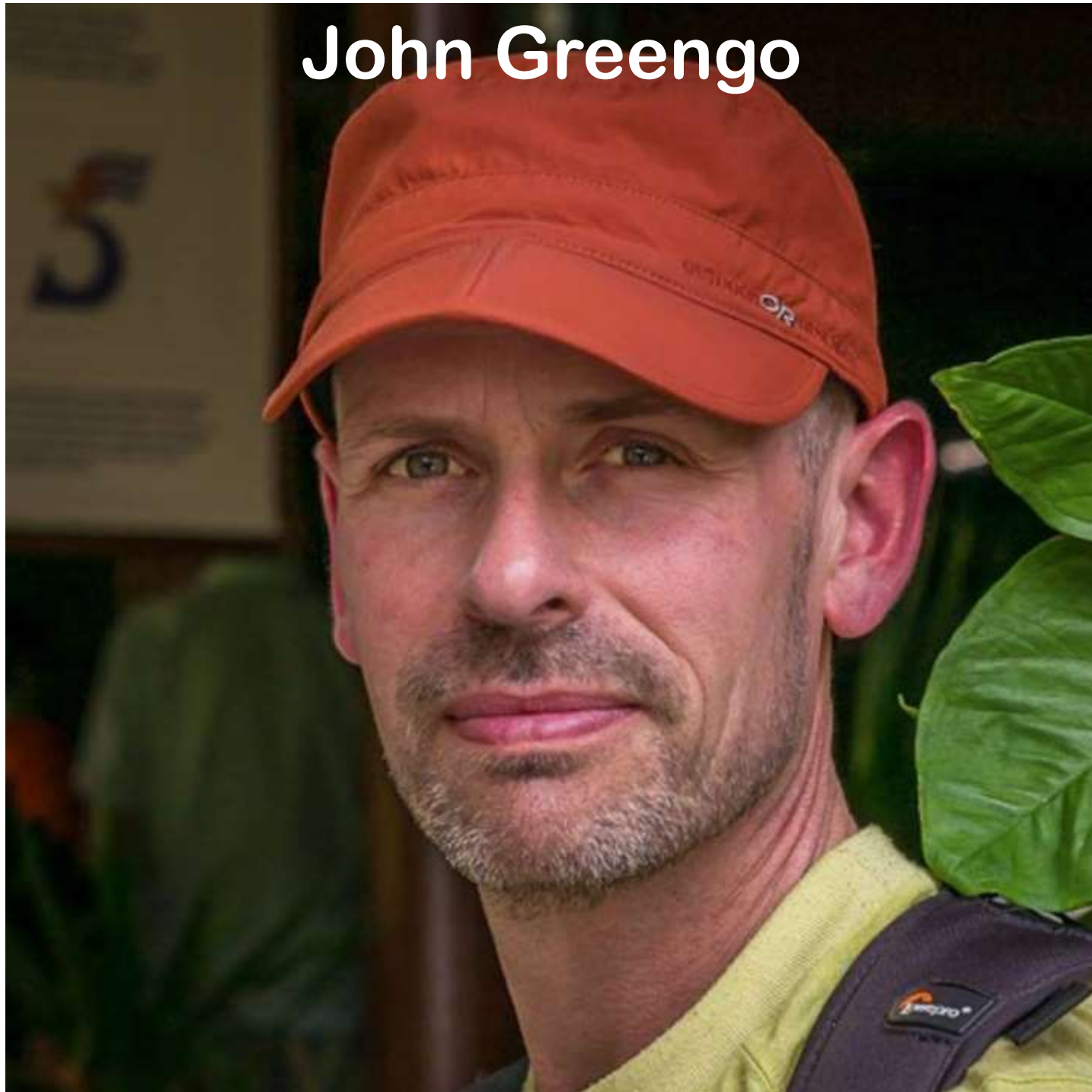
Meeting John Greengo

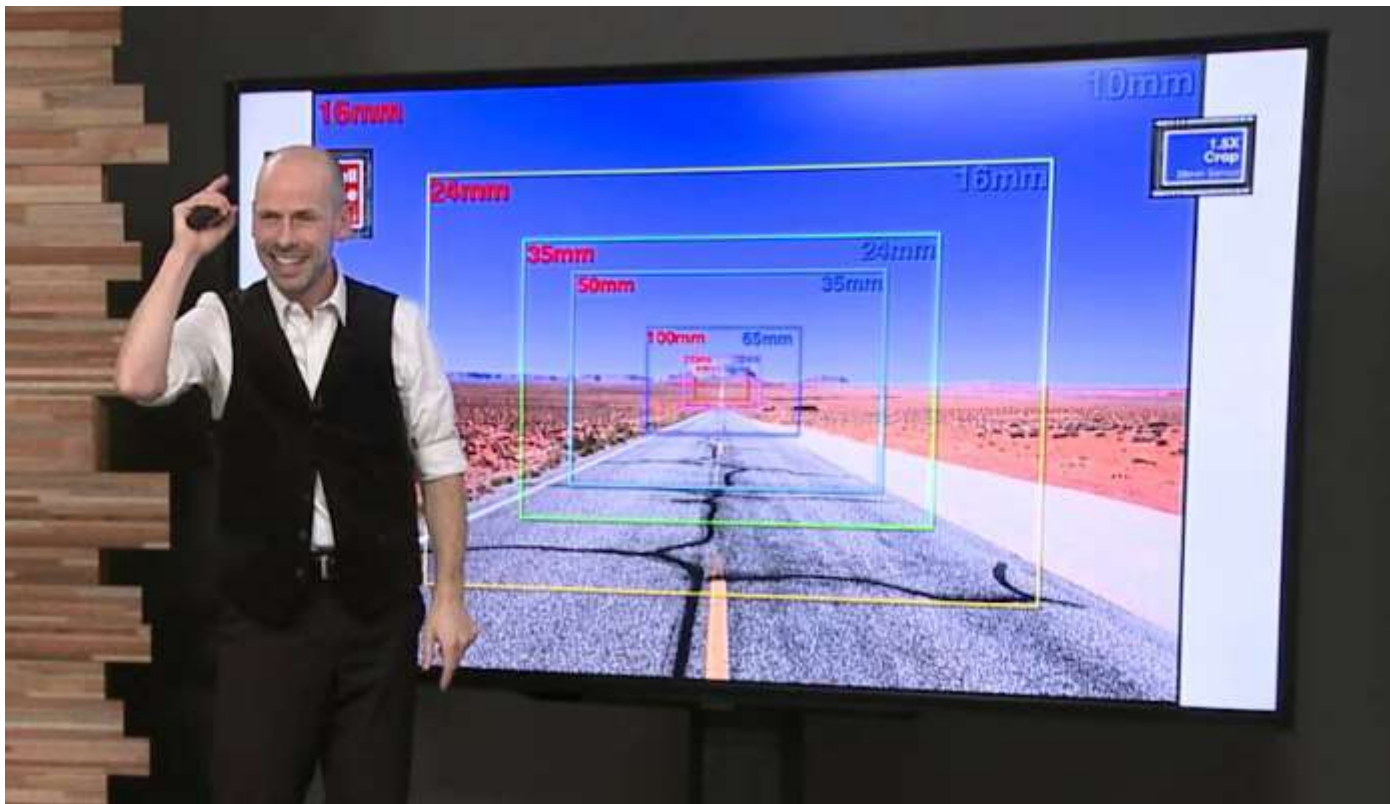


**Sunset from “Painted Wall View”,
Black Canyon of the Gunnison National Park**



John Greengo





**Before Sunrise from “Dragon Point”,
Black Canyon of the Gunnison National Park**





Shutter Speed


8000
4000
2000
1000
500
250
125
60
30
15
8
4
2
1"
2"
4"
8"
15"
30"

Aperture

22
16
11
8
5.6
4.0

ISO

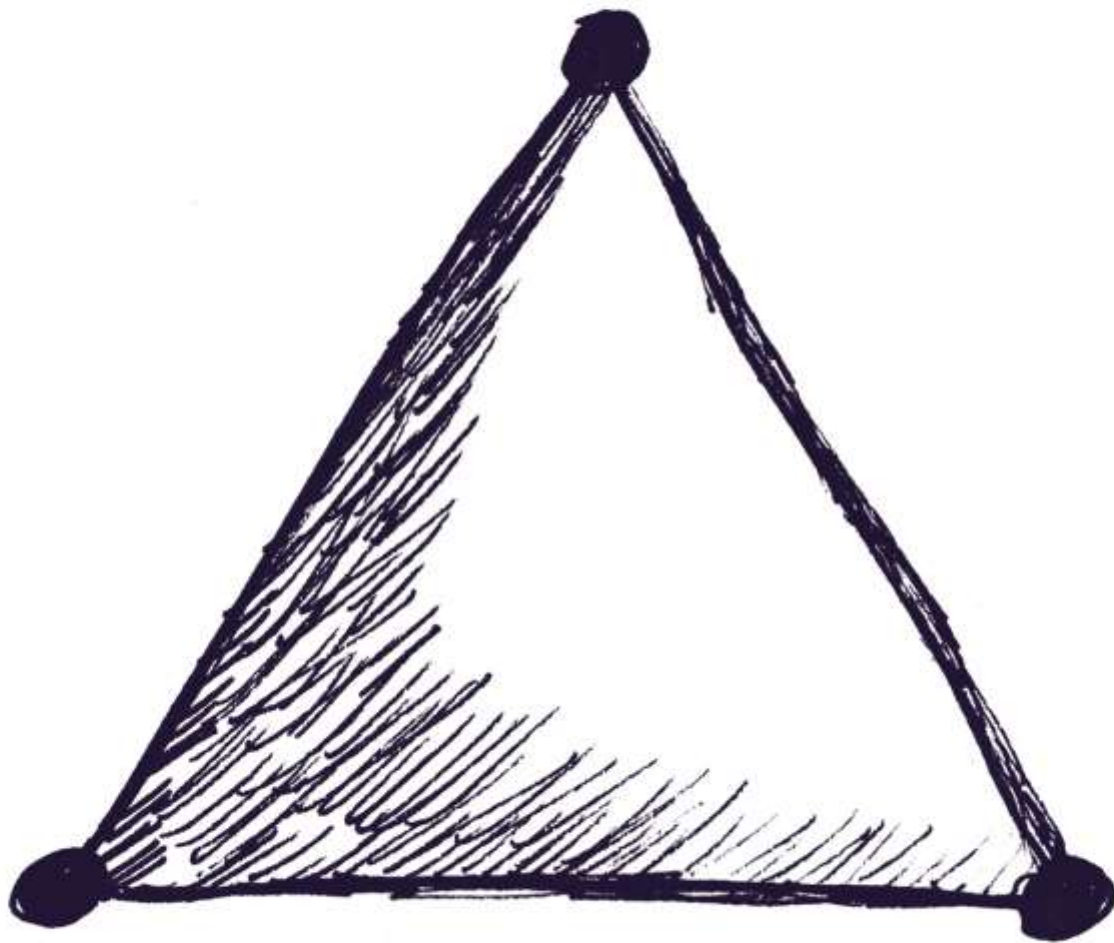
100
200
400
800
1600
3200
6400



Freeze motion

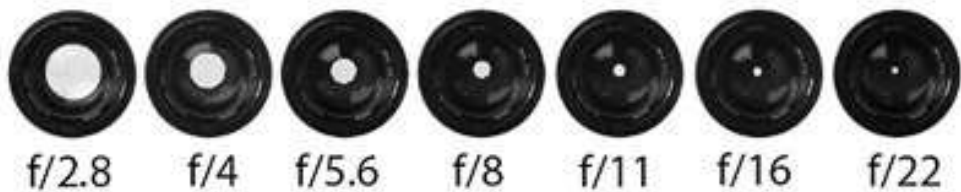
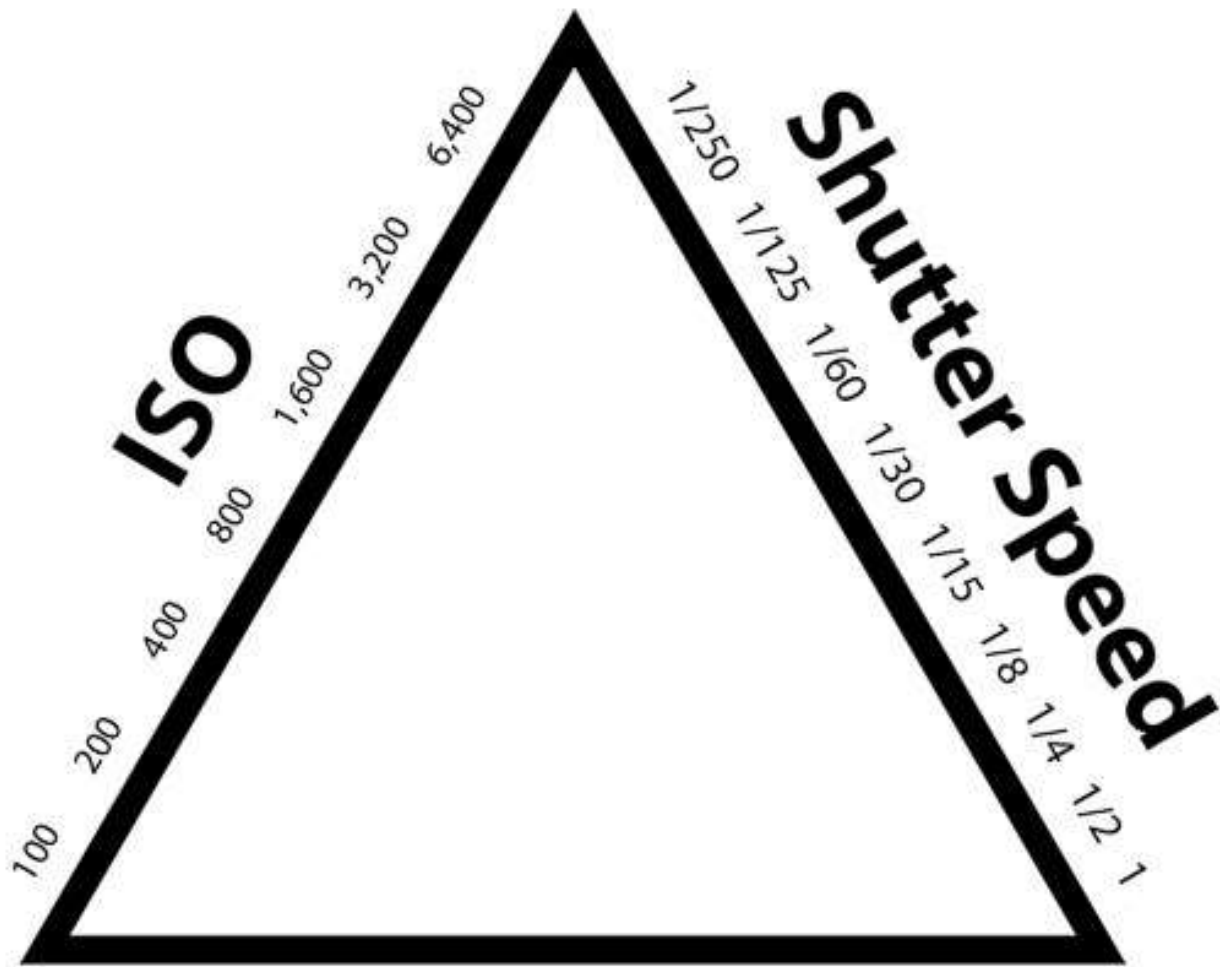
-2 · · 1 · · **0** · · 1 · · +2

APERTURE



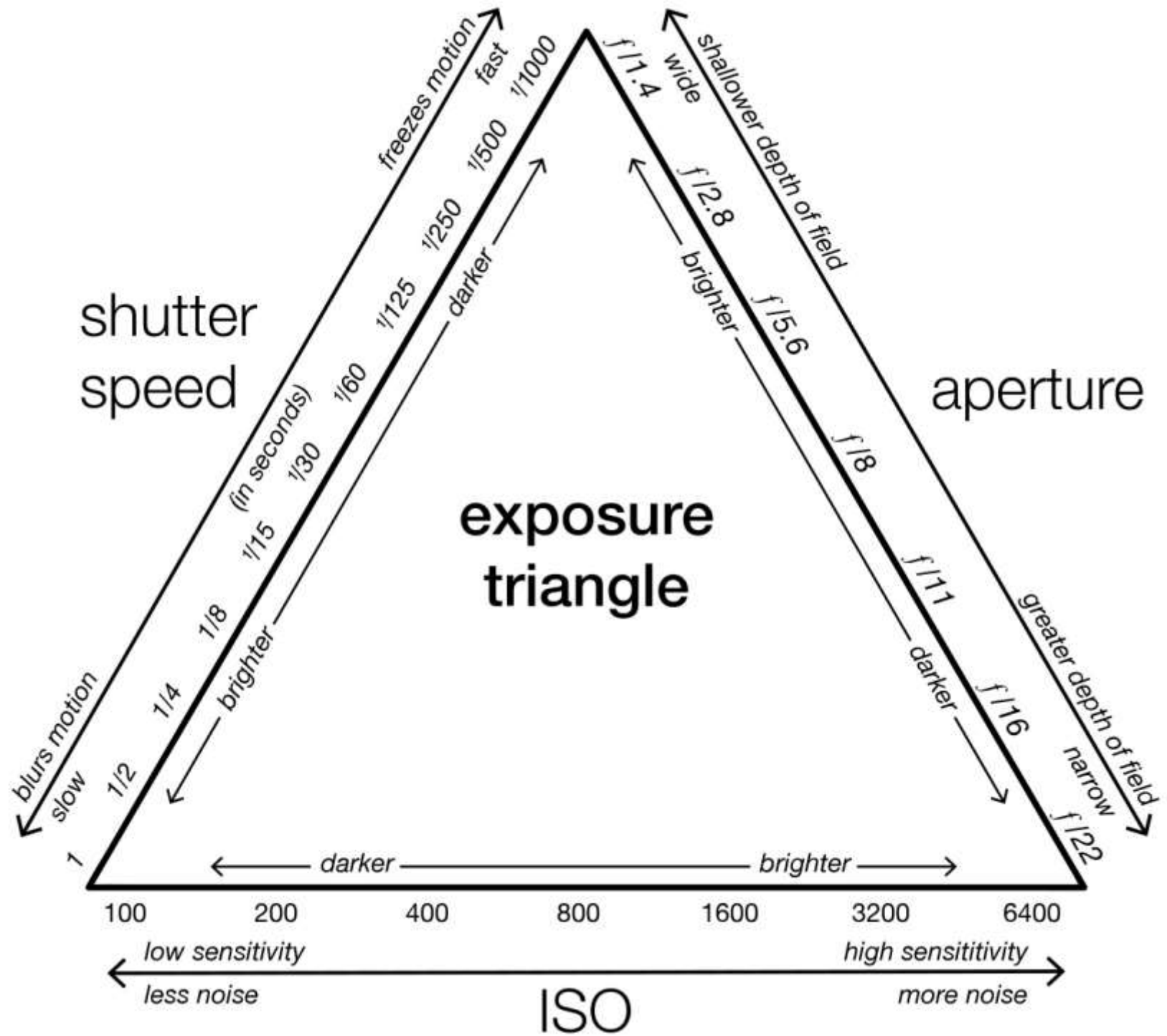
ISO

SHUTTER
SPEED



f/2.8 f/4 f/5.6 f/8 f/11 f/16 f/22

Aperture



Photographic Aims

- Choose:** **Isolate part of the image**
- Image in focus everywhere**
- Choose:** **Motion removed**
- Motion emphasized**
- Choose:** **Low noise**
- Maximum sensitivity**
- Choose:** **Maximum image quality**

Tips

It helps to know the ultimate destination of your images because:

SIZE: Larger display sizes require more sharpness, less unintentional blur and less noise.

PRINT: Prints compared to electronic displays demand more sharpness, less blur and less noise.

Depth of Field

Isolate Part of the Image

If a shallow depth of field is required

Set a wide aperture (f stop)

Use “Smaller” numbers (f/1.4, f/2, f/2.8, f/4)

Image in Focus Everywhere

If a deep depth of field is required

Set a narrow aperture (f stop)

Use “Larger” numbers (f/22, f/16, f/11, f/8)

Isolate Part of the Image



Image in Focus Everywhere



Aperture Setting Tips

As manufacturers put more and more pixels on the same size sensor, the pixels have to be made smaller and smaller. This causes an overall and increasing loss of sharpness as narrow apertures are used (this is due to diffraction).

In addition, it is very difficult (and therefore very expensive) to build lenses that produce the sharpest images using very wide apertures.

This is especially true of zoom lenses, when used at their shortest and longest focal lengths.

It is therefore best to:

▶ Avoid the use of the narrowest and the widest aperture settings unless necessary to produce the depth of field desired. Set $f/5.6$, $f/8$ or $f/11$ to use the lens at its sharpest.

Example Aperture Setting Scale

~~$f/2.8$~~ ● $f/4$ ● $f/5.6$ ● $f/8$ ● $f/11$ ● $f/16$ ● ~~$f/22$~~

~~$f/4$~~ ● $f/5.6$ ● $f/8$ ● $f/11$ ● ~~$f/16$~~

Show Motion

Motion Removed

If removal of motion is required

Set a fast shutter speed

Use “larger” numbers ($1/8000$, $1/4000$, $1/2000$, $1/1000$, $1/500$)

Motion Emphasized

If emphasis of motion is required

Set a slow shutter speed

Use “smaller” numbers ($30''$, $15''$, $8''$, $4''$, $2''$, $1''$, $1/2$, $1/4$, $1/8$)

Motion Removed



Motion Emphasized



Shutter Speed Setting Tips

Shorter shutter speeds can be used to prevent shooter or platform movement from blurring an image (image stabilizers can also help). As a rule, a shutter speed equal to or shorter than $1/\text{lens focal length}$ can eliminate most blurring (if using a crop sensor body, multiply the focal length by 1.5, 1.6 or 2 to be sure).

Shorter shutter speeds can be used to remove subject movement (or longer shutter speeds used to emphasize subject movement). The actual speeds required are best determined by experimenting, experience and testing. For example, most human movement can be removed at speeds equal to or shorter than $1/250$ and most animal movement using a setting of $1/1000$ or $1/2000$.

Portraits can usually be taken without visible motion when using $1/125$ and in many cases the motion of moving water or clouds can be emphasized using shutter speeds of $1/8$ to 2 seconds.

ISO

Low Noise

If low noise is required

Set a low ISO number

Use “smaller” numbers (100, 200, 400)

High Sensitivity

If high sensitivity is required

Set a high ISO number

Use “larger” numbers (6400, 3200, 1600)

Low Noise



High Sensitivity



ISO Setting Tips

Since all noise reduction involves blurring the image to a degree to remove irregularities in density (luminosity noise) and/or colour (colour noise), it is best to use no noise reduction or use a noise reduction setting as low as possible.

It is therefore best to:

- ▶ Avoid the use of the “H”, “H2” or “L” settings.
- ▶ Avoid the use of the highest two settings.

Example ISO Setting Scale

~~L~~ • 100 • 200 • 400 • 800 • 1600 •
3200 • 6400 • 12800 • 25600 • ~~H1~~ • ~~H2~~

Image Quality

Maximum Sharpness Throughout

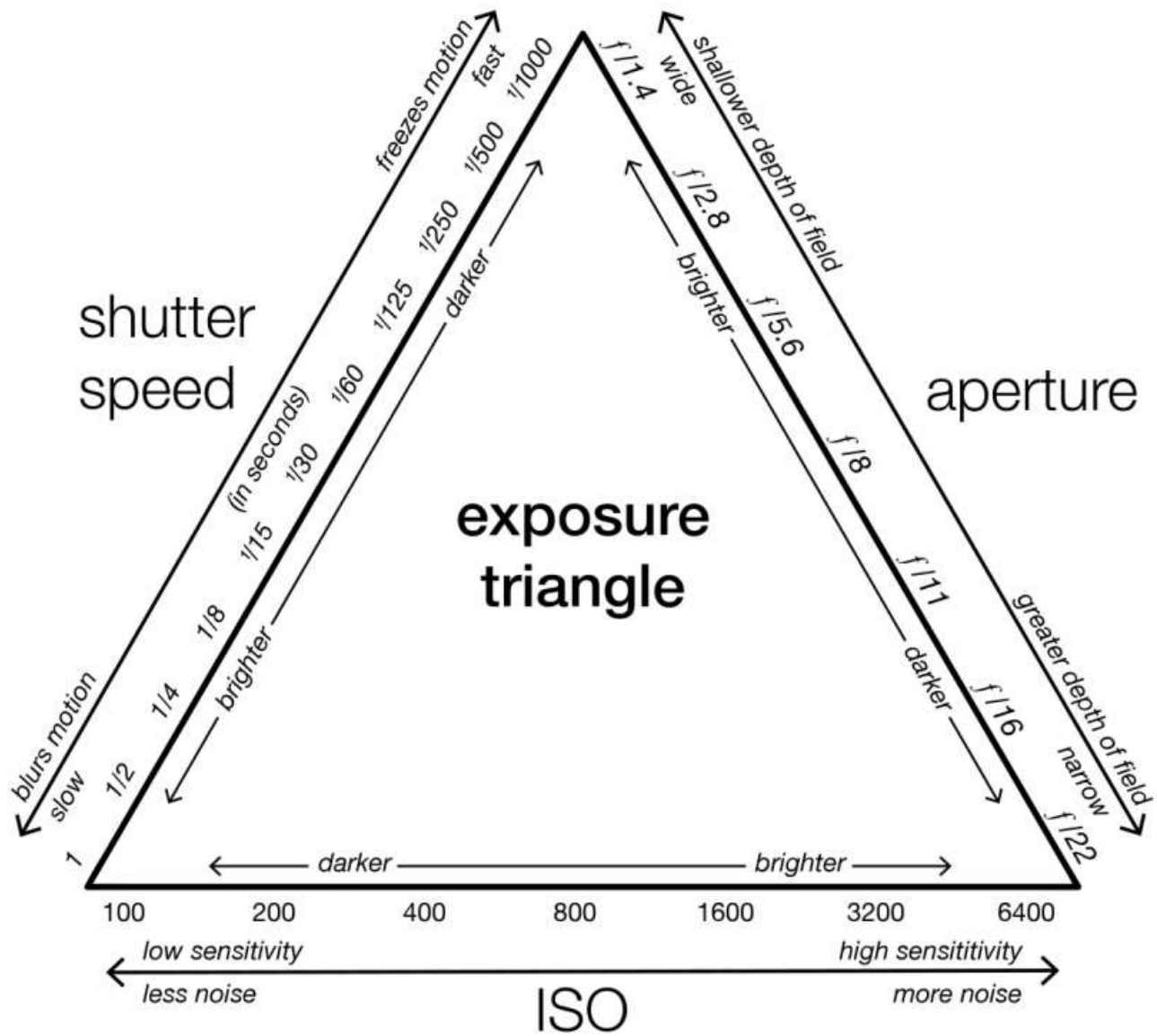
If the image has to be as sharp as possible

Set an f stop near the middle of the lens' range

Typically $f/5.6$, $f/8$, $f/11$

Maximum Sharpness Throughout





Canon 5D3 EF 16-35mm f/4L IS tripod breezy



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

f/22

1/60

100

f/16

1/30

200

f/11

1/15

400

f/8

1/8

800

f/5.6

1/4

1600

f/4

1/2

3200

1"

6400

2"

4"

8"

15"

30"



-2 -1 0 +1 +2



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

f/22

1/60

100

f/16

1/30

200

f/11

1/15

400

f/8

1/8

800

f/5.6

1/4

1600

f/4

1/2

3200

1"

6400

2"

4"

8"

15"

30"



-2 -1 0 +1 +2



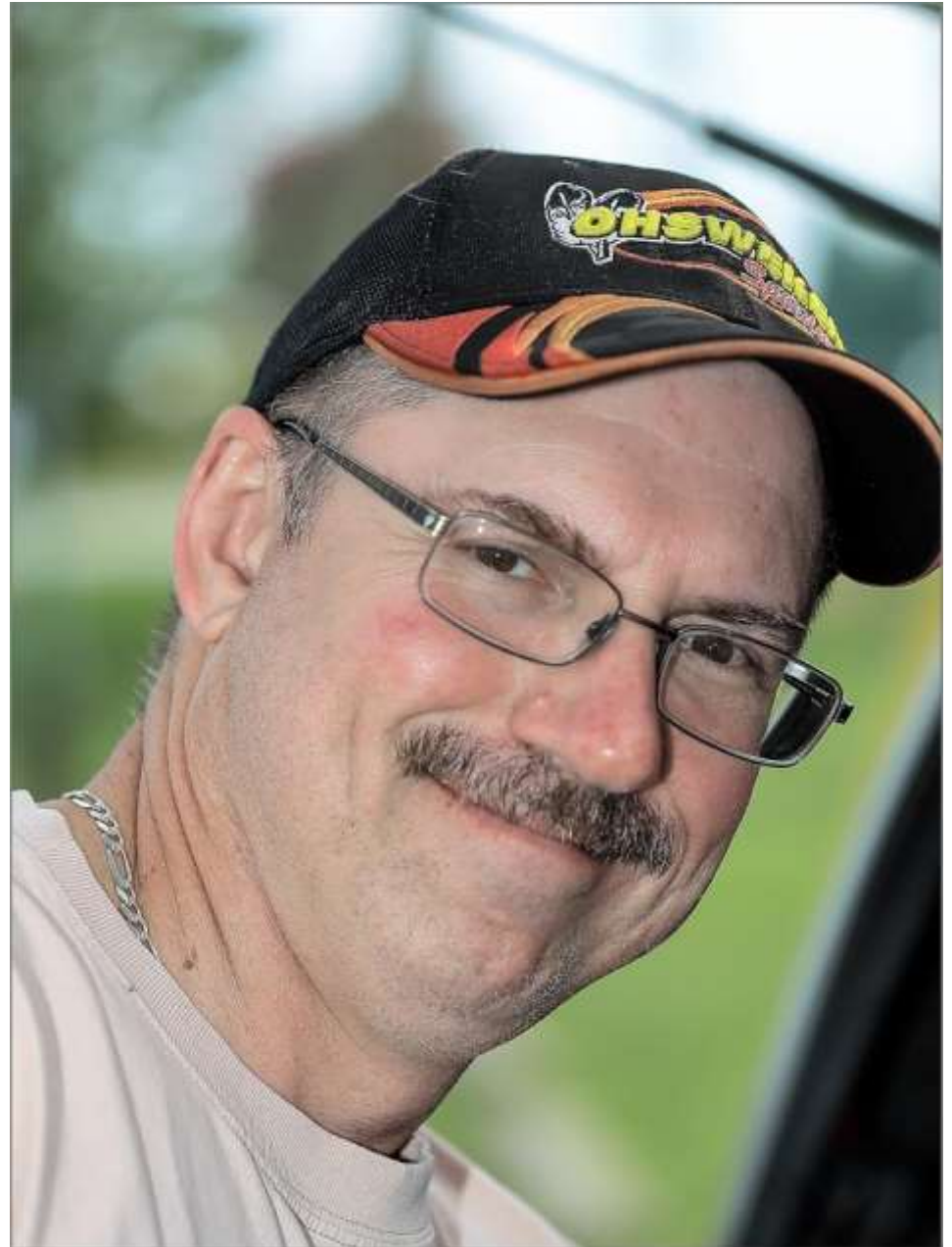
Aperture f/16 Shutter 1/60 ISO 200



Canon 1D4 EF 100mm f/2.8 no tripod flash



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
f/2.8	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



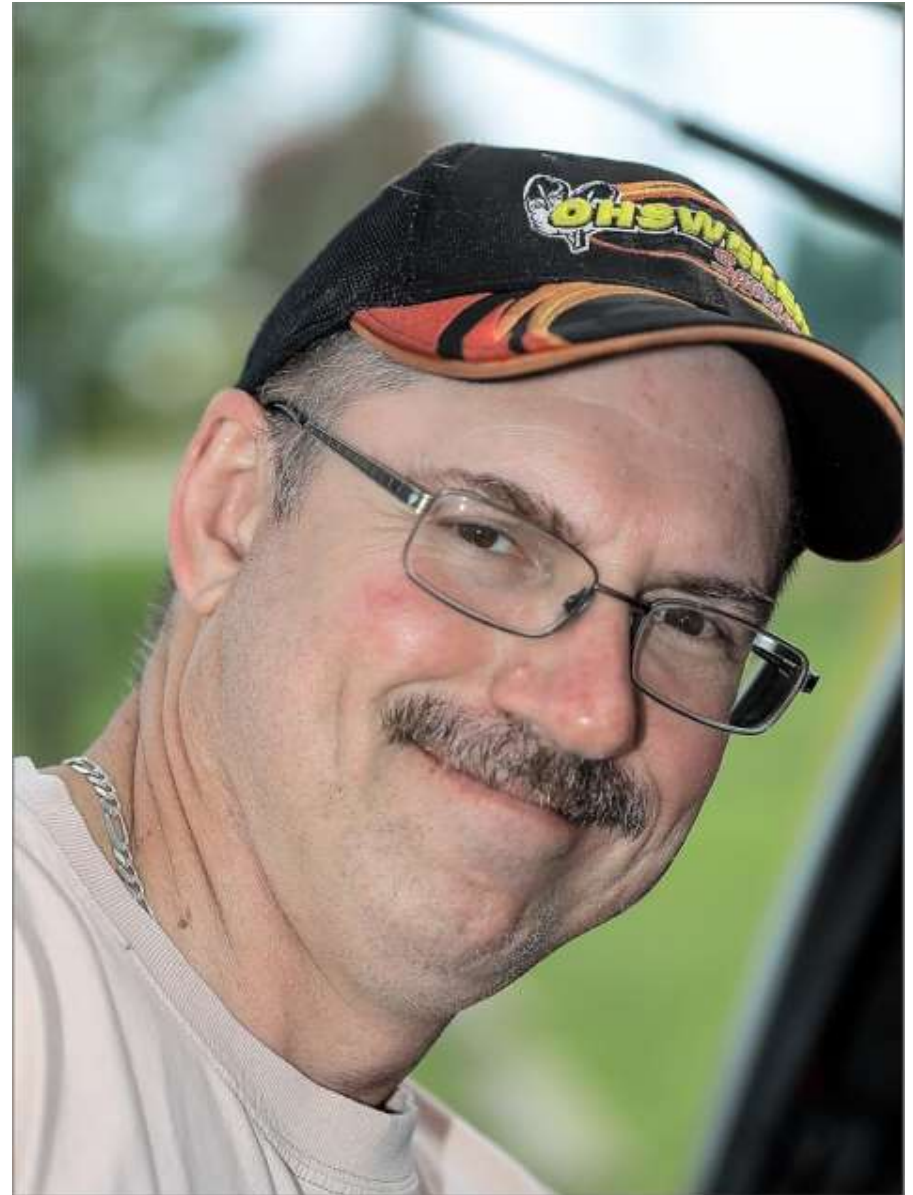
F STOP	SHUTTER	ISO
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	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
f/2.8	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
f/2.8	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	

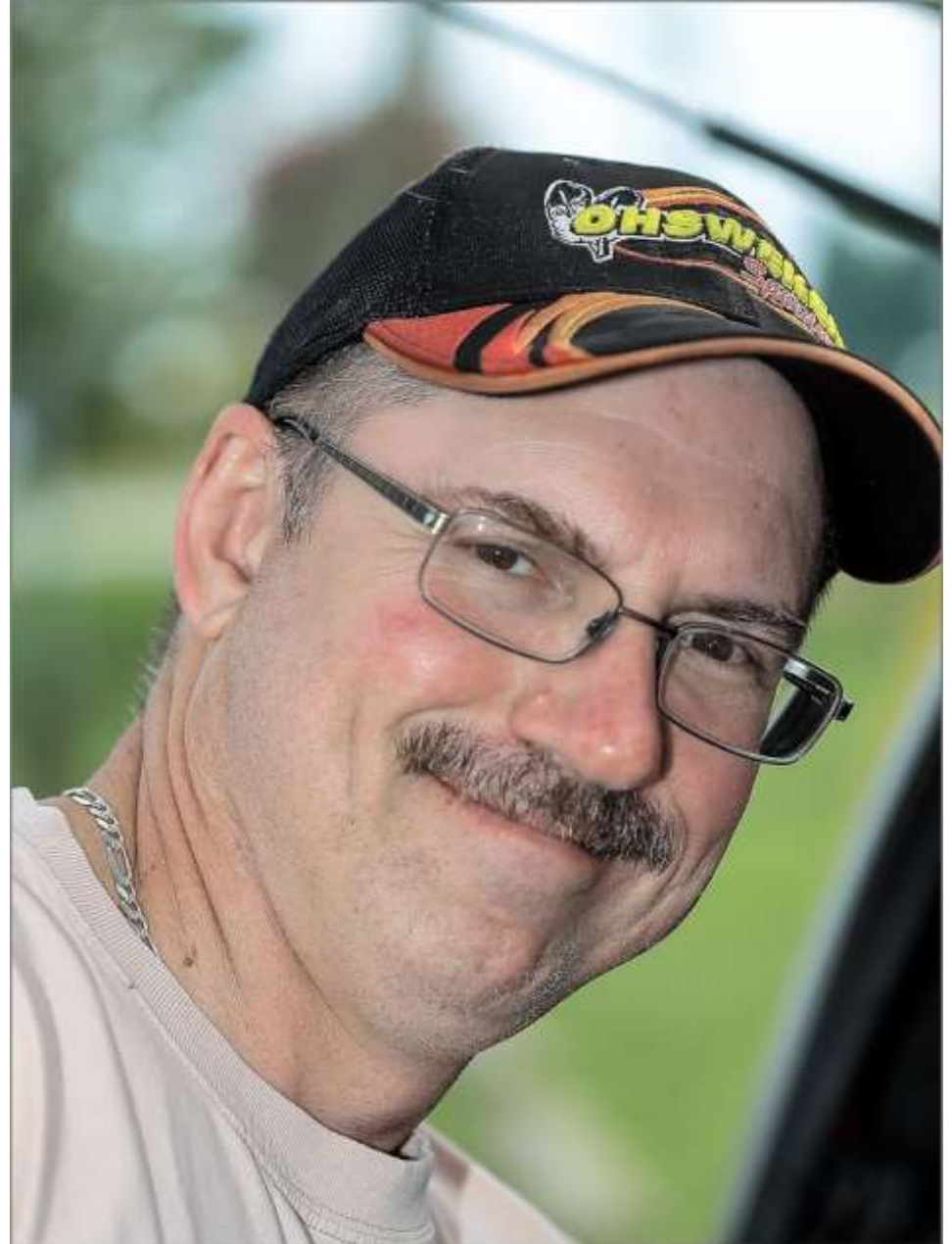


F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
f/2.8	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



-2 -1 0 +1 +2
▲

Aperture f/2.8 Shutter 1/250 ISO 100



Canon 1D4 EF 70-200mm f/4 no tripod no flash



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

f/22

1/60

100

f/16

1/30

200

f/11

1/15

400

f/8

1/8

800

f/5.6

1/4

1600

f/4

1/2

3200

1"

6400

2"

4"

8"

15"

30"



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

f/22

1/60

100

f/16

1/30

200

f/11

1/15

400

f/8

1/8

800

f/5.6

1/4

1600

f/4

1/2

3200

1"

6400

2"

4"

8"

15"

30"



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

f/22

1/60

100

f/16

1/30

200

f/11

1/15

400

f/8

1/8

800

f/5.6

1/4

1600

f/4

1/2

3200

1"

6400

2"

4"

8"

15"

30"



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

f/22

1/60

100

f/16

1/30

200

f/11

1/15

400

f/8

1/8

800

f/5.6

1/4

1600

f/4

1/2

3200

1"

6400

2"

4"

8"

15"

30"



-2 -1 0 +1 +2



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

f/22

1/60

100

f/16

1/30

200

f/11

1/15

400

f/8

1/8

800

f/5.6

1/4

1600

f/4

1/2

3200

1"

6400

2"

4"

8"

15"

30"



-2 -1 0 +1 +2



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

f/22

1/60

100

f/16

1/30

200

f/11

1/15

400

f/8

1/8

800

f/5.6

1/4

1600

f/4

1/2

3200

1"

6400

2"

4"

8"

15"

30"



-2 -1 0 +1 +2



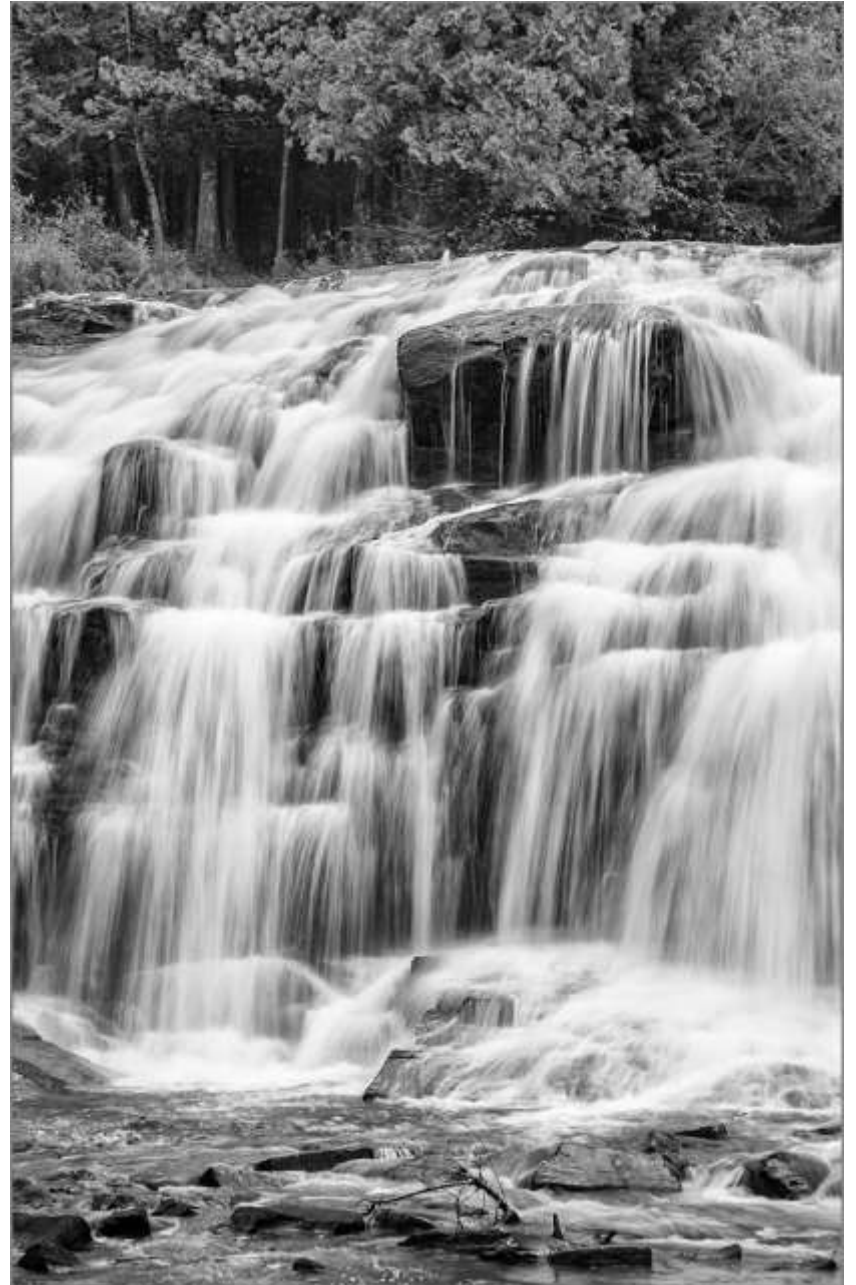
Aperture f/5.6 Shutter 1/250 ISO 3200



Canon 5D3 EF 24-105mm f/4 tripod no flash



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	

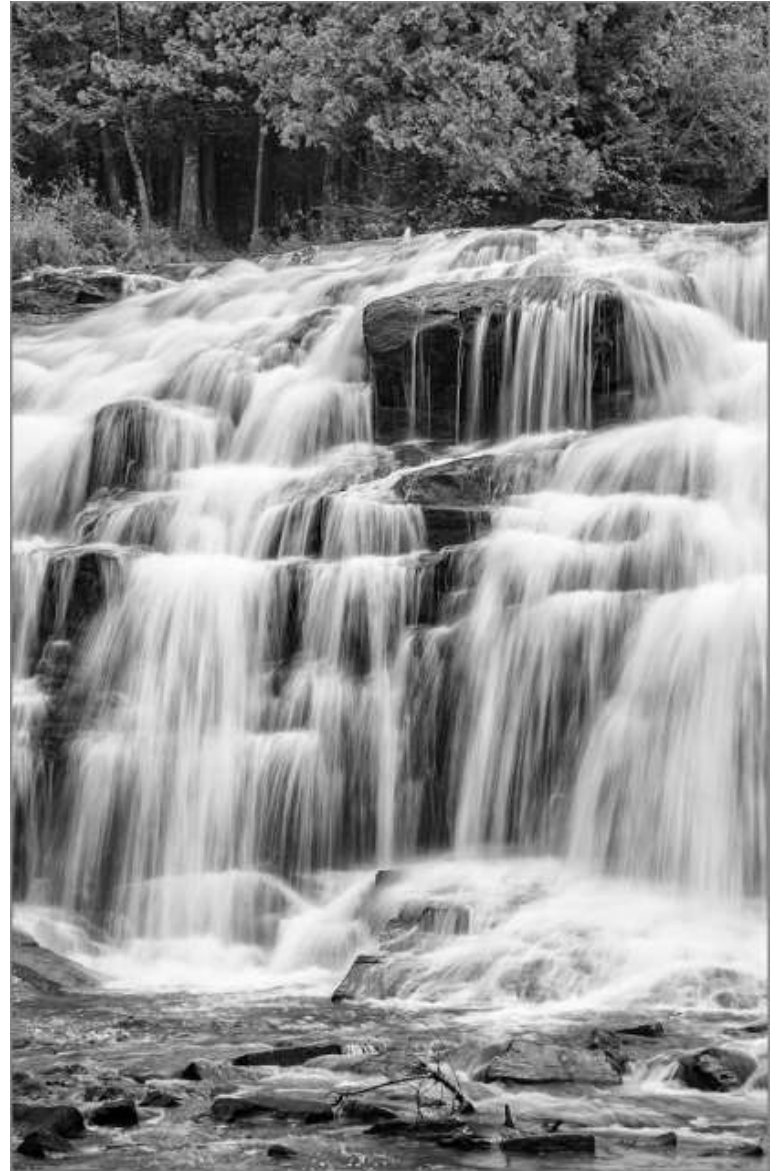


F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



-2 -1 0 +1 +2
▲

F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



-2 -1 0 +1 +2

▲

Aperture f/11 Shutter 1" ISO 100



Canon 5D3 EF 100-400mm f4.5-5.6 tripod



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



-2 -1 0 +1 +2



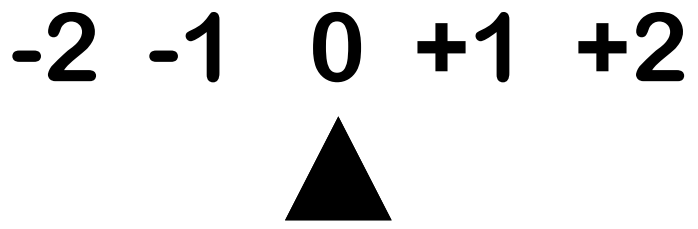
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	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



-2 -1 0 +1 +2



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



Aperture f/8 Shutter 1" ISO 3200



Canon 5D3 24mm f/3.5 TS tripod



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

1/60

100

f/22

1/30

200

f/16

1/15

400

f/11

1/8

800

f/8

1/4

1600

f/5.6

1/2

3200

f/4

1"

6400

2"

4"

8"

15"

30"



-2 -1 0 +1 +2



F STOP SHUTTER ISO

1/8000

1/4000

1/2000

1/1000

1/500

1/250

1/125

1/60

100

f/22

1/30

200

f/16

1/15

400

f/11

1/8

800

f/8

1/4

1600

f/5.6

1/2

3200

f/4

1"

6400

2"

4"

8"

15"

30"



-2 -1 0 +1 +2



Aperture f/11 Shutter 8" ISO 100



REVERSE
ENGINEER #1, 2 & 3

Canon 5D2
EF24-105mm f/4L IS
tripod

Arkona
Rock Glen
Falls



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



REVERSE ENGINEER #4

Canon 5D2 EF100-400mm f/4.5-5.6L IS

Pelican, Cocoa Beach, Florida





F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/32	1/60	100
f/22	1/30	200
f/16	1/15	400
f/11	1/8	800
f/8	1/4	1600
f/5.6	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/32	1/60	100
f/22	1/30	200
f/16	1/15	400
f/11	1/8	800
f/8	1/4	1600
f/5.6	1/2	3200
	1"	6400
	2"	
	4"	
	8"	
	15"	
	30"	

REVERSE
ENGINEER #5

Canon 7D
EF24-105mm f/4L IS
no tripod

Kinsman Fair



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	
	2"	
	4"	
	8"	
	15"	
	30"	



REVERSE
ENGINEER #6

Canon 7D
EF70-200mm f/4L IS
no tripod

Kinsman Fair



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	
	2"	
	4"	
	8"	
	15"	
	30"	



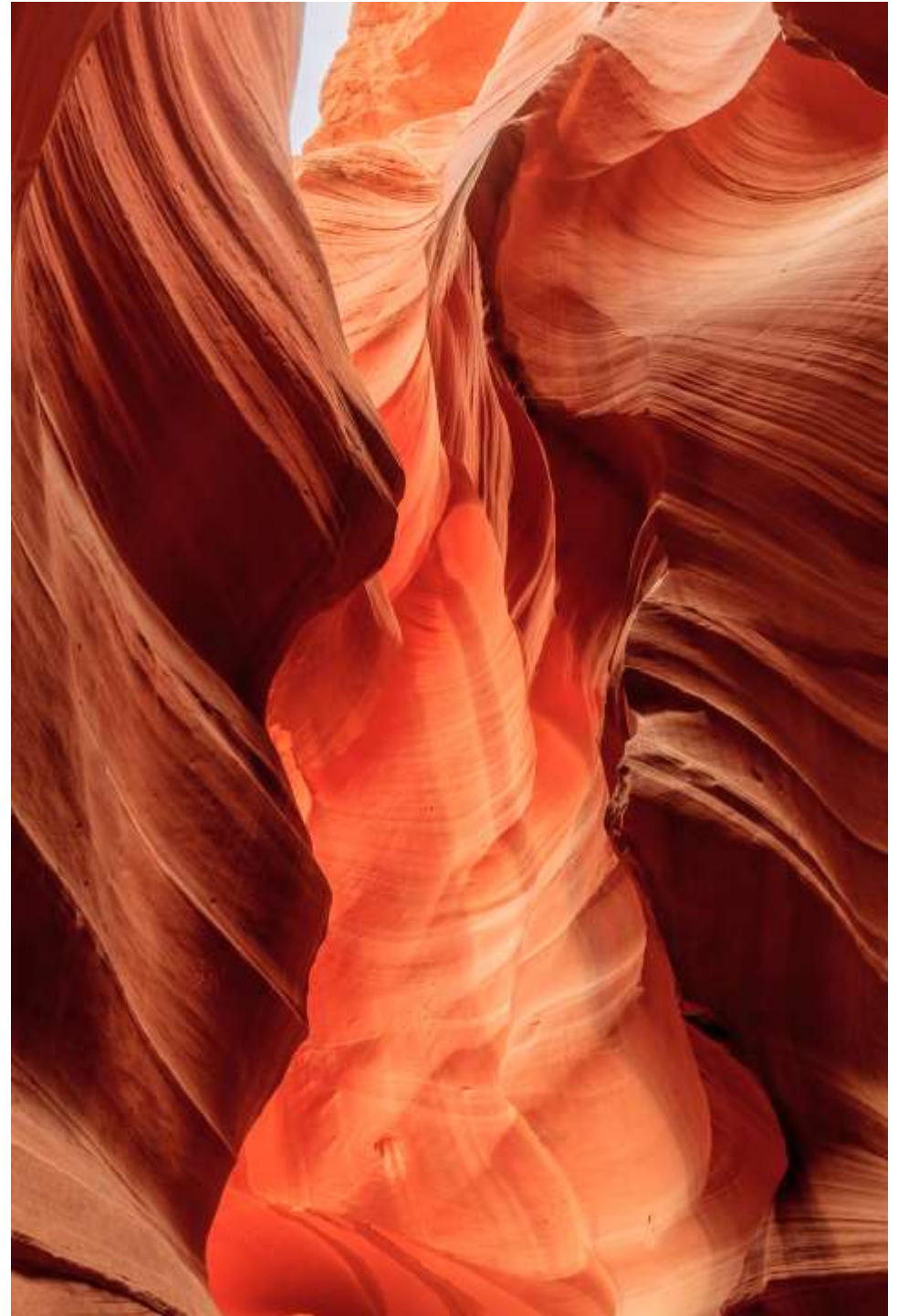
F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	
	2"	
	4"	
	8"	
	15"	
	30"	



REVERSE
ENGINEER #7

Canon 1D4
EF16-35mm f/4L IS
tripod

Antelope Canyon



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	
	2"	
	4"	
	8"	
	15"	
	30"	



F STOP	SHUTTER	ISO
	1/8000	
	1/4000	
	1/2000	
	1/1000	
	1/500	
	1/250	
	1/125	
f/22	1/60	100
f/16	1/30	200
f/11	1/15	400
f/8	1/8	800
f/5.6	1/4	1600
f/4	1/2	3200
	1"	
	2"	
	4"	
	8"	
	15"	
	30"	

