Intro to Small Unmanned Aircraft Systems & Recreational Drones

Photography

“A picture is worth a thousand words”

Brownie Camera (1900)

Introduced the “snapshot” to the masses!

Snapshot vs. Photograph

A snapshot captures a moment; a photograph captures a memory.

A photograph tells a story and makes the viewer think and ask questions.

A photograph is a view of something many others have seen before but seen from a new perspective.

Commercial photography is as an artistic expression of a vision, but with the goal of advancing a business or cause.

Photography Niches

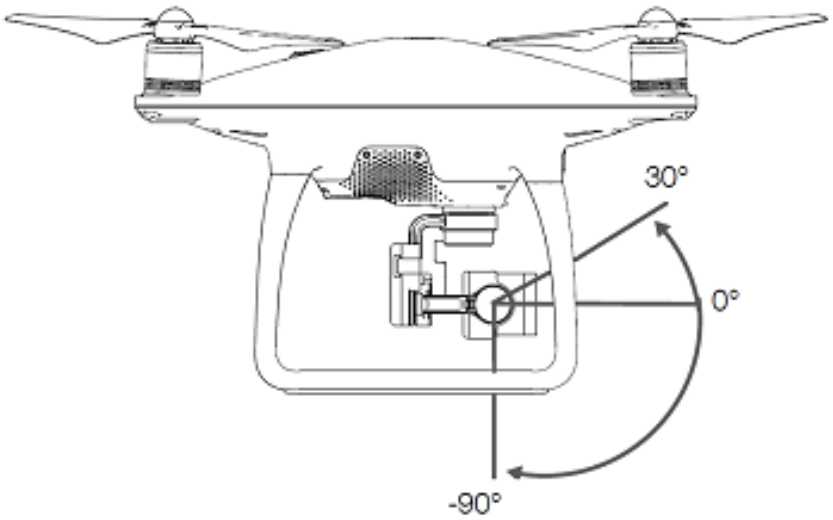
Food	Stock	Event
Sports	Street	Aerial
Macro	Portrait	Wildlife
Fashion	Still Life	Weather
Newborn	Landscape	Architectural
Documentary	Long Exposure	Photo-journalism

Aerial Photography

Aerial Photography gives a new perspective of things viewed from above. It is literally a "bird's eye view" of the world.

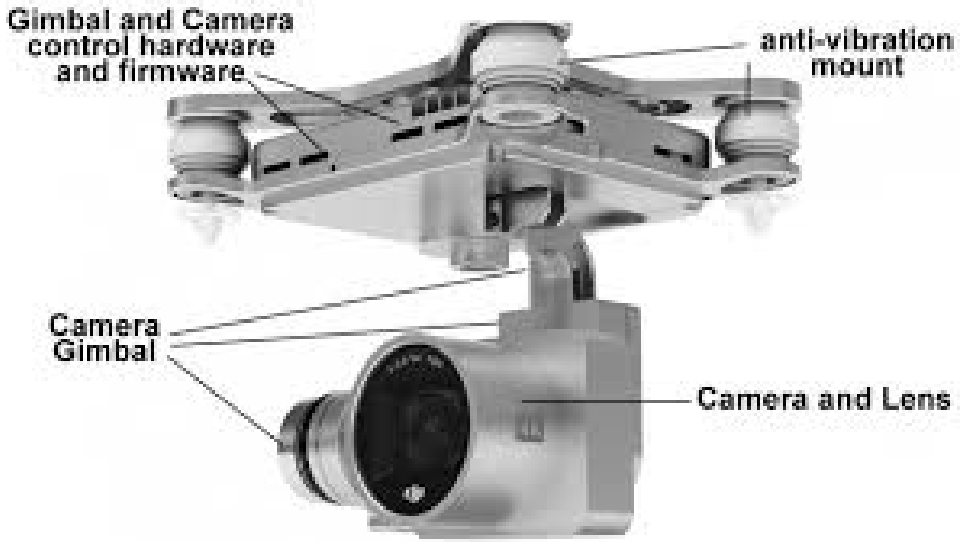
Early Aerial Photography

New York City – 1930 by Fairchild Aerial Photo



- Provides a stable platform for a camera
- Designed for specific camera & drone model
- 2-Axis & 3-Axis Stabilized
- Integrated or separate control

Gimbals



- Joystick Control
- Head Tracking

Gimbals

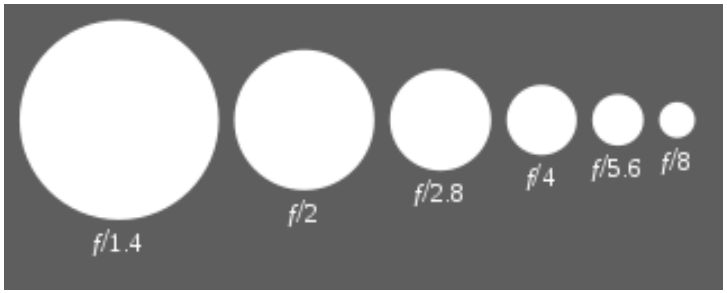
Camera Basics

Three Primary Adjustments

- **Aperture** – "f-stop" or shutter opening

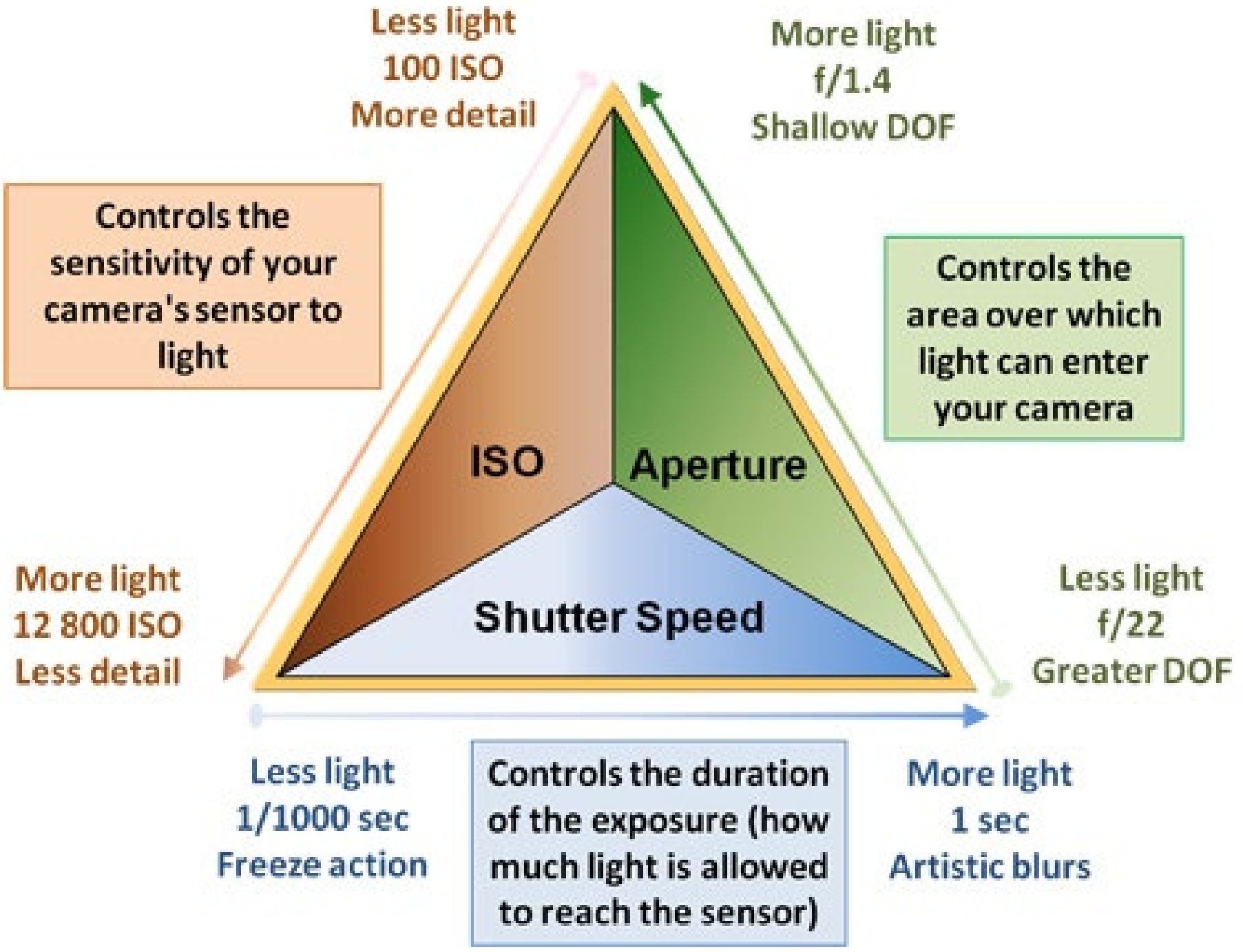
  f/1.2 – f/2.0 – **f/2.8** – f/4.0 –

  f/5.6 – f/8.0 – f/11 – f/16 – f/32



Most drones have a fixed f/2.8 aperture.

- **Shutter Speed** – in seconds or fractions of a second – length of exposure – 1 sec – ½ sec – ¼ sec
- **ISO** – sensor sensitivity – low ISO for bright scenes & high ISO for low light


Less light
100 ISO
More detail
More light
f/1.4
Shallow DOF
Controls the sensitivity of your camera's sensor to light
Controls the area over which light can enter your camera
ISO
Aperture
Shutter Speed
More light
12 800 ISO
Less detail
Less light
f/22
Greater DOF
Less light
1/1000 sec
Freeze action
Controls the duration of the exposure (how much light is allowed to reach the sensor)
More light
1 sec
Artistic blurs

Exposure Choices

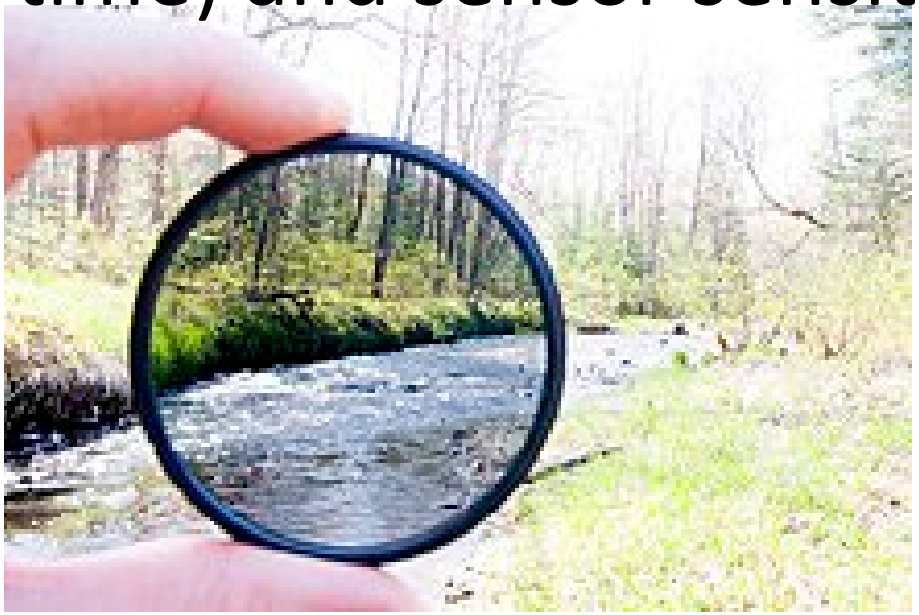
Small aperture increases the depth of field so more of the photo is “in focus”.

Fast shutter speed “stops the action” and gives a sharp photo.

Low ISO is good in “bright light” and reduces the noise or false pixels. It also reduces the sensor heating.

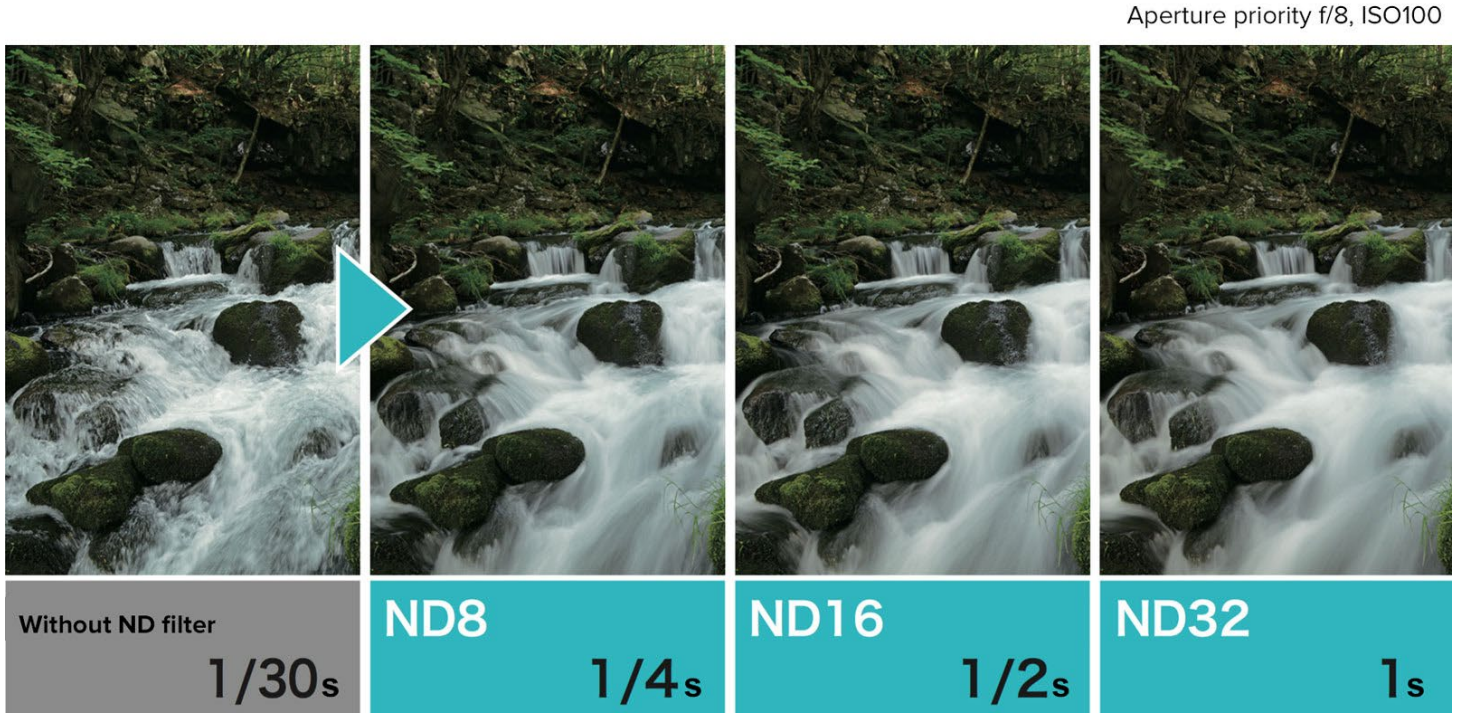
Neutral Density Filters

A neutral-density filter (ND) reduces the light intensity. Doing so allows the photographer with a fixed aperture drone to select the desired shutter speed (exposure time) and sensor sensitivity.

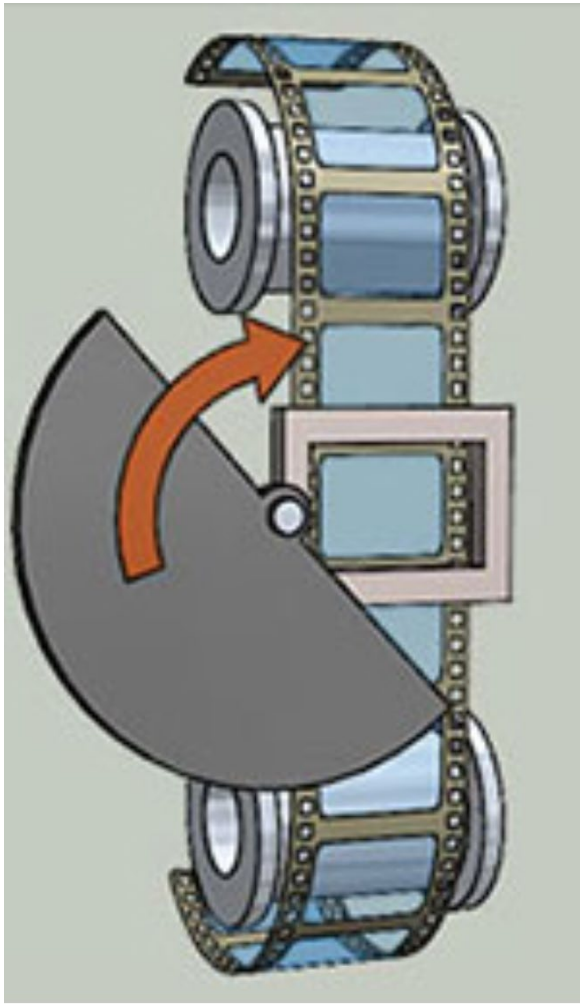


Neutral Density Filters

Use neutral-density filters (ND) to reduce incoming light which allows you to set the shutter speed.



Videography



A movie camera uses a rotating shutter to control how long each frame is exposed. Typically, these cameras record at 24 frames per second, allowing the human eye to see smooth motion with minimal blur and synchronized lip movement.

Videography

"Cinematic Shutter Speed" is the setting where shutterless video closely matches that of a video camera with a rotating shutter. This allows seamlessly blending video footage from two sources.

Example:

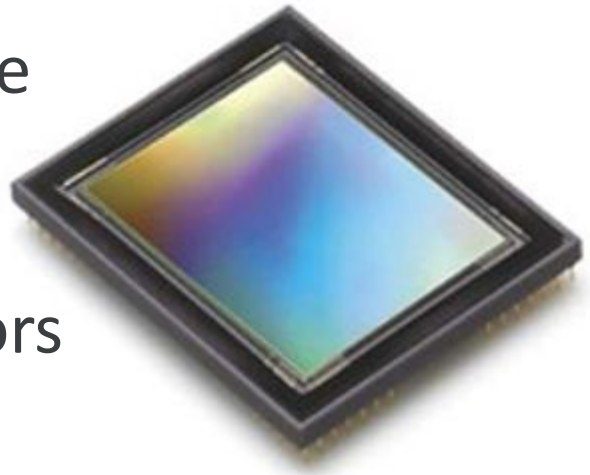
120 FPS x 2 = 240 or 1/240th shutter speed

60 FPS x 2 = 120 or 1/120th shutter speed

30 FPS x 2 = 60 or 1/60th shutter speed

Drone Camera Specs

- **Sensors**
  - **CMOS** (complementary metal oxide semiconductor) sensors are faster, which allows for higher video frame rates. CMOS sensors are less expensive to manufacture.
  - **CCD** (charge-coupled device) sensors provide higher dynamic range and require less current and voltage to operate. CCD sensors have superior low light performance and deliver better image quality.

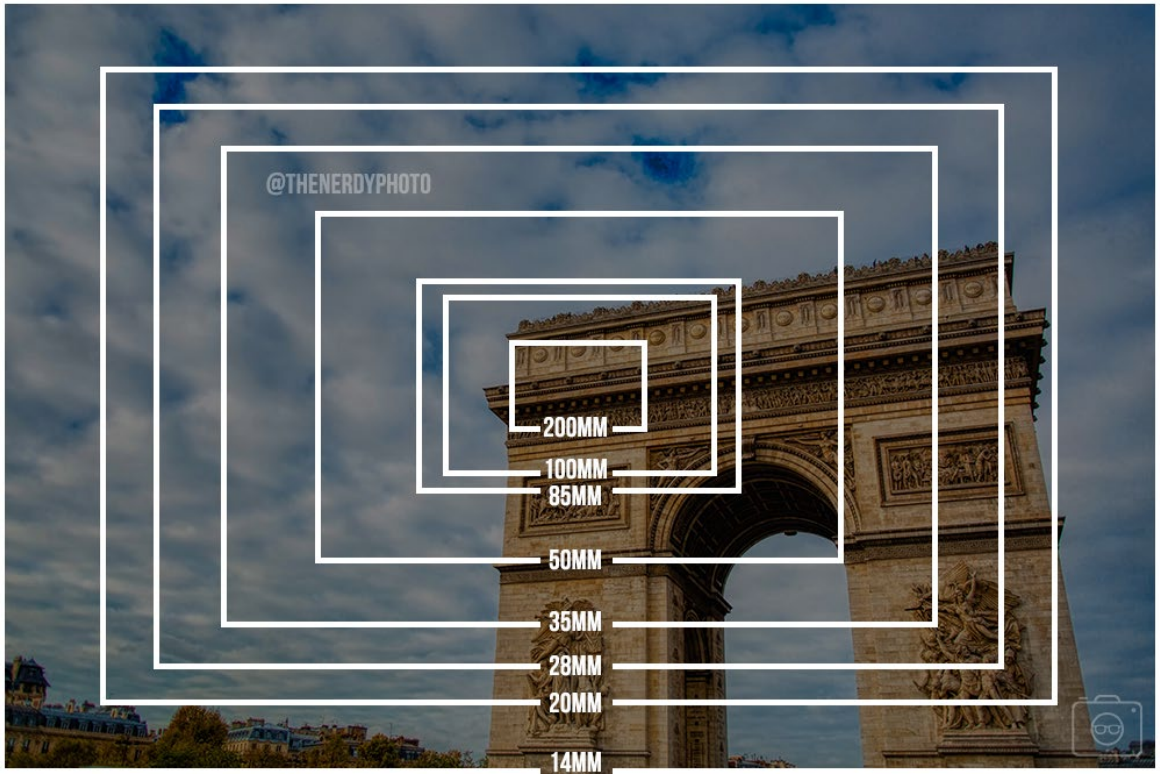


Field of View (FOV)

84° is 24mm equivalent

108° is 16mm equivalent

120° is 12mm equivalent



Drone Camera Specs

- **Video Resolution**
  - **5.1K:** 5120×2700 @ 24 to 50 fps
  - **Cinema 4K:** 4096×2160 @ 24 to 120* fps
  - **4K:** 3840×2160 @ 24 to 120* fps
  - **Full HD (FHD):** 1920×1080 @ 24 to 200* fps
  - **HD:** 1280x720 @ 30 to 60 fps

*Videos recorded at high framerates will be played as slow-motion videos.

Drone Camera Specs

- **Video Formats**
- **MP4:** A highly compatible and widely used container format, making it suitable for sharing and viewing. Commonly used on PCs.
- **MOV:** A container format, often associated with Apple's QuickTime, that can hold high-bitrate video files and is good for editing.

Photography is more than Megapixels

12 MP Cameras

Videography is more than Resolution

- 4K
- 1080i
- 720p
- WVGA

Each of these shoots in 4K resolution.

Print or Video?

Print – image size is important – larger print size or cropped images are better with more MP and larger sensors

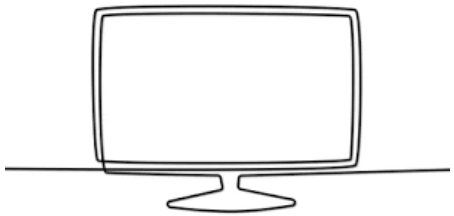
Video – view on a phone, a monitor, high-definition TV or large projections – commercial uses require higher resolution

PPI vs. DPI

Video screens use pixels to create an image

Pixel are measured in Pixels Per Inch (PPI)

Monitors have from 94 to 160 PPI

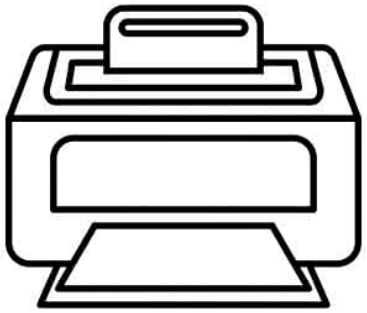


Printers use ink to create an image

Ink is measured in Dots Per Inch (DPI)

5x7 or 4x6 photos are fine with 300 DPI

8x10 photos need 600 DPI to look good



Print Image Size Ratio (W x H)

35mm camera film = 36mm x 24mm (3:2)

Drones have a 3:2 or 4:3 aspect ratio

Standard Print Paper Sizes (USA)

- 4x6 (3:2)
- 5x7 (7:5)
- 6x8 (4:3)
- 8x10 (5:4)
- 8x12 (3:2)
- 10x12 (6:5)
- 10x15 (3:2)
- 11x14 (14:11)
- 11x17 (17:11)
- 12x16 (4:3)
- 12x18 (3:2)
- 16x20 (5:4)
- 20x24 (6:5)
- 20x30 (3:2)

Video Image Size Ratio (W x H)

Drones have a 3:2 or 4:3 native image ratio but can be cropped to 16:9

- Facebook*/Instagram* = 1:1 (1200 x 1200 pixels)
- Standard TV = 4:3 (640 x 480 pixels)
- HDTV = 16:9 (1920 x 1080 pixels)
- 4K Ultra HD = 16:9 (3840 x 2160 pixels)
- Cinema 4K = 17:9 (4096 x 2160 pixels) – Letterbox on a HDTV
- Ultra-widescreen = 21:9 (10240 × 4320 Pixels) – shown in theaters

* *Social media offers different sizes for different purposes from profile photos to cover photos.*

CAMERA SENSOR SIZE COMPARISON

MEDIUM FORMAT

53.0 x 40.20mm

FULL-FRAME

35.00 x 24.00mm

APS-C

23.60 x 15.60mm

MICRO 4/3

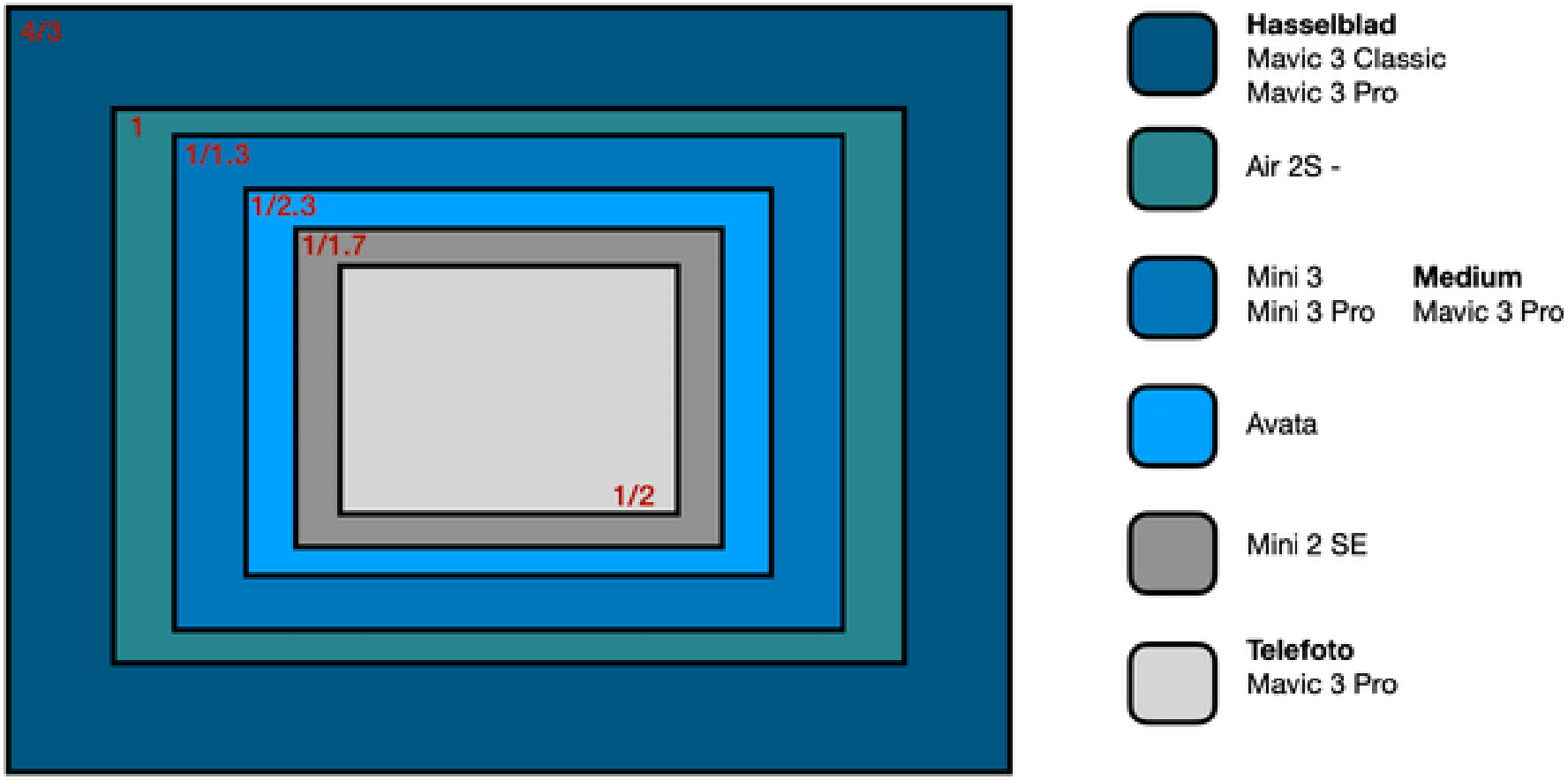
17.00 x 13.00mm

1”

12.80 x 9.60mm

1/2.55”

6.17 x 4.55mm



These sensors are all larger than the iPhone 17 which has three 48MP rear cameras: main (1/1.3-inch), telephoto and ultra-wide (1/2.55-inch)

JPEG or RAW (DNG)

Post processing a RAW photo in Lightroom or Photoshop can greatly improve photo quality over a compressed JPEG.

Normal Lens

Wide Angle or Fisheye vs. Normal

Normal Lens

← Wide Angle – Telephoto →

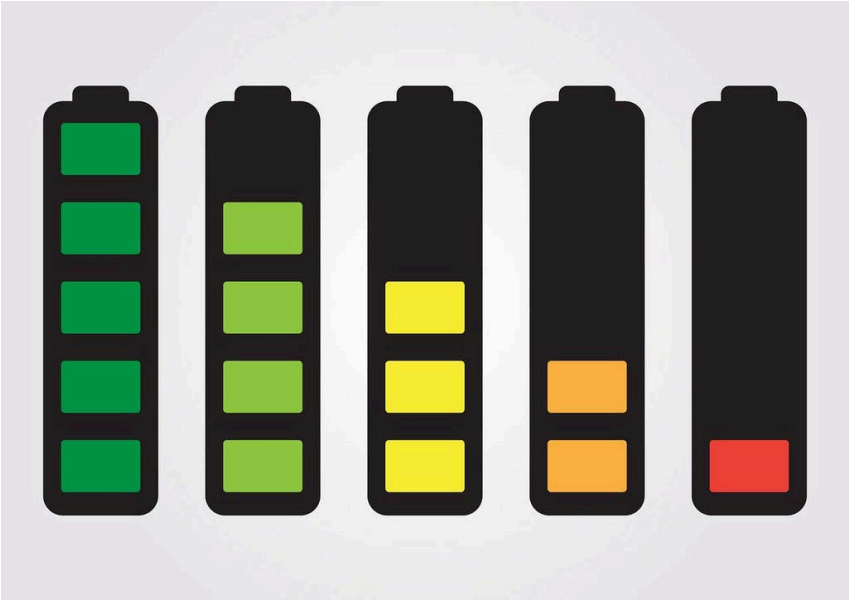
Avoid “selfie nose”

Stable Hover

Stable hovering requires an advanced flight control system and onboard sensors.

Flight Time

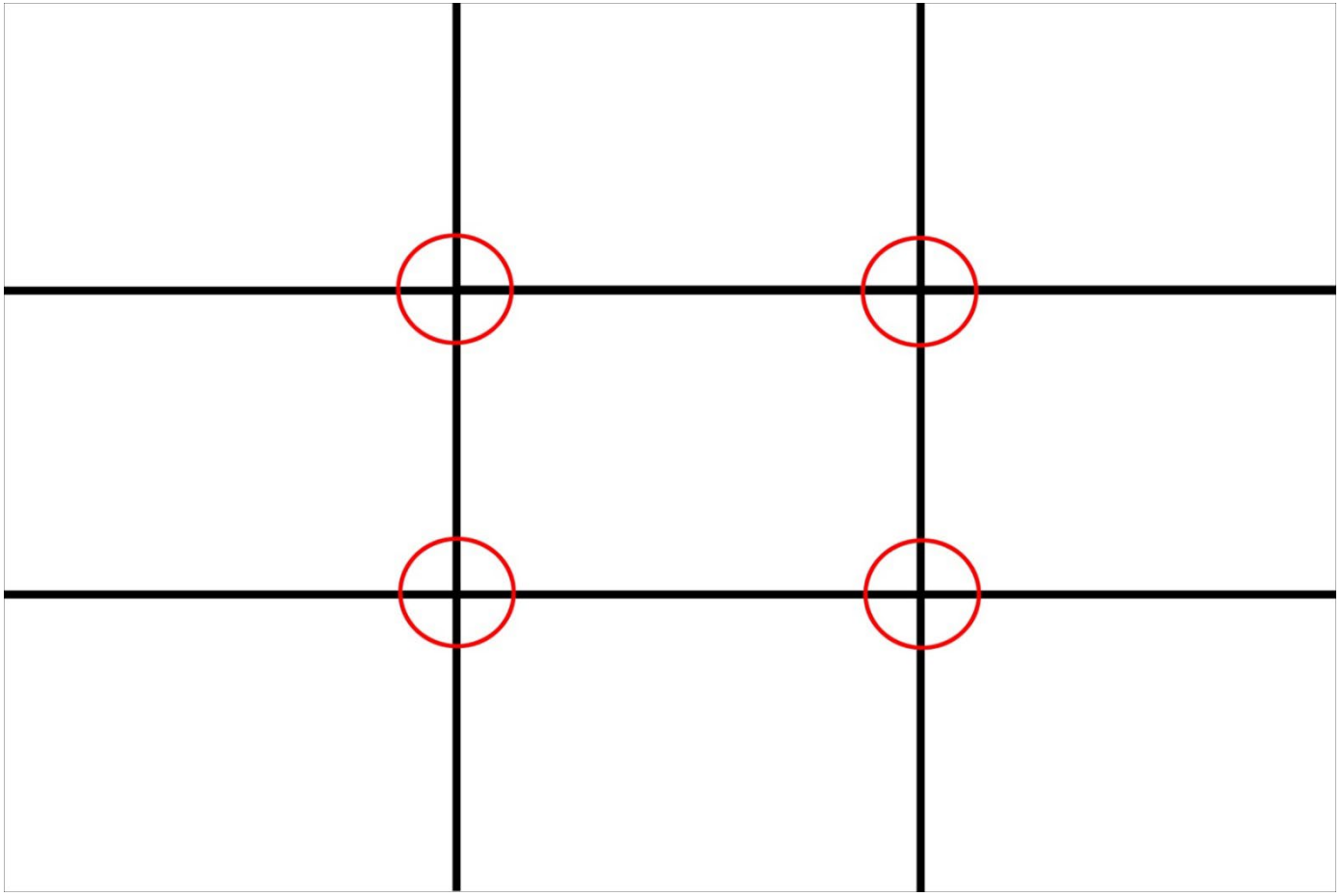
Most camera drones will fly for 20+ minutes, which is plenty of time to take a good photograph. So don’t worry about flight time but carry 2 or 3 extra batteries.



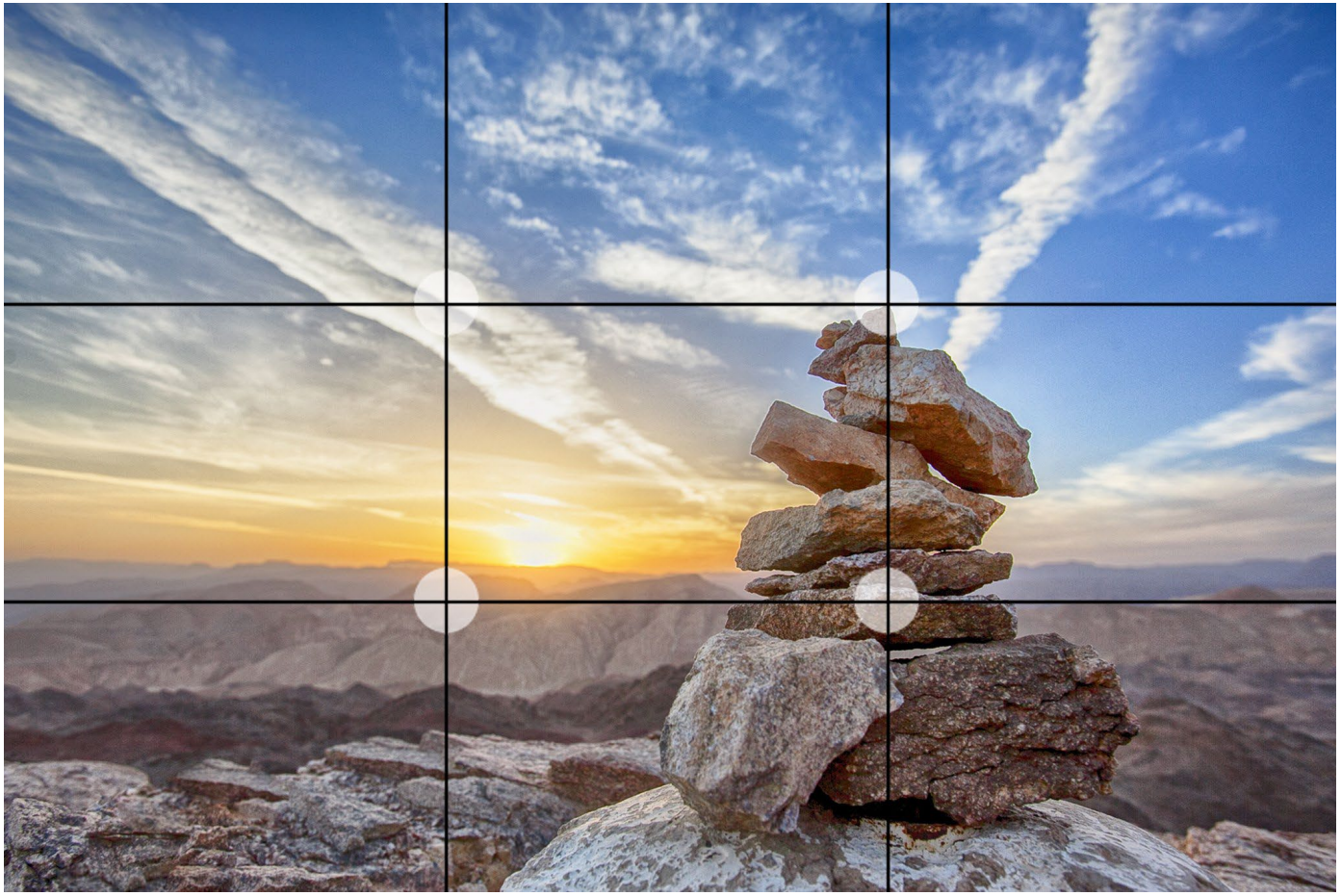
Basic Photography Composition

- Rule of Thirds
- Leading Lines
- Symmetry
- Patterns

Rule of Thirds



Rule of Thirds

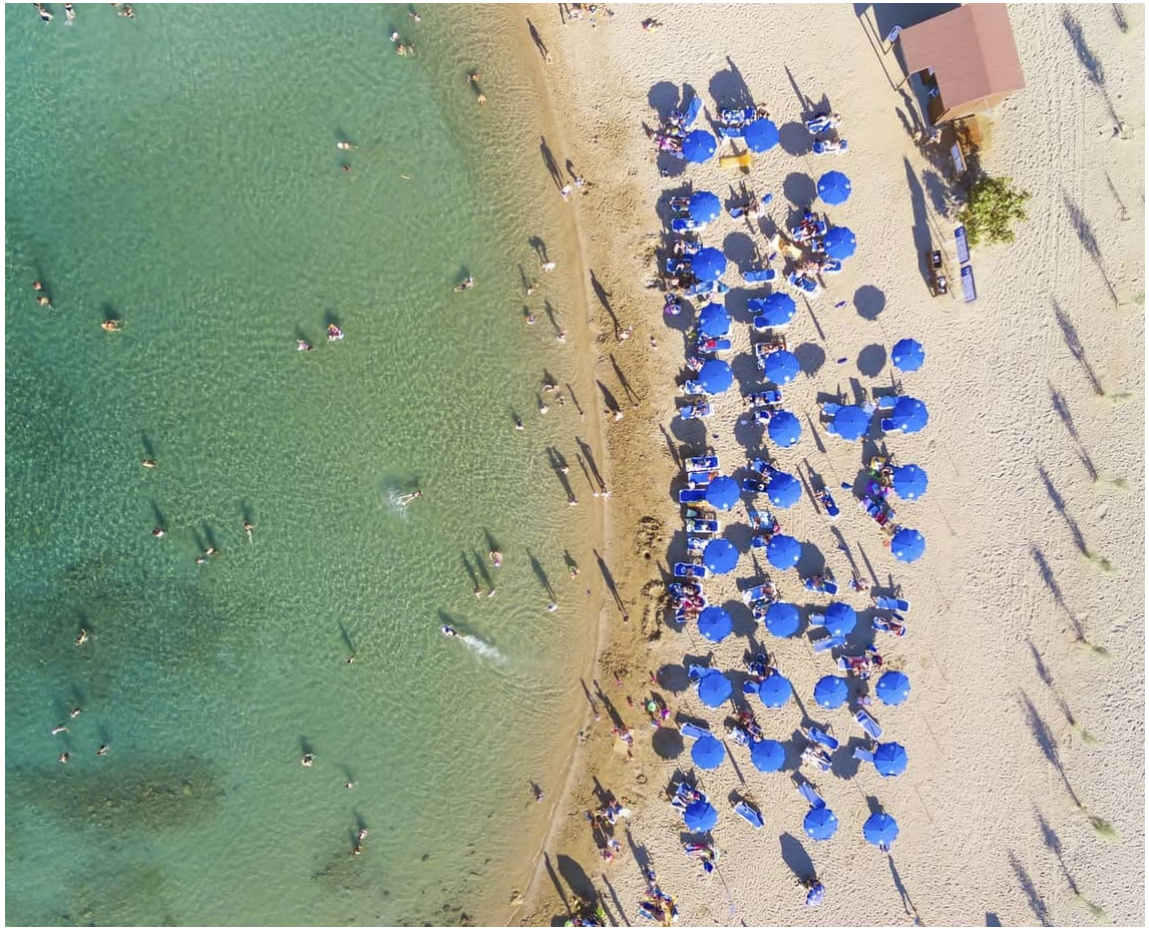


Leading Lines give Structure

Patterns

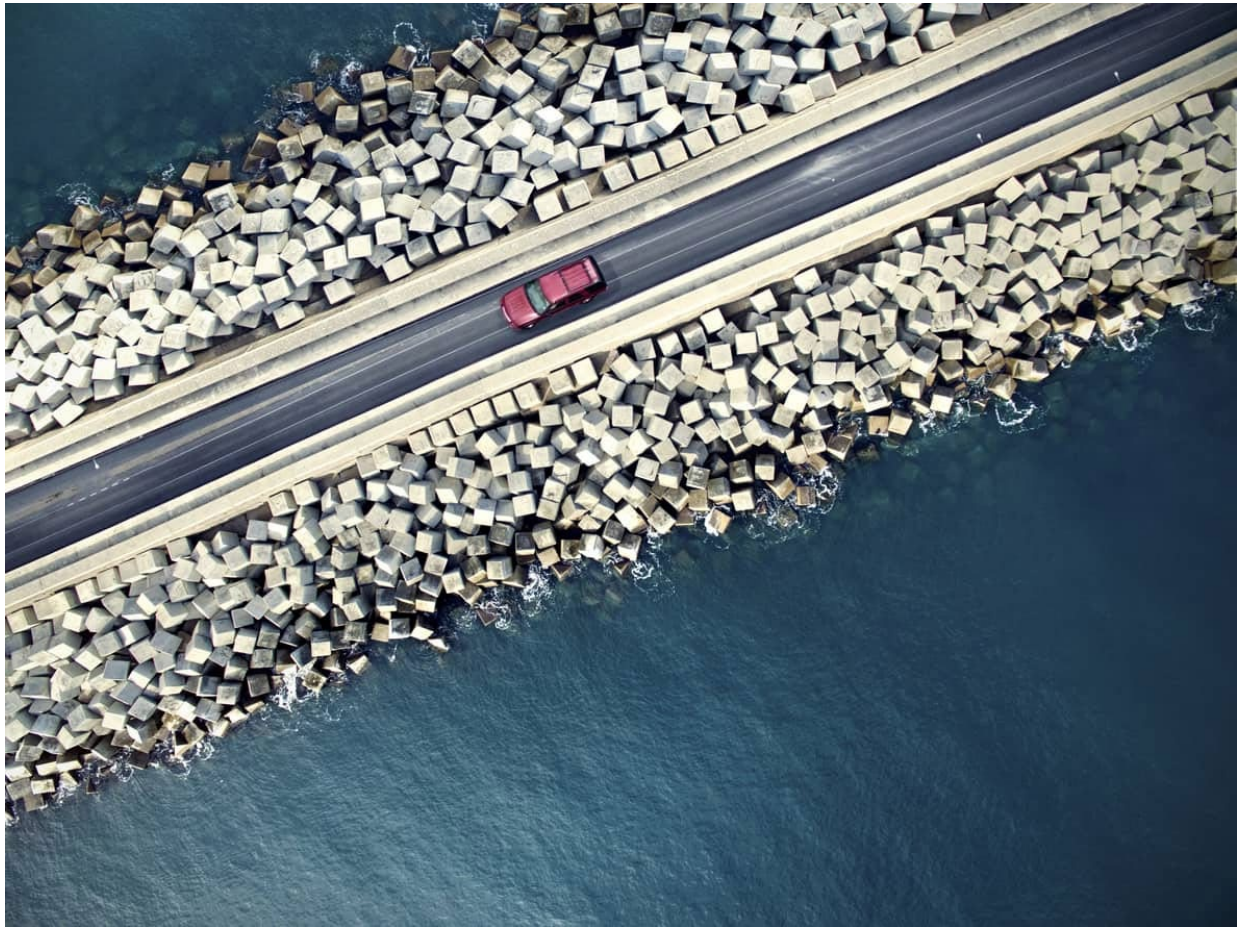
Symmetry

Include People in the Photo



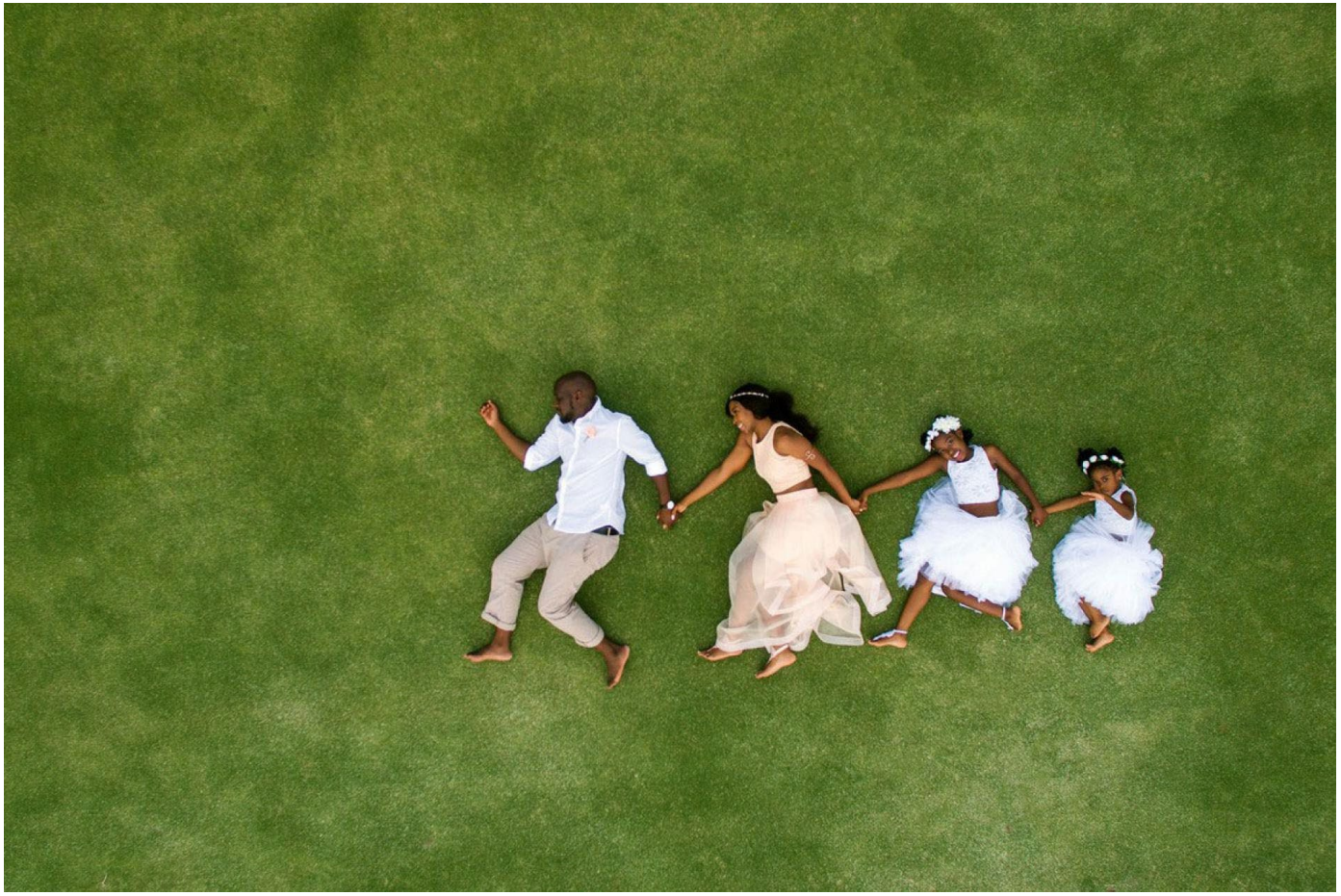
Look for Color

Texture Creates a 3-Dimensional Look



Wedding Photography

Andrew Morgan – Tanzania



Baldwin Foley – Family Photo

Commercial Aerial Photography - Waterloo

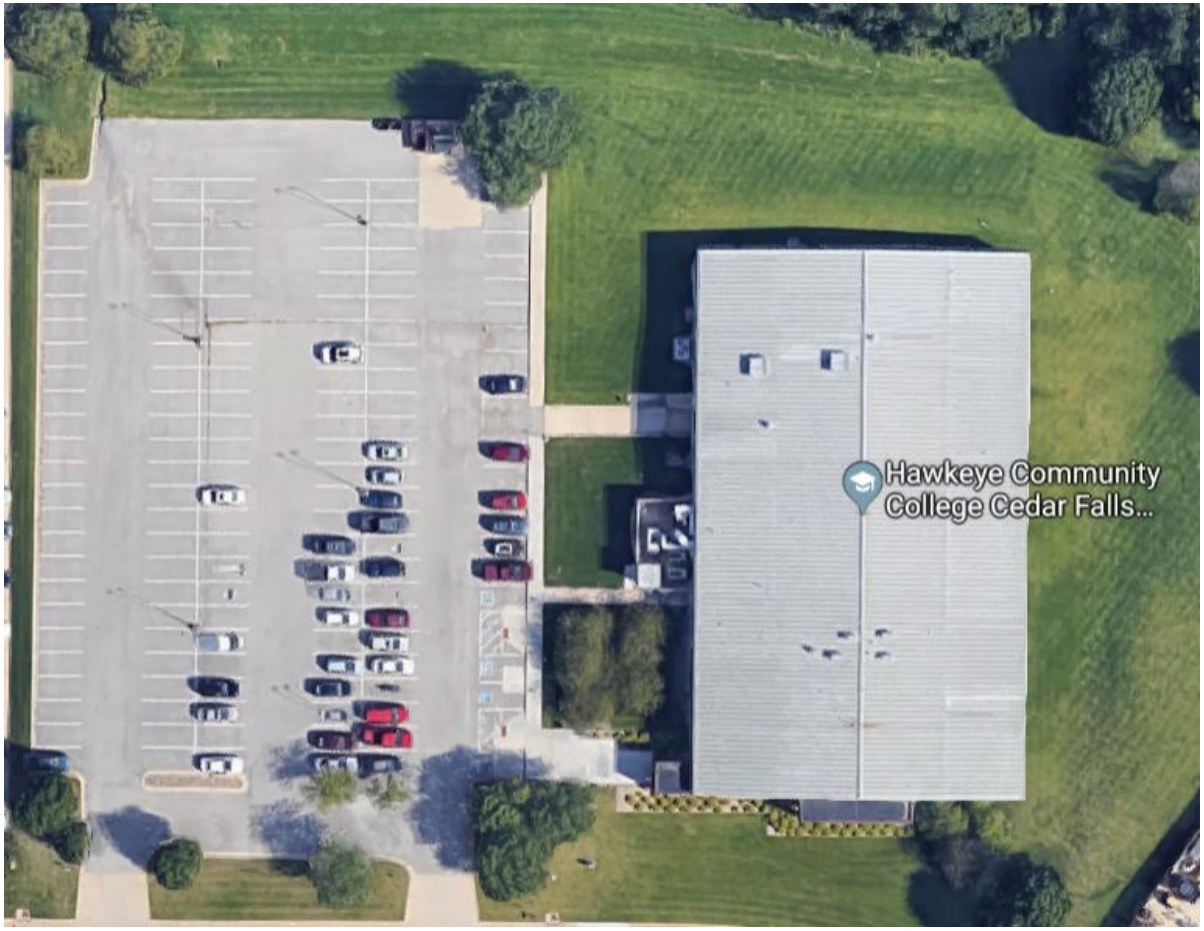
Flowerama – Iowa City, IA

Real Estate – Cedar Rapids

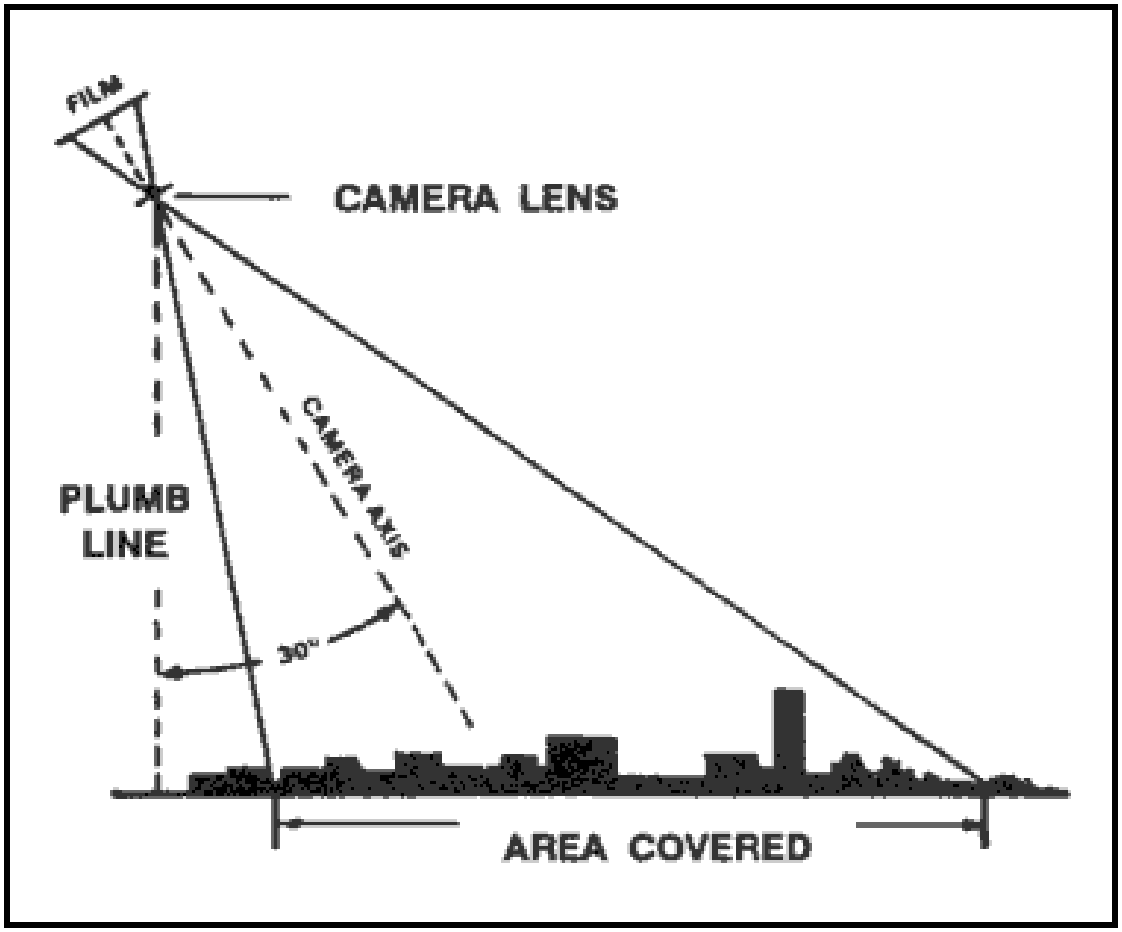
Types of Aerial Photographs

- ***Orthophotos*** – vertical photographs which have been geometrically "corrected" to be usable as a map
- ***Low Oblique*** – photographs taken from a low angle – No Horizon
- ***High* or *Steep Oblique*** – photographs taken from a high angle – Visible Horizon
- ***Vertical*** – photographs taken straight down

Orthophotos

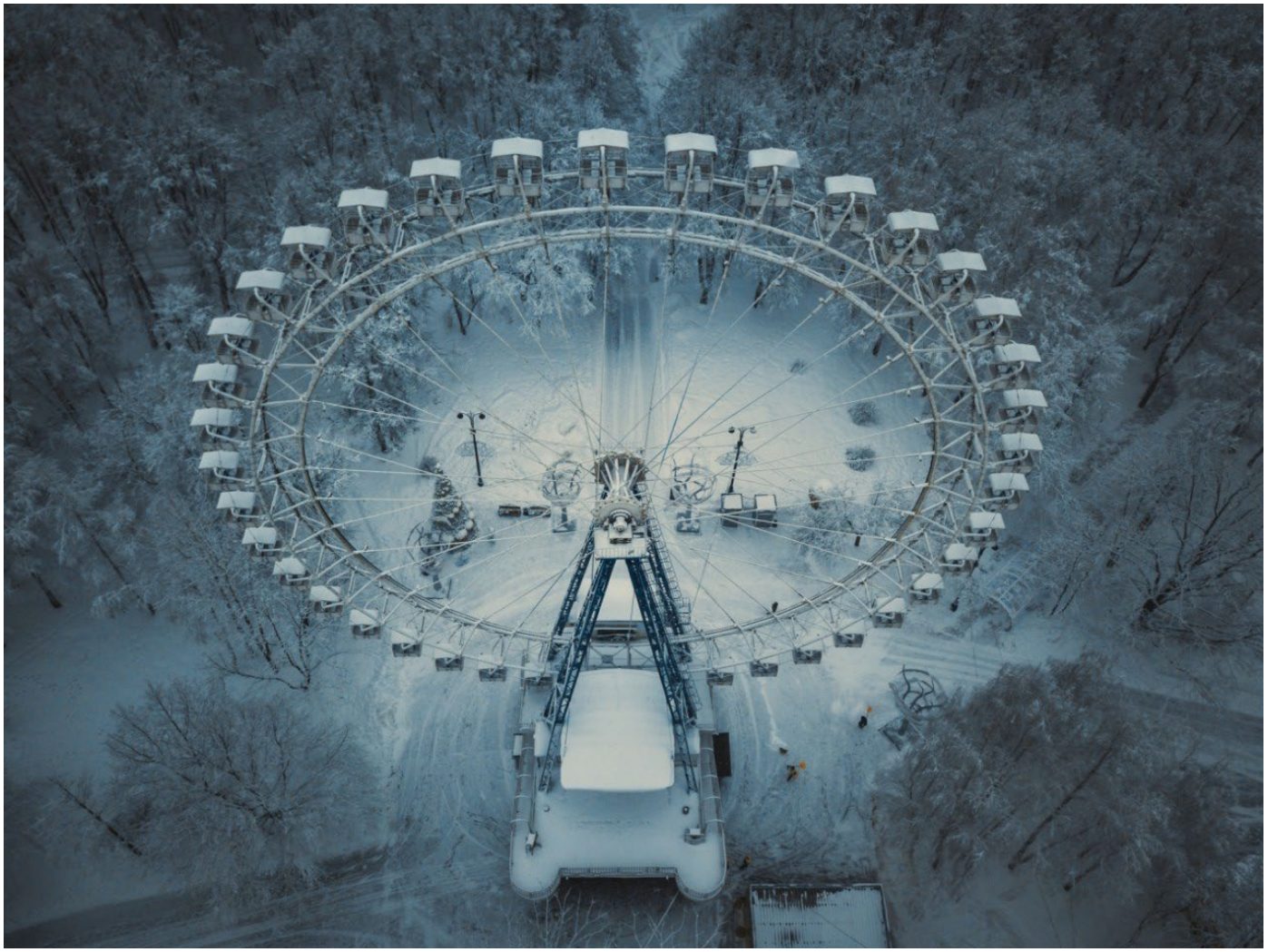


Low Oblique



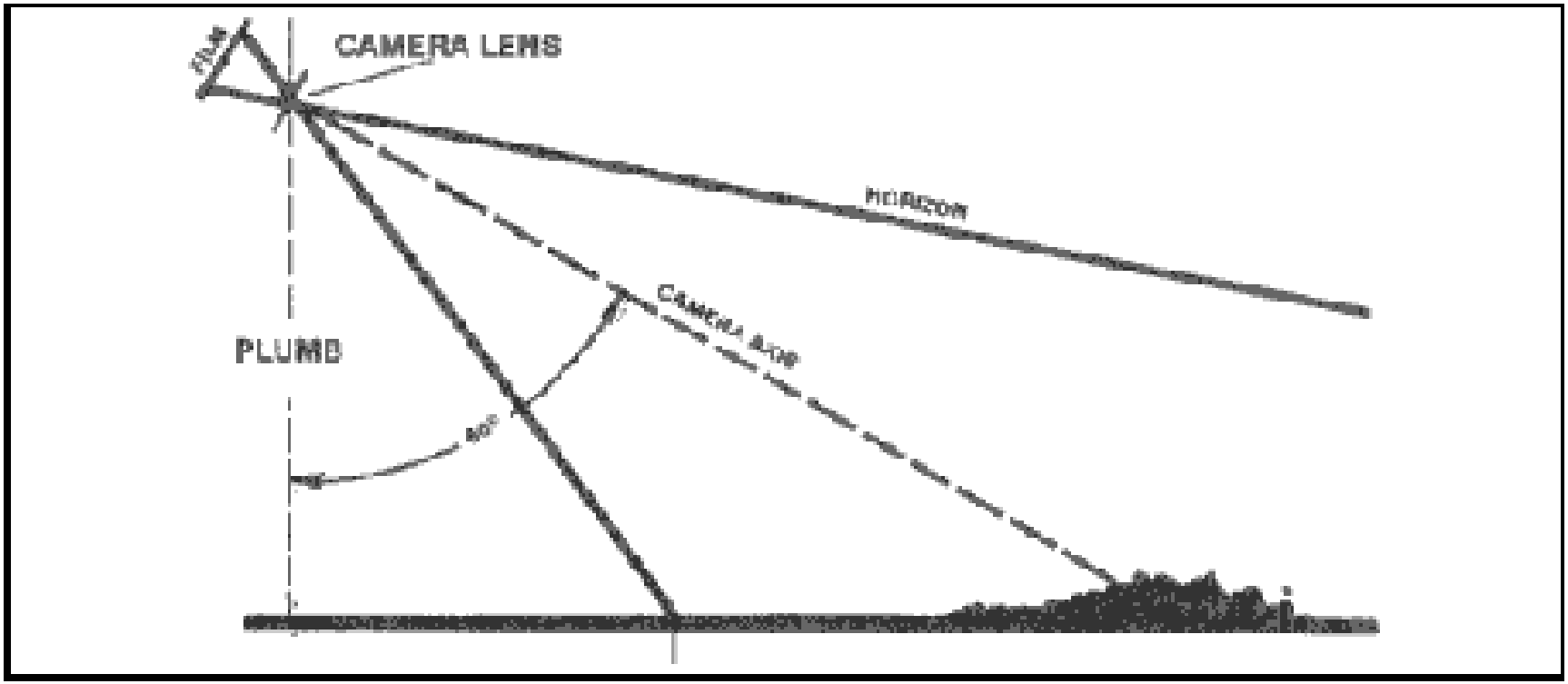
Tuilp Fields, by Anders

Urban Frozen Fun - Sergey Farenyuk



Francis Scott Key Monument
by Terry and Belinda Kilby

High or Steep Oblique



'Above the Mist' Maringa Cathedral, Brazil by Ricardo Matiello

Baltimore's Inner Harbor
by Elevated Element

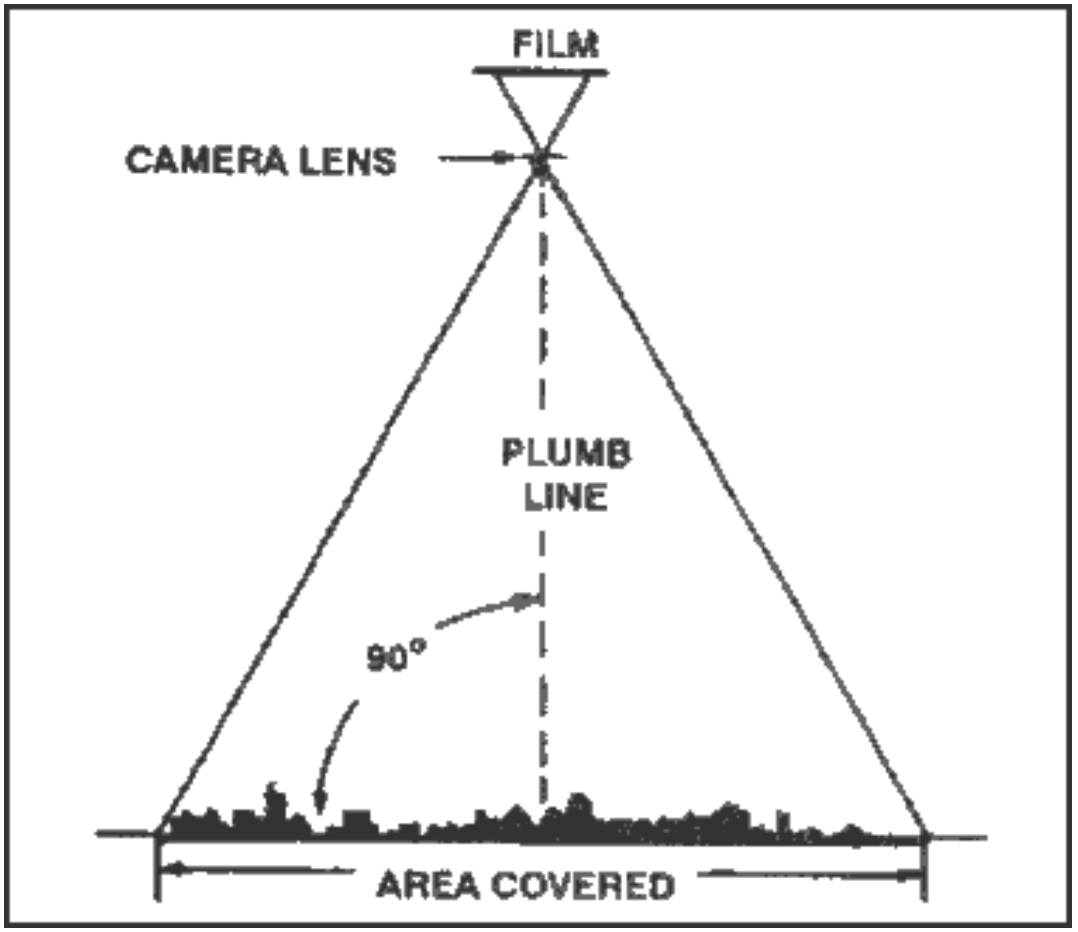
Seven Foot Knoll Lighthouse
by Elevated Element

Geese Meeting the Winter - Terje Kolaas

Polk City Sunset

QC Drone – Des Moines

Vertical



Moab Rock Climbing by Max Seigal

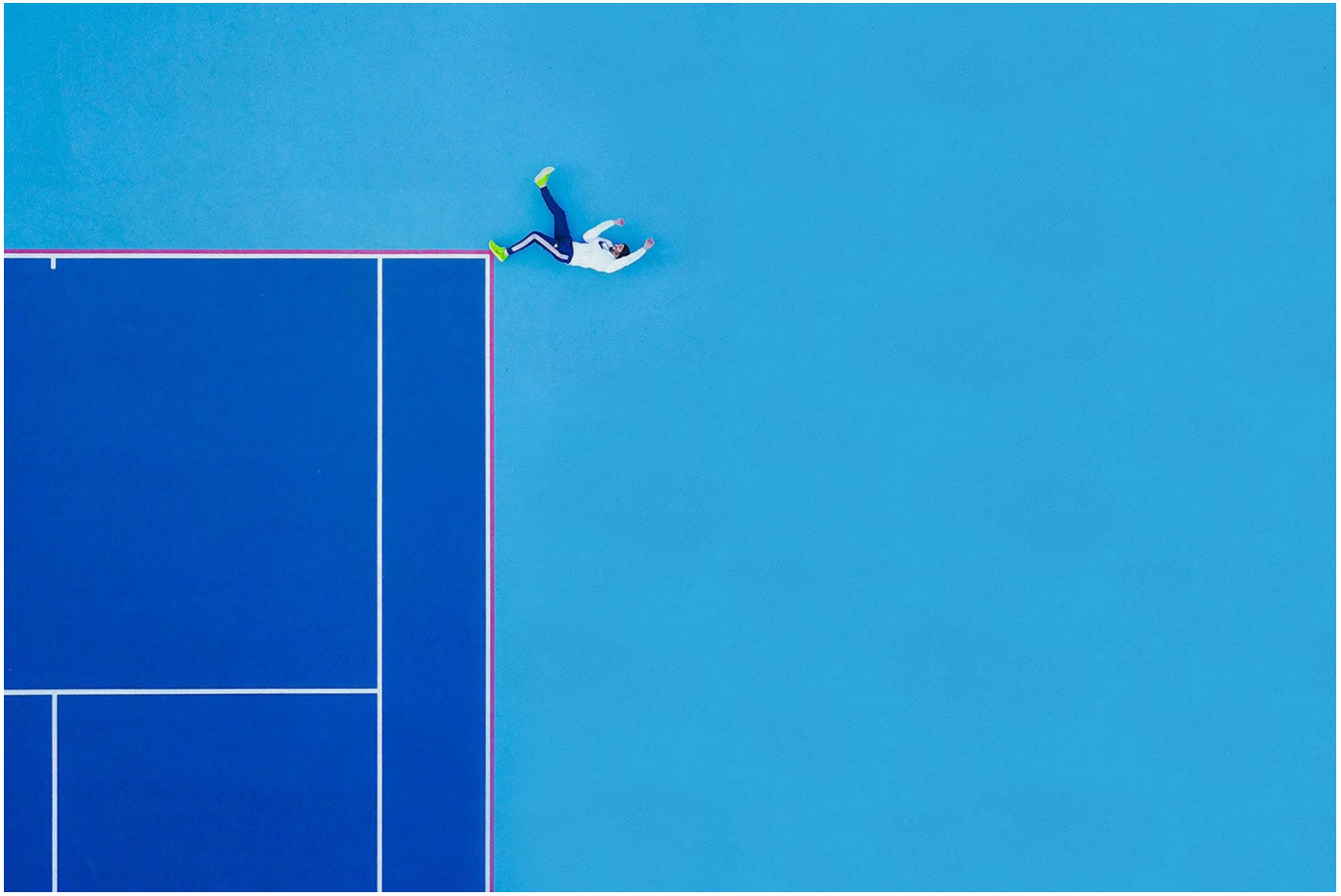
Where's Wally, Limassol Carnaval
by Fly Over Media

JCOURTIAL – Provence, France

Luke Maximo Bell – South Africa

Wrong Way Buddy! - John Cowpland

Martin Sanchez – New Jersey



Scrap Combine Yard, Colfax, IA

Ghost Ranch, Abiquiu NM

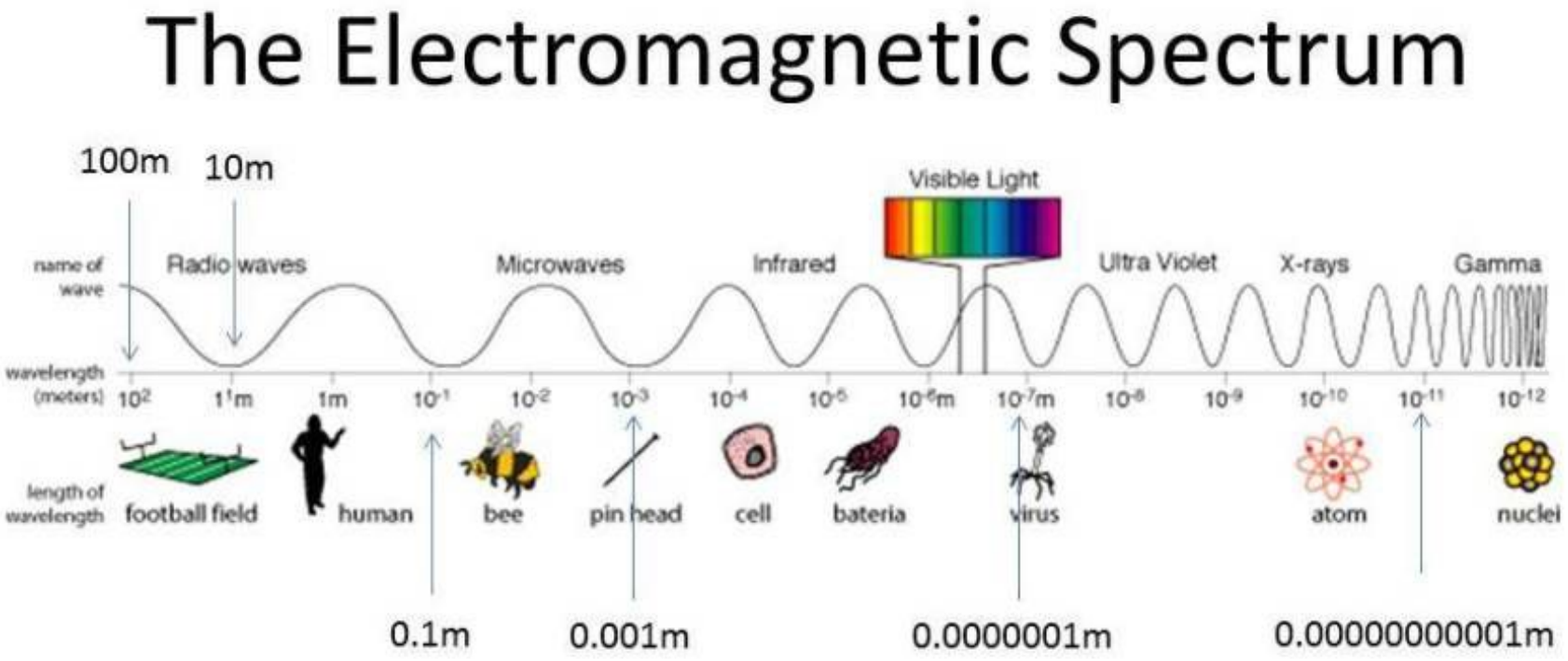
Ghost Ranch, Abiquiu NM

Ghost Ranch, Abiquiu NM

Drone Photo Tips

- Check the weather forecast
- Shoot in RAW or DNG format
- Utilize the thirds grid overlay for composition
- Stick to a lower ISO
- Take advantage of Auto Exposure Bracketing
- Be prepared to improvise
- Create higher resolution images with panoramic shots
- Experiment with both aspect ratios (16:9 or 4:3)
- Use camera lens filters
- Seek out symmetry, patterns, and lines
- Play with lights and shadows
- Take a drone “selfie”

Photography Beyond the Visible



Picture credit: NASA. Arrows & numbers added by Baldscientist.

Infrared, Thermal & Night Vision

All three use the same camera with a CCD sensor

Infrared – daylight, monochrome or false-color, plants reflect infrared light

Thermal – day or night, false-color, relies on temperature differences between object and background

Night Vision – nighttime, monochrome image, requires a light source such as a red LED

FLIR – Forward Looking Infrared

Search and rescue operations for missing persons especially in wooded areas or water – Can see through smoke and haze

Monitoring wild game habitats

Detection of energy loss or insulation defects in buildings in order to reduce energy consumption

Pinpoint sources of ignition during firefighting operations

Detecting faulty or overheating electrical joints, connections and components

Night driving

Infrared Photograph

Thermal Image

What to consider when buying a photo drone

- Megapixels & Resolution
- Sensor Size – bigger is better
- Aperture – fixed or variable
- Field of View (FOV) – wide angle or telephoto
- Shutter type – electronic or mechanical
- Shutter speed – up to 1/8000 second
- ISO range – 100 up to 6400
- Photo Flight Modes – tripod, cinema, movie modes


Any
Questions