

Welcome  
To  
“Drones Take Flight”

Presented by

Zack Nicklin  
UAS Program Manager

Tom Biller  
Director, DroneTECH



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## Whats the big deal about drones?

### JOBS WITH DRONES



An estimated 140,000 new jobs will be created by 2025 with direct use of unmanned aerial systems (UAS), or drones.

-Unmanned Safety Institute

### Growth in Industry Adoption (YoY)

While dozens of industries use drones, the fastest growing commercial adopters of aerial data come from the construction, agriculture, and mining industries.



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# Goals and Objectives

Discover Revolutionary Opportunities in New and Emerging Technology

- Focus on K-12 and 2 Year Post Secondary Educators/Students
  - Educator Workshops (DT1 and DT2)
  - STEM Summer Camps
  - Distance Options
  - Drone TECH Trainers



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# Workshop Agenda

- Anatomy of a Drone
- Part 107 and What it Means to Educators
- Lunch (12:00 to 12:30)
- Drone Operations and Best Practices
- Rise of the STEM Drones
- STEM Drone Program on a Shoestring Budget
- Student Competitions
- Virtual Happy Hour Open Discussion



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# Anatomy of a Drone

Presented by

Tom Biller

Director, DroneTECH

[Thomas.biller@northlandcollege.edu](mailto:Thomas.biller@northlandcollege.edu)



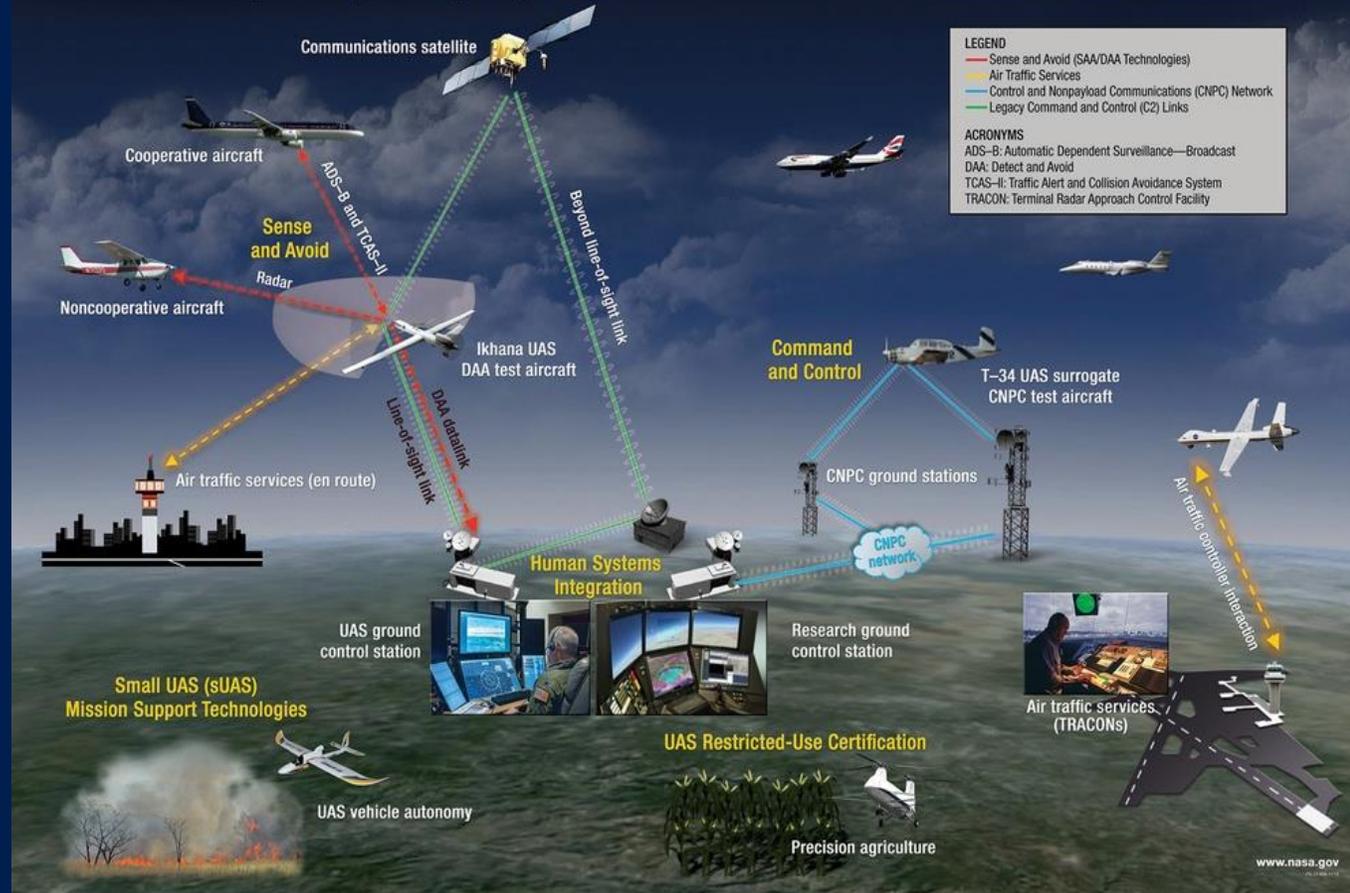
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## Terminology

- What is a Drone?
  - Unmanned Aerial System (UAS)
  - Unmanned Aerial Vehicle (UAV)
  - Ground Control Station (GCS)

### Unmanned Aircraft Systems (UAS) Integration in the National Airspace System (NAS) Project



<https://www.thedroneinfo.com/popular-drone-terminology/>



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## Drone Types

### Fixed Wing



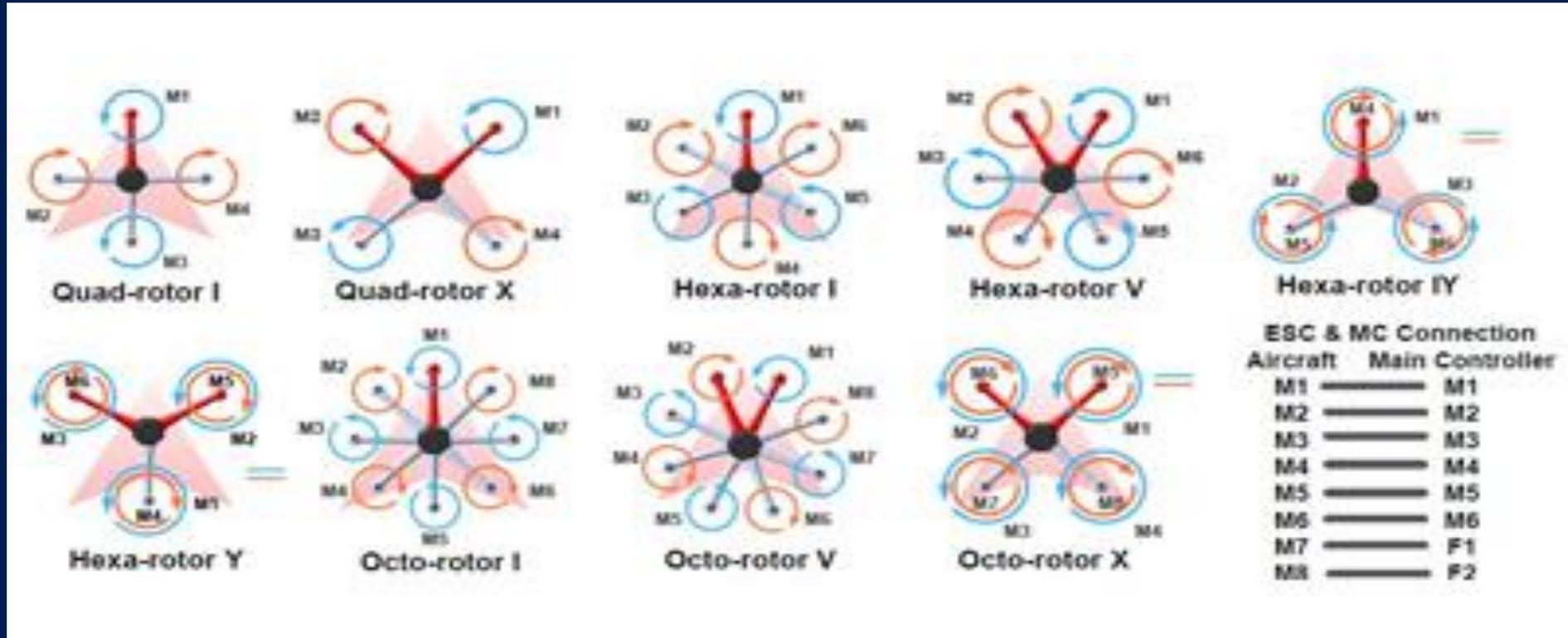
### Multi-rotor



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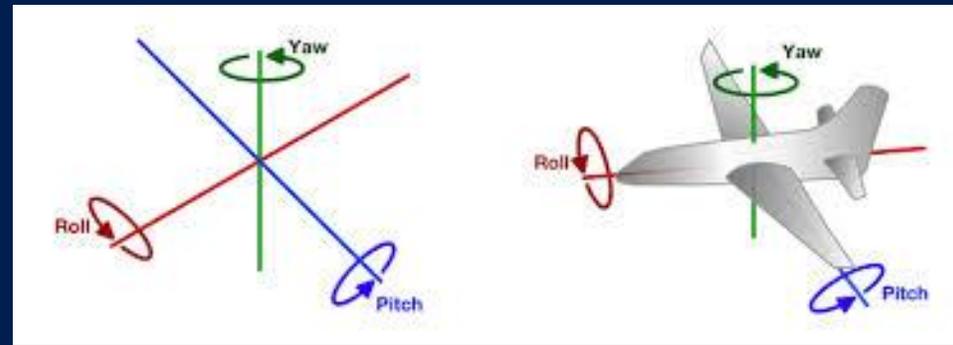
## Configurations



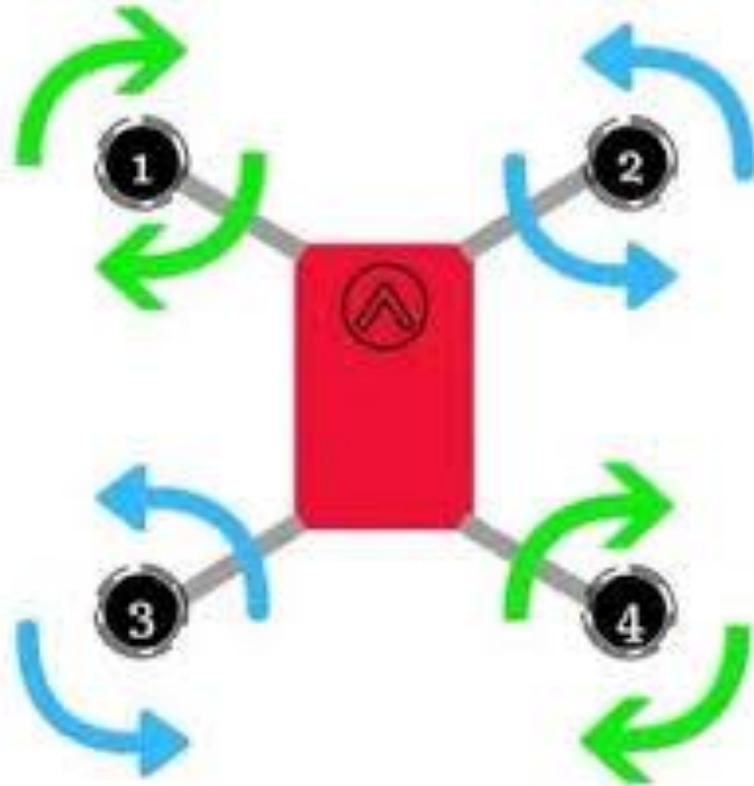
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## Flight Physics



<https://learn.parallax.com/tutorials/series/elev-8-v3-tutorial-series>



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# DRONETECH

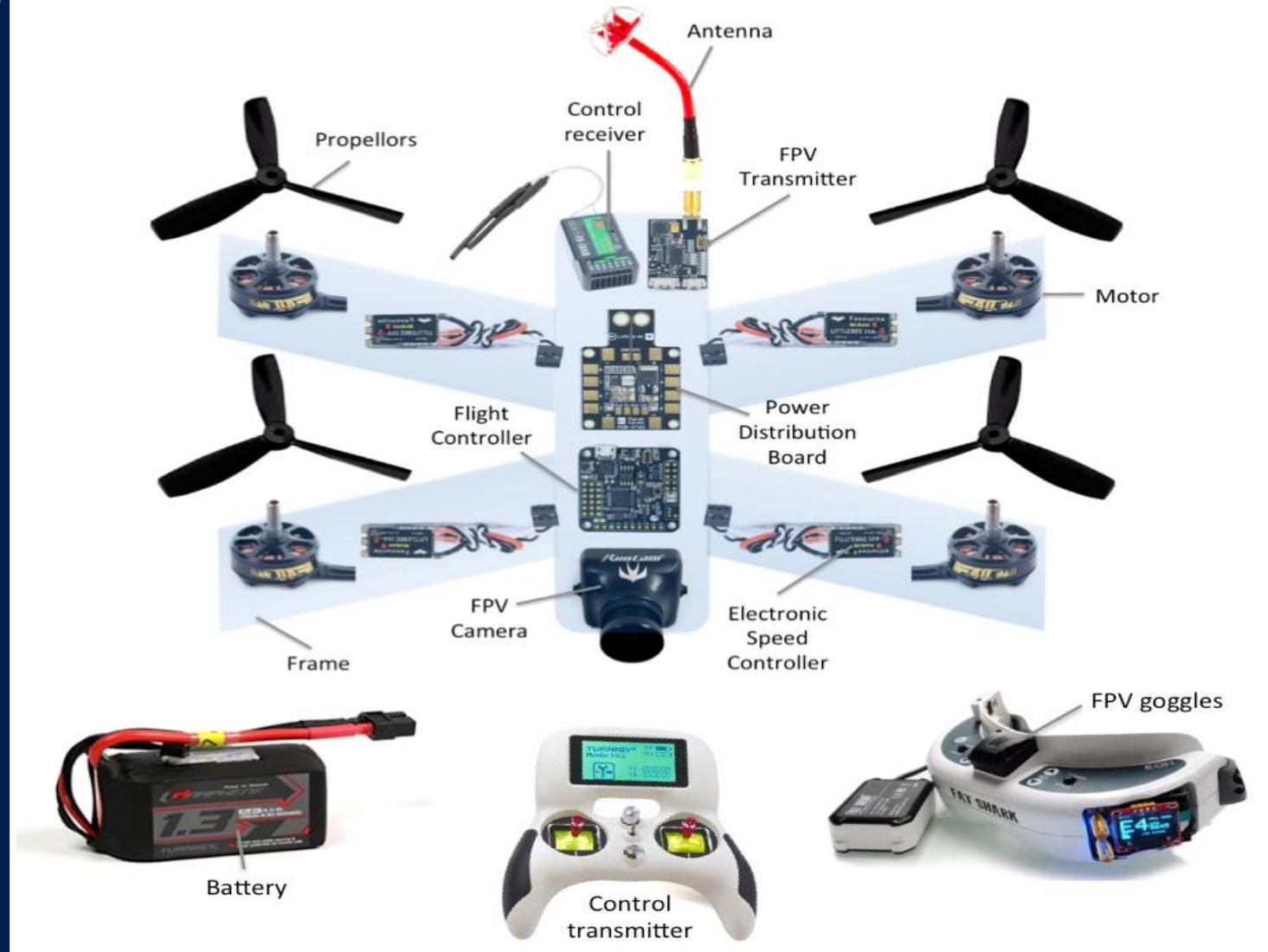
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## What Makes a Drone Tick?

- Flight Controller/Sensors
- Motors
- ESC
- Props
- Battery
- Frame
- Control Receiver
- Control Transmitter

<https://www.dronezon.com/learn-about-drones-quadcopters/drone-components-parts-overview-with-tips/>

Interactive CLICK each Part for Buyers Guide



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# DRONETECH

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## Flight Controller

### Evolution of Flight Controllers

**Size**

- 45x45mm
- 30x30mm
- 20x20mm
- 16x16mm

**CPU**

- F1
- F3
- F4
- F7

**Features**

- FC
- FC PDB ESC
- FC PDB OSD VTX
- FC PDB RX OSD ESC SD Card

<https://oscarliang.com/flight-controller-explained/>

**LPC1769 uC:**  
ARM Cortex M3 @ 120Mhz  
512 KB Flash  
64 KB RAM

**JTAG:**  
LPCXpresso compatible

**USB:**  
Power the board  
CDC/Mass Storage/etc

**Altimeter:**  
Bosch BMP085

**Magnetometer:**  
HMC5883L

**uSD Card slot:**  
FAT32 & up to 32 GB  
Firmware upgrading  
Configuration  
Data logging

**Accel & Gyro:**  
MPU6000/50  
6 DOF sensor  
Attitude estimation

**Xbee Radio**

**Battery input:**  
Up to 40V input  
No need for BEC  
Switching power supply to 3.3V

**4x High power Red/Green LEDs**

**4x Arms interface:**  
ESC output  
Analog/Timer input  
2 more without connector  
Hexacopters

**Power selector:**  
USB or Battery

<https://3dinsider.com/drone-sensors/>

<https://youtu.be/eqZgxR6eRjo>

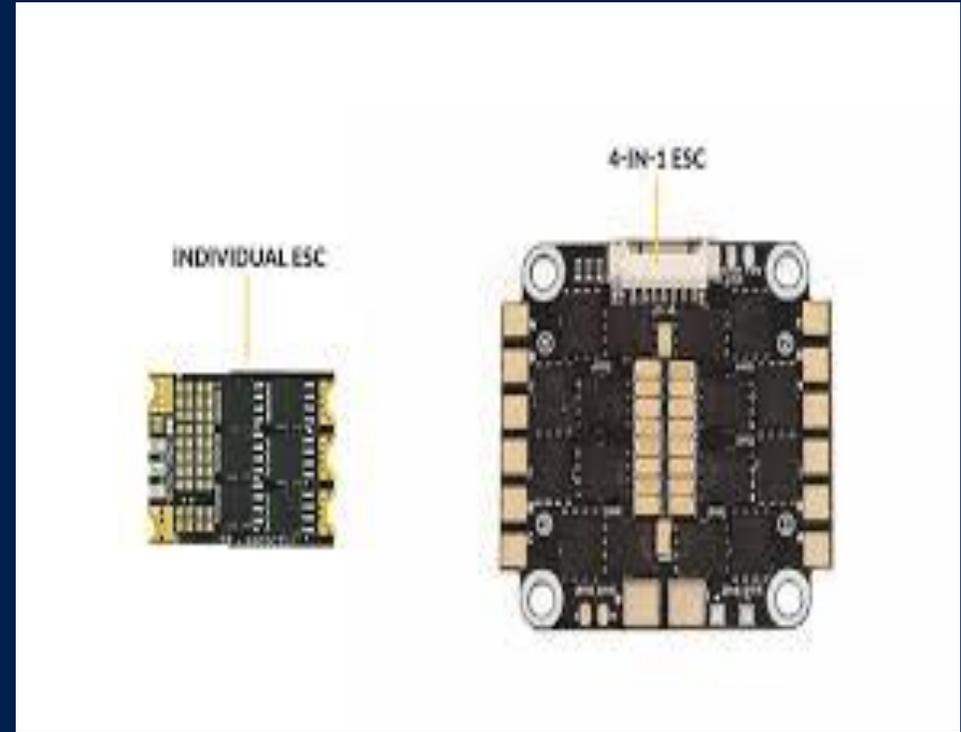
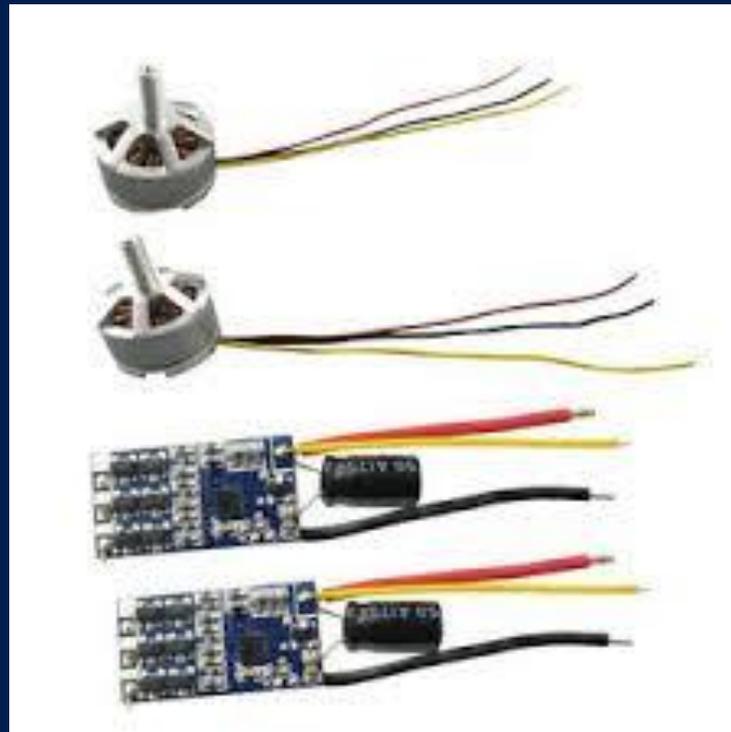
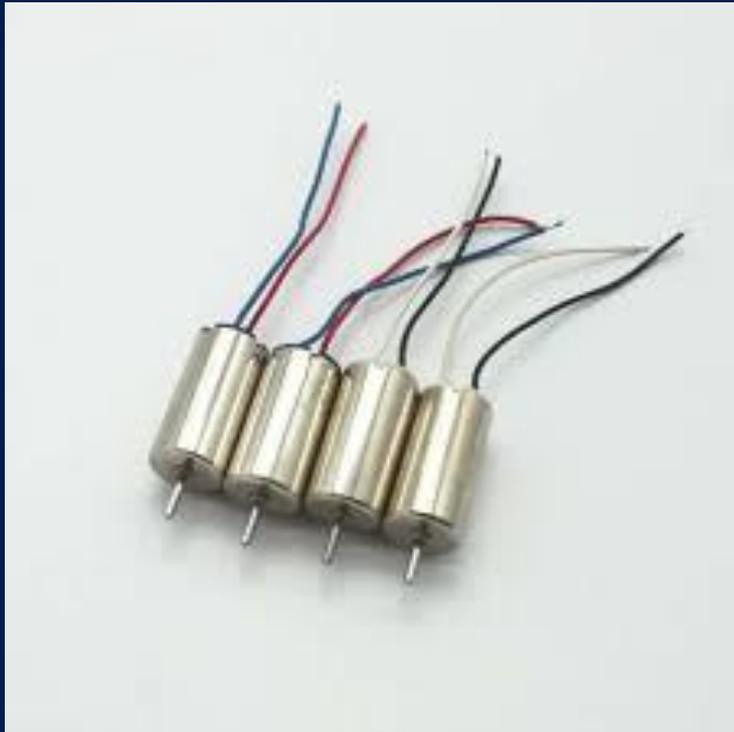


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## Motors and ESCs

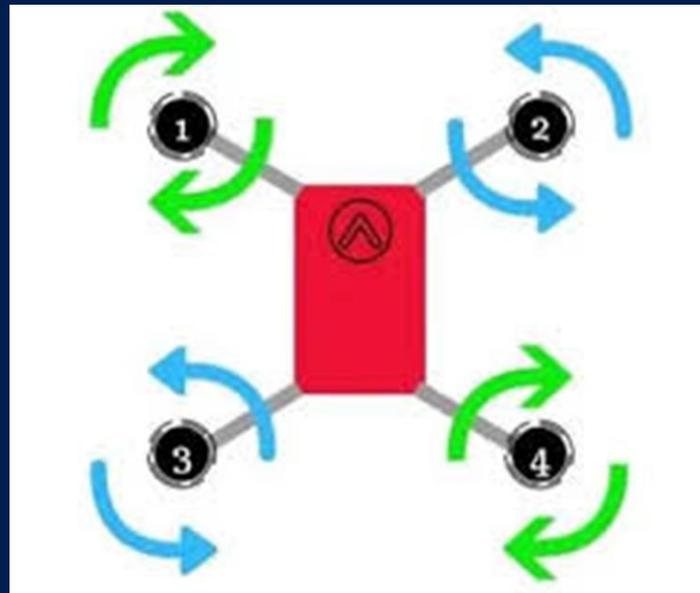
<https://youtu.be/uOQk8SJs06Q>



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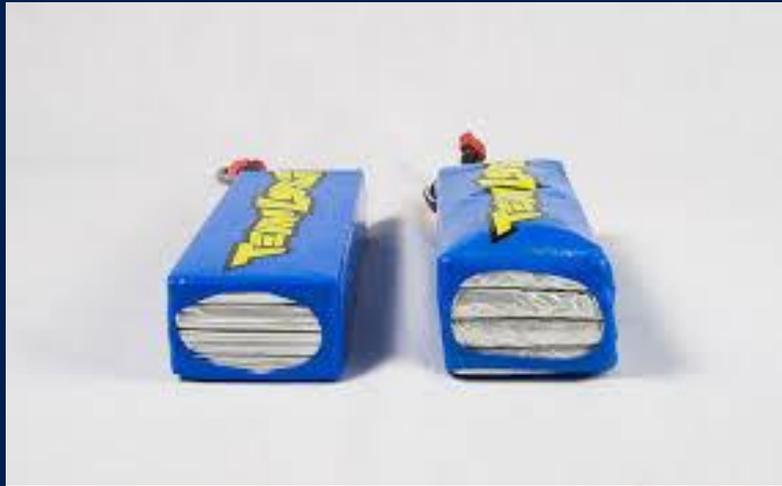
## Props! Props! Props!



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## Batteries



<https://www.droneomega.com/quadcopter-battery-guide/#lipo%20battery>



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## Frames



<https://dronenodes.com/how-to-build-a-drone/>

<https://www.ftstem.com/curriculum?fbclid=IwAR2F8jvFy7wr2wxFELM9u3klho7ylrvhf-mIL1Ndq8ttV1INPugTppiAmkU>

<https://all3dp.com/3d-print-drone-parts/>

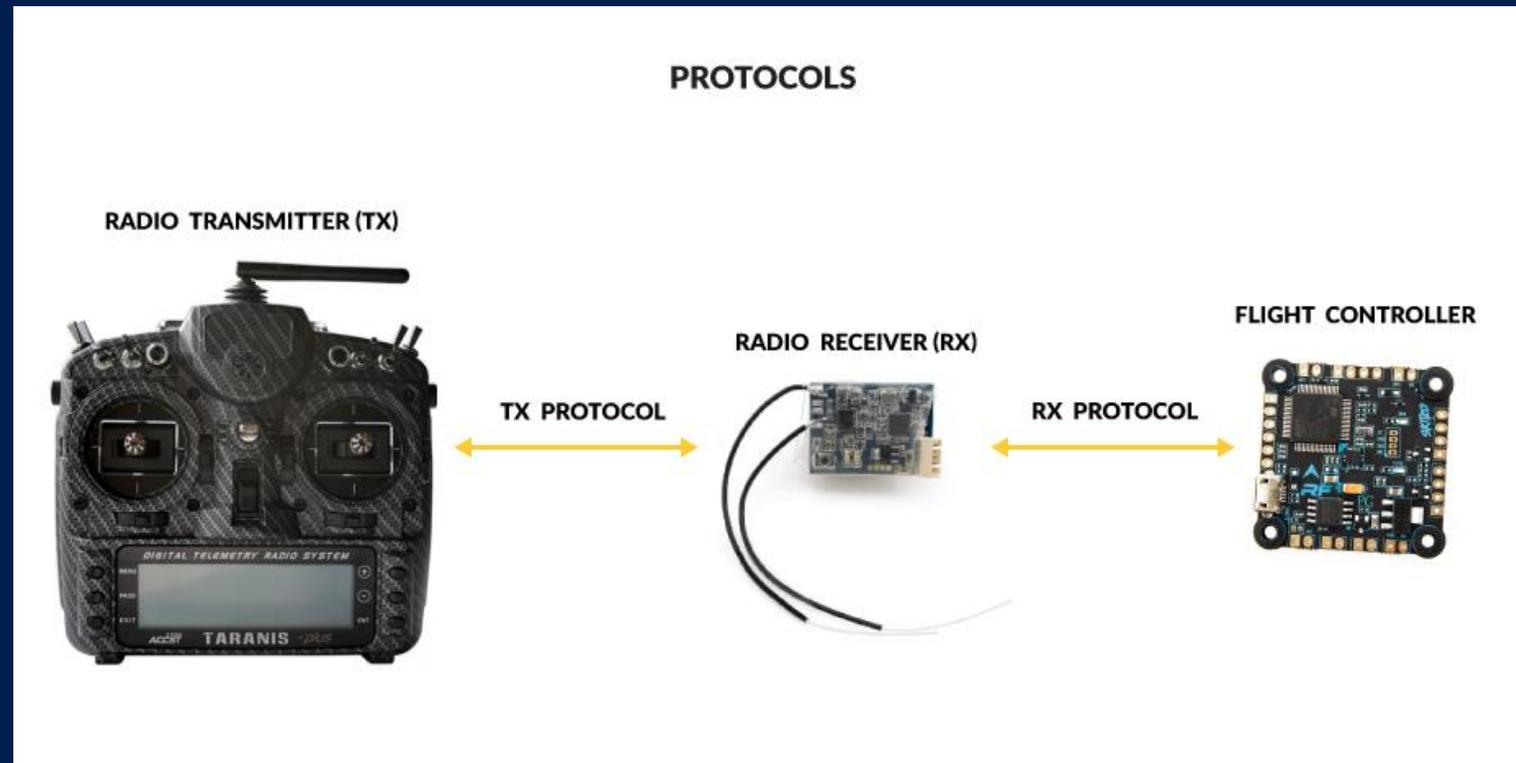


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## Transmitters/Receivers

Frequencies  
Protocols  
Telemetry  
Binding



<https://www.getfpv.com/learn/new-to-fpv/all-about-multirotor-fpv-drone-radio-transmitter-and-receiver/>



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# Questions???



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# Part 107 and What it Means to You



**Zack Nicklin**

**UAS Program Manager NCTC**

**UAS Director/Co-PI NCAT**

**[Zackary.Nicklin@northlandcollege.edu](mailto:Zackary.Nicklin@northlandcollege.edu)**



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# Drones are Regulated!

- 14 CFR Part 107 is the regulation governing *commercial* drone flights in the National Airspace System.
- All flights that are not recreational in nature are considered commercial by the FAA
- Recreational flights are guided by Advisory Circular 91-57B (AC91-57B)
- There are statutory provisions that allow some operations by higher education institutions to be classified as recreational in the 2018 FMRA (PL 115-254, Section 350)



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- Each aircraft must be registered and marked on the outside.
- Under 55lbs
- <100 mph
- VLOS
- Moving cars or over people 
- - 
- Yield to 
- Hazmat (batteries don't count) 
- Below 400ft AGL
- Permission needed for other than "G"  
[https://www.youtube.com/watch?v=tX2\\_G9jzeuc](https://www.youtube.com/watch?v=tX2_G9jzeuc)
- 1 aircraft = 1 RPIC



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## What is on the Test?

UAS Topics	Percentage of Items on Test
I. Regulations	15 – 25%
II. Airspace & Requirements	8 – 15%
III. Weather	11 – 16%
IV. Loading and Performance	7 – 11%
V. Operations	13 – 18%
<b>Total Number of Questions</b>	<b>60</b>



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# Steps to be Eligible to Certify

1. To be eligible to get your Remote Pilot Certificate, you must be:
  - At least 16 years old
  - Able to read, write, speak, and understand English
  - Be in a physical and mental condition to safely fly a UAS
2. Review the full process to get your Remote Pilot Certificate.
3. Study for the Knowledge Test by reviewing the Test Prep materials provided by the FAA.
4. Obtain an FAA Tracking Number (FTN) by creating an Integrated Airman Certification and Rating Application (IACRA) profile prior to registering for a knowledge test.
5. Schedule an appointment to take the Knowledge Test at an FAA-approved Knowledge Testing Center.
6. Once you've passed your test, complete FAA Form 8710-13 for a remote pilot certificate (FAA Airman Certificate and/or Rating Application) using the electronic FAA Integrated Airman Certificate and/or Rating Application system (IACRA)\*



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- Operation from a moving vehicle or aircraft (§ 107.25)
- Daylight operation (§ 107.29)
- Visual line of sight aircraft operation (§ 107.31)
- Visual observer (§ 107.33)
- Operation of multiple small unmanned aircraft systems (§ 107.35)
- Yielding the right of way (§ 107.37(a))
- Operation over people (§ 107.39)
- Operation in certain airspace (§ 107.41)
- Operating limitations for small unmanned aircraft (§ 107.51)



# Recreational Flight in the NAS

- Must be purely for fun (with limited exceptions)
- Under 400ft
- VLOS
- Permission for other than “G”
- 🌙 Required lighting
- Yield to ✈️
- No moving cars or over people
- Aeronautical Knowledge Test

**COMING SOON!**



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# Educational Exemption

- **INSTITUTION OF HIGHER EDUCATION.**—The term “institution of higher education” has the meaning given to that term by section 101(a) of the Higher Education Act of 1965 (20 U.S.C. 1001(a)).
- **(2) EDUCATIONAL OR RESEARCH PURPOSES.**—The term “education or research purposes”, with respect to the operation of an unmanned aircraft system by an institution of higher education, includes—
  - **(A)** instruction of students at the institution;
  - **(B)** academic or research related uses of unmanned aircraft systems that have been approved by the institution, including Federal research;
  - **(C)** activities undertaken by the institution as part of research projects, including research projects sponsored by the Federal Government; and
  - **(D)** other academic activities approved by the institution.



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# Educational Exemption Cont.

- Administration and especially insurance providers =



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Overwhelmed Yet?



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- Safety is still important
- Use nets or gym dividers
- Keep it to participants
- Use geofencing
- Prop guards



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# Additional Factors

- Drone Policy
- Who is in charge?
- Maintaining the equipment
- IT help (installs, upgrades)
- What is the goal of using drones in your program?
- Funding sources (budget)
- Know your modes (RTH, Atti, geofencing, etc)
- Local ordinances
- System Limitations

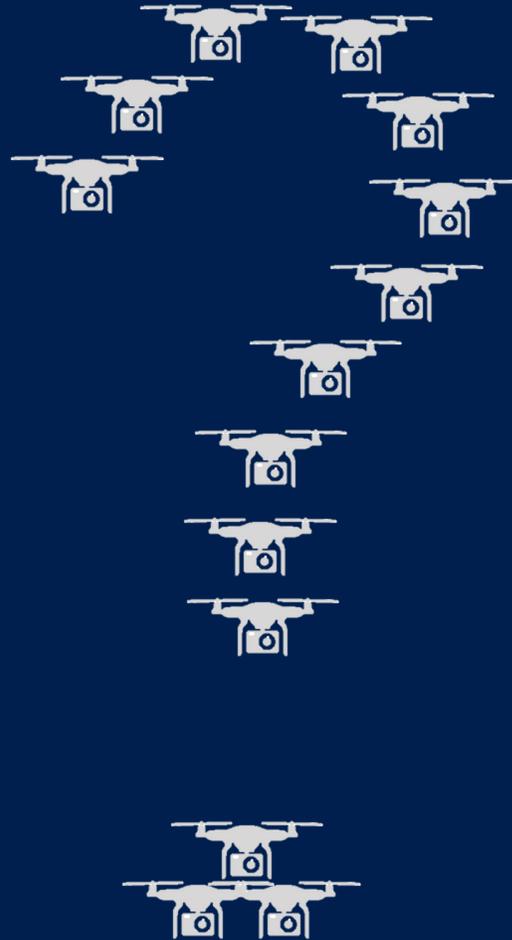


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**LUNCH BREAK!**  
**We will return at 12:45 CST**

<https://www.youtube.com/watch?v=Fl40XNdRpdQ>



# Drone Operations and Best Practices

Presented by

Tom Biller

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SPEEDMOTION  
FILMS

PRESENTS

# DRONE BLENDER



dji

PHANTOM



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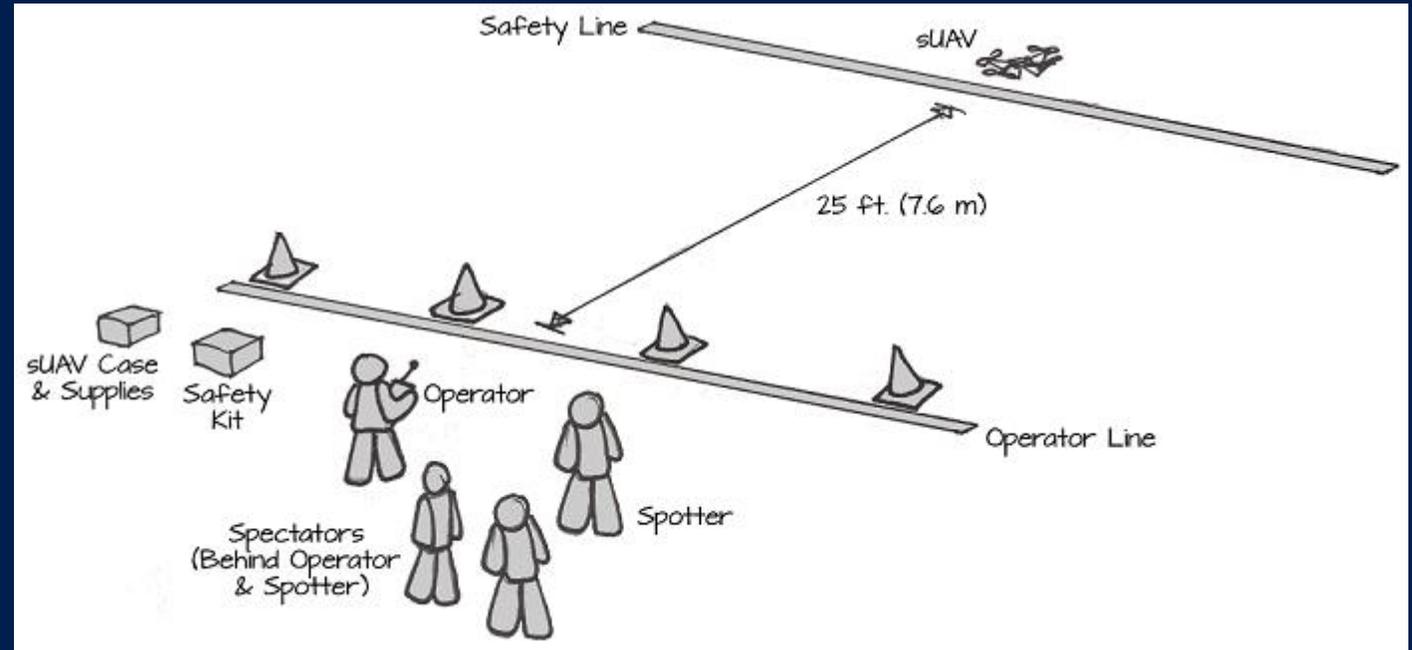
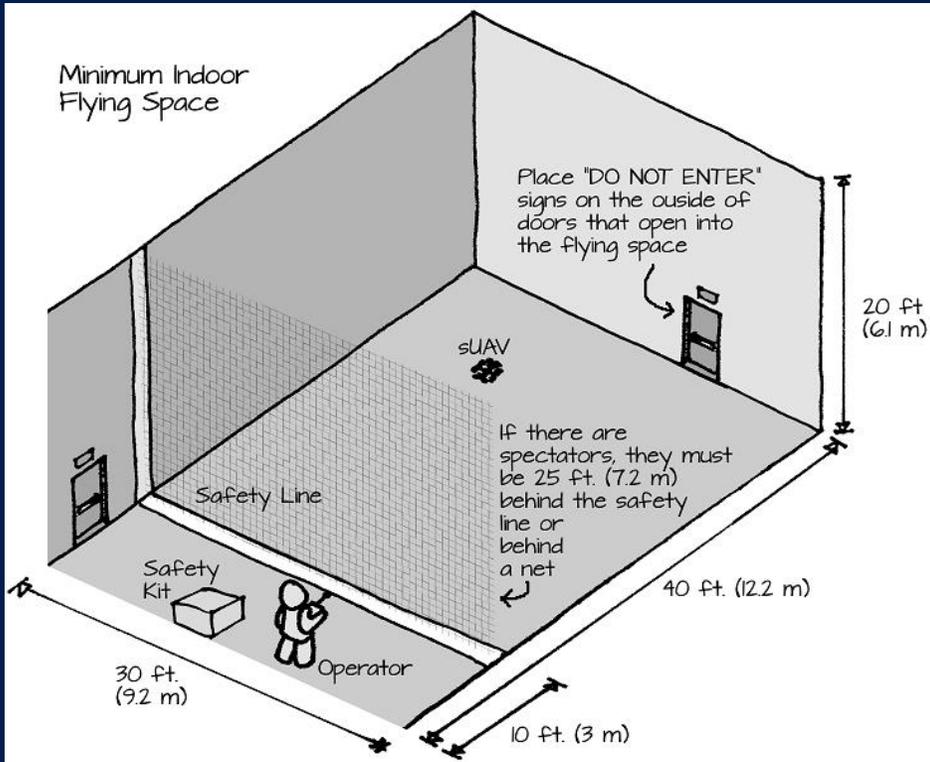
- Safety First!
- Read The Manual
- Log Books and Tracking Flight Hours
- Flight Simulators
- Pre-flight/post flight checklists



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## Safety First!



<http://learn.parallax.com/>



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# Read The Manual



[https://dl.djicdn.com/downloads/phantom\\_4\\_pro/Phantom+4+Pro+Pro+Plus+User+Manual+v1.0.pdf](https://dl.djicdn.com/downloads/phantom_4_pro/Phantom+4+Pro+Pro+Plus+User+Manual+v1.0.pdf)



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## Log Books

The image shows two identical forms for "UAS PILOT SAFETY & FLIGHT LOG". Each form contains the following fields:

- FLIGHT LOG #
- DATE
- TIME
- Daytime
- Night
- OPERATOR
- EXEMPTION #
- AIRCRAFT ID #
- SPOTTER/SAFETY PILOT
- LATITUDE/LONGITUDE
- LOCATION/CITY NAME
- FLIGHT TYPE
- MISSION
- EXPERIENCE
- SESSION LOG

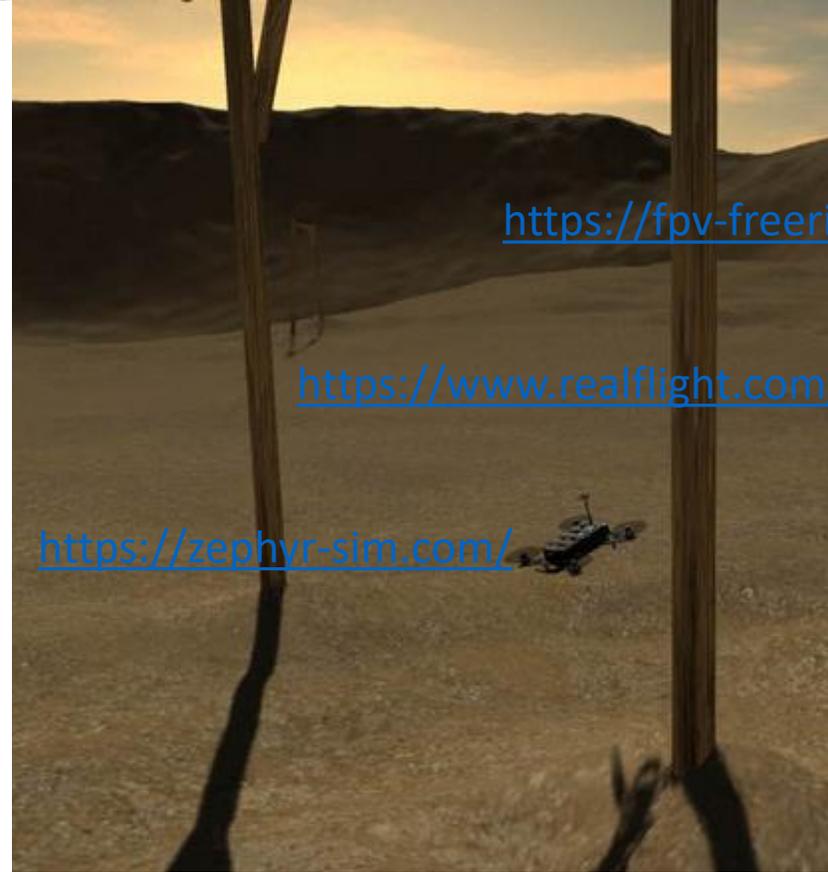
The "SESSION LOG" section includes a table with columns for #, FLIGHT TIMES (START, END, TOTAL), and NOTES, MANUEVERS, LOCATION... The BuzzItSafe.com logo, featuring a blue shield with wings and the text "DRONE", is overlaid in the center of the forms.

<https://thedronetrainer.com/free-drone-logbook/>



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<https://fpv-freerider.itch.io/fpv-freerider>

<https://www.realflight.com/index.php>

<https://zephyr-sim.com/>

# Flight Simulators



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## Pre/Post Flight Checklists



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# Questions???



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# Rise of the STEM Drones

Presented by

Tom Biller

Director, DroneTECH

[Thomas.biller@northlandcollege.edu](mailto:Thomas.biller@northlandcollege.edu)



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# Meet our Competitors..



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Under .5 lbs!!!  
Indoor Friendly  
Fly with phone  
Just plain Cute!

<https://dronepilots.community/>

		
<b>Drone</b>	<b>Mambo</b>	<b>Tello</b>
<b>Flight Time</b>	<b>10 minutes</b>	<b>13 minutes</b>
<b>Range</b>	<b>100 meters</b>	<b>100 meters</b>
<b>Camera</b>	<b>0.9 MP 720p (removable)</b>	<b>5 MP 720p</b>
<b>Image Stabilization</b>	<b>None</b>	<b>Electronic</b>
<b>Cost</b>	<b>\$110-180</b>	<b>\$99-160</b>
<b>Programming</b>	<b>Tynker</b>	<b>Scratch</b>
<b>Others</b>	<b>Cannon and Grabber modules available</b>	<b>EZ shot flight modes</b>



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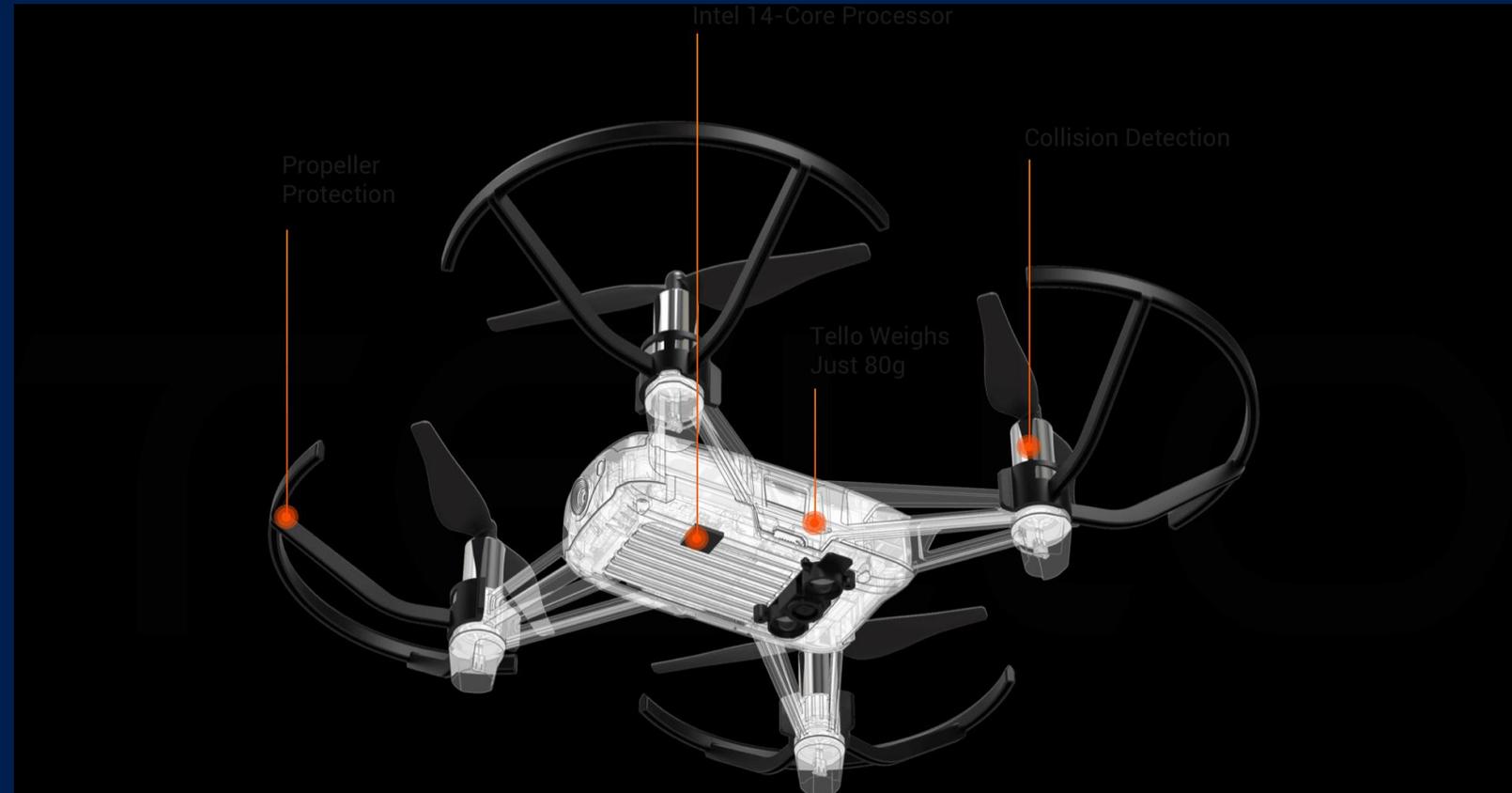


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## Ryze Tello

<https://www.ryzerobotics.com/tello>



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## Parrot Mambo FTW Robotics

<https://www.ftw-robotics.com/>



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# Questions???



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# STEM Drone Program on a Shoestring Budget

Presented by

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Director, DroneTECH

[Thomas.biller@northlandcollege.edu](mailto:Thomas.biller@northlandcollege.edu)



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# Funding???????

- Grants
- Sponsorship  
Local/Corporate
- Fundraising



<https://www.ncatech.org/>



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## STEM Drones and Future Skill Building

### Design and Engineering

<https://www.tinkercad.com/>

<https://www.autodesk.com/education/about-autodesk-education>

<https://www.thingiverse.com/>

## Electronics

<https://www.circuitlab.com/>

<https://learn.sparkfun.com/tutorials/using-eagle-schematic>

<http://www.ibiblio.org/kuphaldt/socratic/index.html>

## Coding

<https://edu.workbencheducation.com/>

<https://scratch.mit.edu/>



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# Budgeting a Basic Drone Program

- Each Drone can support up to 3 kids
  - Define roles: Pilot, Engineer, Safety/spotter (switch roles)
- Drone= \$100 - \$180 each for basic setup
- Flight Sims= Free - \$200 depending
  - Need right computer/controller; many mobile apps available
- Coding= free apps and pay versions available
- CAD software= Autodesk Free for schools/ tynker free for all
- 3D printers= \$200 and up/ don't forget materials cost!
- Curriculum= canned versus free



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# Questions???



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# Student Competitions

Presented by

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Director, DroneTECH

[Thomas.biller@northlandcollege.edu](mailto:Thomas.biller@northlandcollege.edu)



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# Robotics Aerial Drone (RAD)

REC

<https://www.roboticseducation.org/>

FTW Robotics



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# Aerial Response Competition (ARC)

Skills USA

<https://www.skillsusa.org/>

Pitsco Education

<https://www.pitsco.com/Our-Programs/>



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# Questions???



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# Surveys Happy Hour!!



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