



Twelve significant photographs in any one year is a good crop.
- Ansel Adams

The Exposure Triangle

Introduction to Digital Photography

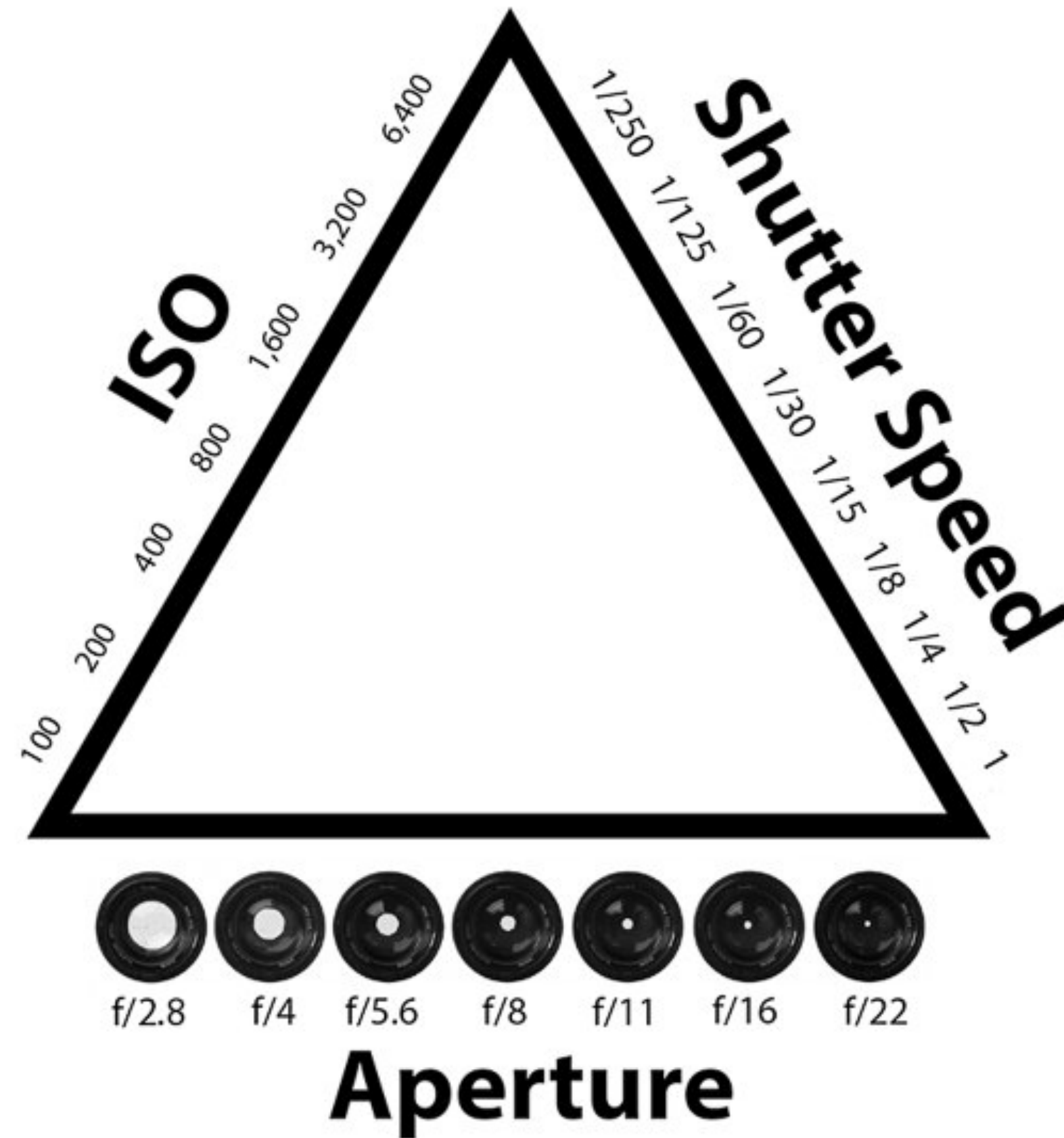
Lecture Outline

- The Exposure Triangle
 - ISO
 - Shutter speed
 - Aperture
 - Shutter speed / aperture relationship





The Exposure Triangle





The Exposure Triangle: ISO

- ISO
 - International Organization of Standards
 - Adopted 1980s by Kodak, other film makers
 - ASA (American Standard Association) [Kodak (America)]
 - DIN (Deutsche Industrie Norm) [Agfafilm (Europe), Fujifilm (Japan)]
 - Standardization of film speed (e.g., ASA 100 / DIN 21)

The Exposure Triangle: ISO

- ISO
 - Film speed = sensitivity of film to light
 - Higher the ISO number
 - More sensitive to light
 - Less exposure time needed
 - More graininess (larger grains = larger surface area = shorter exposure time)
- Push / Pull process
 - Exposing film outside normal ISO boundary
 - Selectively exposing film [under (pull) / over (push)]



The Exposure Triangle: ISO

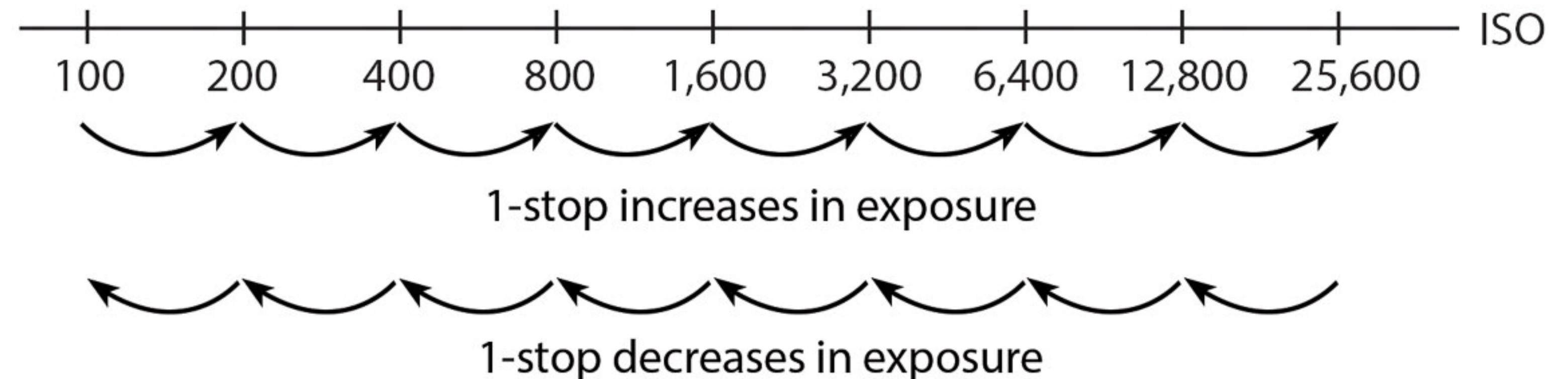
- Digital ISO
 - Don't have to change rolls of film to change ISO
 - Cameras have an inherent native ISO value
 - Example: Nikon D200 = ISO 100; Nikon D300 = ISO 200
 - Sensor noise \approx film graininess
 - Some noise can be reduced in post processing
 - Color noise reduced by converting to B & W



The Exposure Triangle: ISO

- ISO and exposure
 - Changing ISO
 - Going smaller: more light needed
 - Factor of 2 for each full ISO increment
 - Going larger: less light needed
 - Factor of $\frac{1}{2}$ for each full ISO increment

ISO Scale



A person wearing a teal beanie is holding a Nikon camera, looking through the viewfinder. The camera is a black DSLR with a large lens. The person's hands are visible, holding the camera from the sides. The background is dark and out of focus.

The Exposure Triangle: Shutter speed

- Shutter speed
 - How long the shutter stays open
 - Time ranges from “bulb” to 1/200 - 1/8000 second (depending on camera)
 - Bulb = how long can you keep the shutter pressed?
 - Shutter release
 - Mechanical (cable) or electronic remote (wireless / controlled by phone)



The Exposure Triangle: Shutter speed

- Common shutter speeds (in full stops)

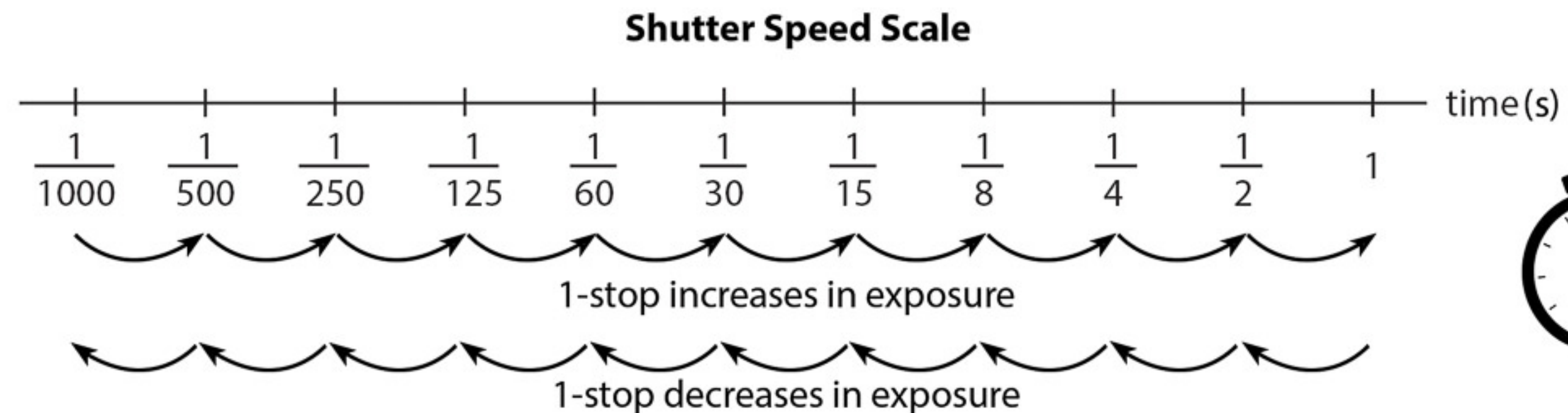
30 seconds	15 seconds	8 seconds
4 seconds	2 seconds	1 second
$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$
$\frac{1}{15}$	$\frac{1}{30}$	$\frac{1}{60}$
$\frac{1}{125}$	$\frac{1}{250}$	$\frac{1}{500}$
$\frac{1}{1000}$	$\frac{1}{2000}$	$\frac{1}{4000}$

Tip for handholding:

Minimum shutter speed = reciprocal of lens focal length.
Example: 50 mm lens = $\frac{1}{50}$ of a second shutter speed to remove any motion blur; 200 mm = $\frac{1}{200}$ of a second

The Exposure Triangle: Shutter speed

- Shutter speed and exposure
 - Changing shutter speed
 - Going slower: more light collected
 - Factor of 2 for each increment
 - Going faster: less light collected
 - Factor of $\frac{1}{2}$ for each increment



A person wearing a teal beanie is holding a Nikon camera, looking through the viewfinder. The camera is a black DSLR with a large lens. The person's hands are visible, holding the camera. The background is dark.

The Exposure Triangle: Aperture

- Aperture
 - Diameter of the aperture stop of a lens
 - Diameter controlled by diaphragm
 - Different lenses have different aperture diameters for the same f -stop value

A person wearing a teal beanie is holding a Nikon camera, looking through the viewfinder. The camera is a black Nikon DSLR with a lens attached. The person's hands are visible, holding the camera. The background is dark.

The Exposure Triangle: Aperture

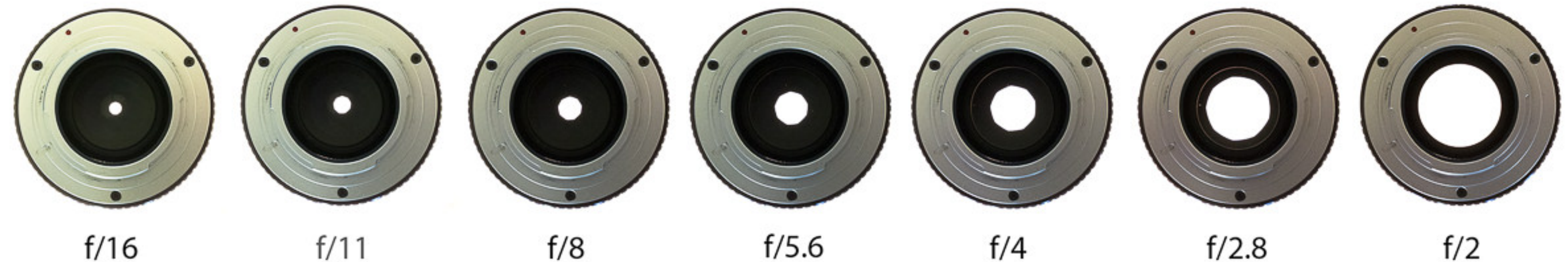
- Aperture
 - For each full stop (f /stop) of aperture:
 - The diameter of the aperture
 - Doubled or cut in half
 - Resulting in
 - 2x or 1/2x the amount of light allowed

The Exposure Triangle: Aperture

Larger aperture (smaller f -stop number)



Aperture Scale



1-stop increases in exposure (dividing f -stop by 1.414 results in opening with twice the area)

1-stop decreases in exposure (multiply f -stop by 1.414 results in opening with half the area)

Smaller aperture (larger f -stop number)



A person wearing a teal beanie is holding a Nikon camera up to their eye, ready to take a photo. The camera is black and has the Nikon logo visible on the top. The background is dark, making the person and the camera stand out.

The Exposure Triangle: Aperture

- Aperture
 - Expressed in numbers ($f2, f2.8, f4, f5.6...f22$)
 - Larger the number, smaller the aperture
 - Fractions
 - $f2 = 1/2, f4 = 1/4, f8 = 1/8, f16 = 1/16$
 - Stopping down = closing aperture (smaller)
 - Opening up = opening aperture (larger)

The Exposure Triangle: Relationship

- Shutter speed / aperture (f /stop) relationship

shutter speed

f /stops

