

EIU - Rural School Initiative

Robots and Drones in the Classroom

October 27, 2022

[Zoom Link](#)

Integrating Problem Solving and Computational thinking



VISITOR SIGN IN School Name

Sign-In

with the secretary before signing in.

DATE	VISITOR'S NAME	REASON FOR VISIT	TIME IN	TIME OUT	SIGN / INITIAL
5/12	Michael Smith	Volunteer Tutoring	4:30	6:00	MS

The image shows a "VISITOR SIGN IN" form. It has a header with "VISITOR SIGN IN" and "School Name" (with a blank space for the name). Below the header is a note: "with the secretary before signing in." The form is a table with 6 columns: "DATE", "VISITOR'S NAME", "REASON FOR VISIT", "TIME IN", "TIME OUT", and "SIGN / INITIAL". The first row is filled with the example: "5/12", "Michael Smith", "Volunteer Tutoring", "4:30", "6:00", and "MS". There are 10 rows in total, with the first row being the example and the rest being empty.

Sign-In





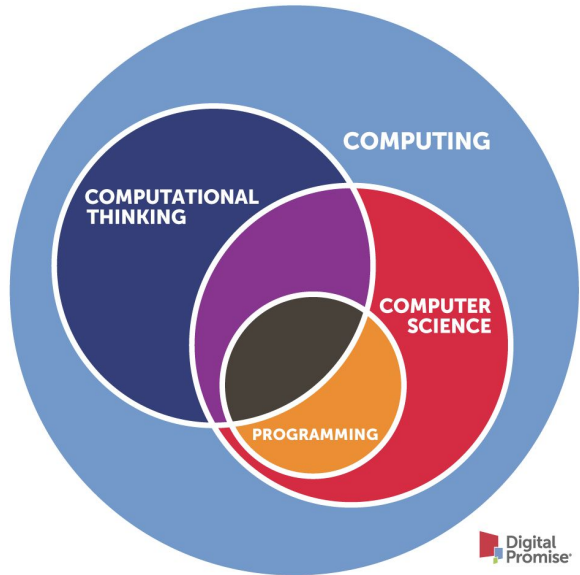
CREDIT to Illinois Learning Technology Center
(LTC) for base information.

Adapted from their Drones in the Classroom
program

Outline for Today

1. What is Computational Thinking
2. Coding and Logic
3. Using Robots as a hands-on coding application
 - a. Try out common classroom robots
4. Drones – robots that fly (more fun too)
 - a. Flying Drones
 - b. Safety and Legal Issues
5. Discussion - where do these fit into the curriculum?
6. Optional Next Steps

Computational Thinking



COMPUTATIONAL THINKING



P.B.L.

Problem Based Learning

Place Based Learning

Project Based Learning / Site Based Learning

Classroom Robots





Hands-on

- iRobot - pen and motion with sensors
- Sphero - general control and measurement
- Lego - large scale complex system
- Vex - battle bots and completion challenges
- – created a VR Robot option which uses the same coding.

Virtual Robots VEX-VR

- <https://www.vexrobot.com/>
- <https://www.youtube.com/>
- <https://vr.vex.com/>

The screenshot displays the VEX-VR software interface. At the top, there is a menu bar with options like 'File', 'TUTORIALS', 'LEARN', 'VR Bot', and 'HEXBUG'. Below the menu bar, the interface is divided into several sections:

- Code Editor:** Shows a block-based program starting with 'when started', followed by a 'repeat' loop of 4 iterations. Each iteration contains 'drive forward for 200 mm' and 'turn right for 90 degrees'.
- Code Viewer:** Displays the corresponding Python code for the block-based program.
- Block Palette:** A sidebar on the left containing various programming blocks categorized by function: Drivetrain, Magnet, Looks, Events, Control, Sensing, Operators, Variables, My Blocks, and Comments.
- Grid Map:** A 3D view of a virtual robot on a grid. A table above the grid provides sensor data.

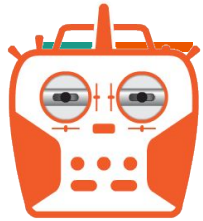
Heading	Rotation	Front Eye	Down Eye	Location	Location Angle	Bumper	Distance
180°	180°	Object: False Color: None	Object: False Color: None	X: -700 mm Y: -700 mm	180°	Left: False Right: False	245 mm

At the bottom right of the interface, there is a 'Convert to Text Project' button.

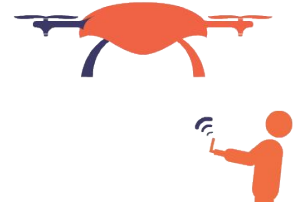
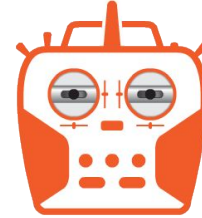


Drones (unmanned aerial vehicles)

- Drones are Robots that “fly”
- Have AI to manage basic aerodynamics, so they are easy to fly
- Data Collection system
- Manual Control
- Automate or pre-program flight path
- Applicable to classroom uses

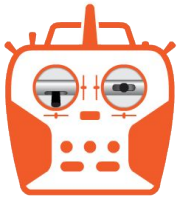


How do drones fly?



Rotation around the front-to-back axis is called **roll**. – Right stick left or right

Rotation around the side-to-side axis is called **pitch**. – Right stick forward or backward



Throttle controls lift. – Right stick up and down



Rotation around the vertical axis is called **yaw**. – Left stick left or right



Different Types of Drones from DJI

- 1) Tello
- 2) DJI Mini
- 3) DJI Mavic Air
- 4) Air 2S



What's a Tello box appropriate for Classroom (\$150)

1. DJI Tello
2. 3 Batteries
3. Multi-Battery Charger
4. Charging Cord
5. Extra propellers

Drone Terminology

- UAV – Unmanned Aerial Vehicle
- UAS – Unmanned Aerial System
- Quadcopter – Aircraft that uses four motors and four propellers
- PIC – Pilot In Charge
- Transmitter (TX) -- A hand-held controller that sends a signal to the drone
- Gimbal -- A platform that can pivot on a single axis; creates a balanced, smooth movement for the camera during flight
- Autonomous Flight -- Aircraft is self-directed and programmed to fly independently, not physically or manually controlled
- First Person View (FPV) -- Also known as remote-person view (RPV), or simply video piloting
- Manual Flight – Transmitter is used by PIC and aircraft is kept in line of sight

Hands on with Drones

GPS

Aerodynamics

Sensors to manage stable flight

Communicate using WiFi for distance



Education Guidelines

As of May 5, 2016, the use of unmanned aircraft systems by students in accredited education institutions as part of their coursework will be allowed under recreational guidelines for model aircraft, provided the aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization

The interpretation also clarifies that UAS can be operated for demonstration purposes at community-sponsored events, provided that the aircraft operator does not receive any compensation, directly or indirectly, related to the operation of the aircraft.

Students can learn how to design, construct and operate small unmanned aircraft (less than 55 pounds) as a component of a variety of science, technology and aviation-related coursework or for other educational purposes such as in connection with television, film or photography courses. These uses fall under hobby or recreational use, according to the FAA's interpretation, and schools and students should follow all the same [protocols as a hobbyist](#).

Federal sUAS

Laws & Guidance

All UAS over 0.55 LBS must be registered with the FAA and properly labeled before flight.

Drone Safety

FAA guidelines

Sect 107 license

Basic license for hobby and school

Weight limits and need to register

LOCATION limits

Weather issues

Time of Day

The following federal laws and guidelines are provided for operators of UAS:



Operate UAS within visual sight at all times



Do not fly under the influence of alcohol or drugs



Contact the airport or air traffic control tower if within 5 miles of an airport



Must remain clear, and yield to all manned aircraft operations



Operate UAS no higher than 400 feet and remain below surrounding obstacles



Do not fly near or over sensitive infrastructures (e.g., power stations, correctional facilities)



Do not fly in adverse weather conditions such as high winds or reduced visibility



Do not fly a UAS if it has not been registered with the FAA and properly labeled



Never fly near emergency response efforts



Do not fly over people



Never Fly over stadiums or sporting events



Do not fly in national parks

TRUST

The Recreational UAS Safety Test

All recreational flyers must pass an aeronautical knowledge and safety test and provide proof of test passage (the TRUST completion certificate) to the FAA or law enforcement upon request. The [FAA's 2018 Reauthorization Bill](#) (PDF) introduced new requirements for recreational pilots (see P.L. 115-254, [Section 349](#) (PDF) – exception for limited recreational operations of unmanned aircraft).

Let's take The Recreational UAS Safety Test



The Recreational UAS Safety Test



Boy Scouts of America® is an [FAA-approved Test Administrator of The Recreational UAS Safety Test](#) (TRUST).

TRUST is a collaboration between the FAA and industry to provide TRUST and educational safety material to Recreational Flyers.

Recreational flyers can access the [TRUST here](#)

Testing Instructions:

- ✔ Be sure you are not in an incognito browser
- ✔ You must stay within the Exam window throughout your exam
- ✔ You must answer all Exam questions. You can not skip exam questions
- ✔ Once you have completed the test, remember to print or save a digital copy of your completion certificate
- ✔ When printing the certificate, it should be wallet size
- ✔ When emailing the certificate, ensure you are sending it to a valid email address
- ✔ Please access the test through the button below.

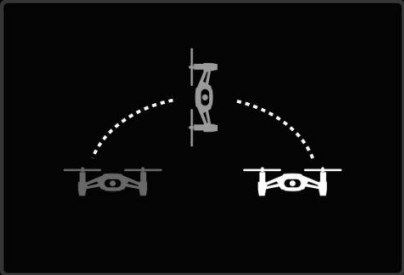
[BEGIN EXAM](#)

Tello Flight Modes

< Flight Modes


Flight Modes

i



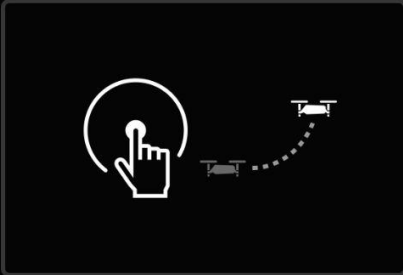
8D Flips

Slide on the screen to flip in up to eight different directions.



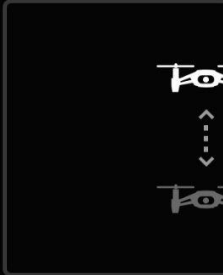
Throw & Go

Toss the aircraft, and it will hover in place.



Up & Away

Record a short video while flying upward and backward.



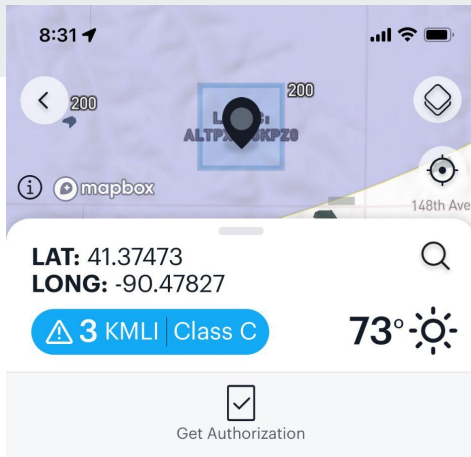
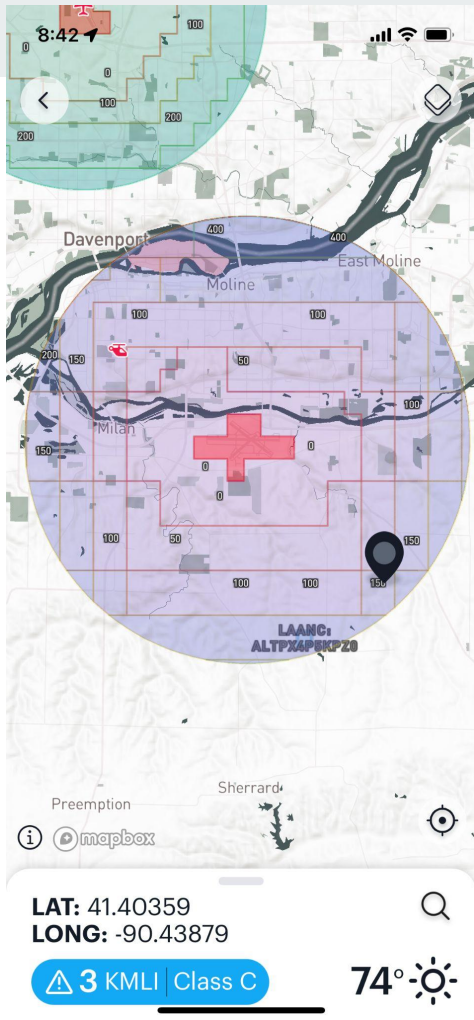
Bounce Mode

Automatically fly up and down 1.2 meters of a flat aircraft.



HS 0.0m/s H 0.0m



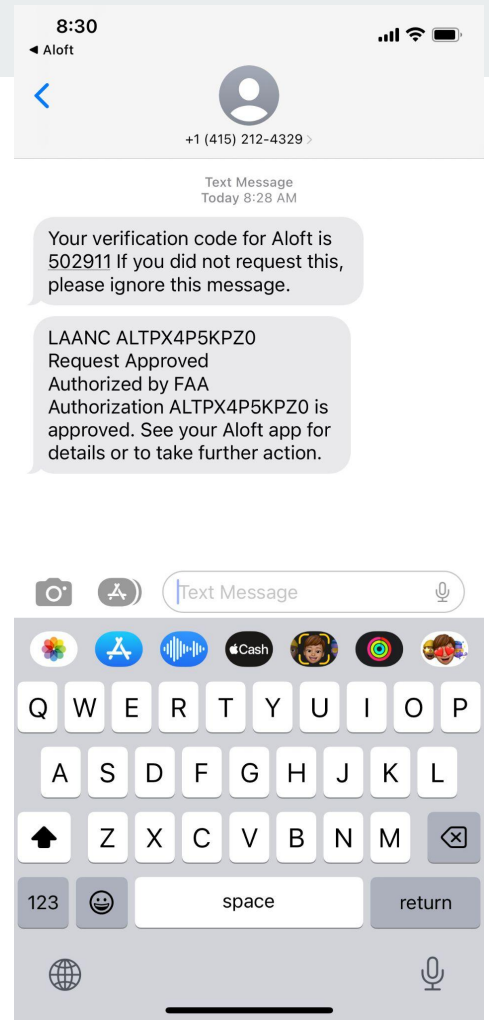


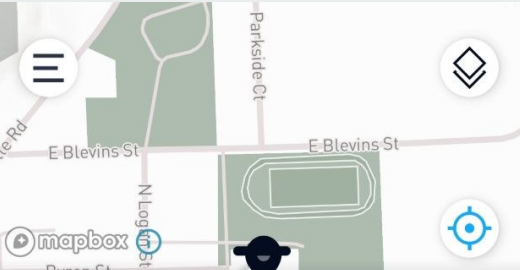
Airspace Weather

LAANC ALTPX4P5KPZO
Starts in 1 minute. [more](#)

UAS Facility Map
Permissible altitude for authorization: 200 ft. [more](#)

MOLINE CLASS C
Class: C [more](#)





Air Control & Weather

Home Missions LAANC

LAT: 39.65782
LONG: -88.02112
38° | ☀️

Airspace Weather

Summary 38° Clear
Wind 8mph From E
Gusts 15mph
Visibility 10.00mi

FLY



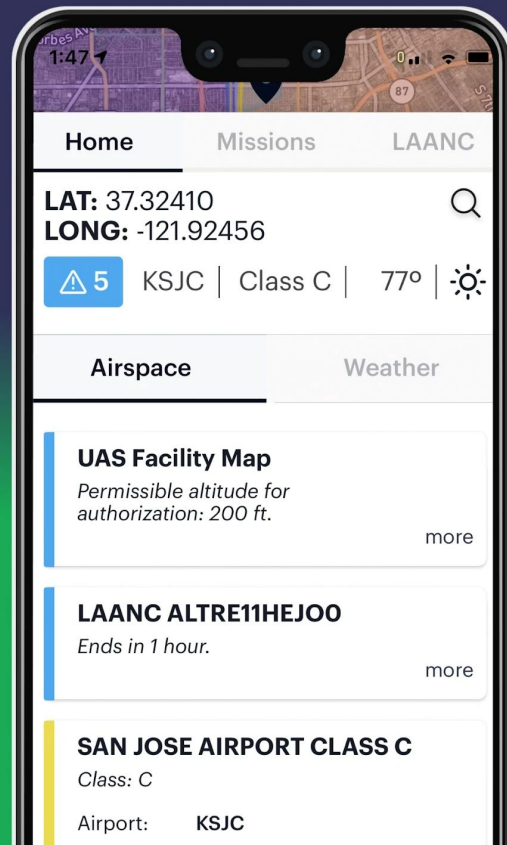
ALOFT - Air Control (app)

Air Space Restrictions

Weather Details

Nearby Sensitive Areas

View authorizations directly from Dynamic Airspace



Drone Blocks

Pre-Program the flight path

The screenshot displays a programming interface for a drone, with a sidebar on the left and a main workspace on the right. The sidebar contains a vertical stack of colored blocks representing different categories: Takeoff (dark blue), Navigation (green), Camera (light blue), Loops (yellow), Logic (red), Math (purple), Variables (pink), and Land (orange). The main workspace shows a sequence of blocks starting with a 'take photo' block. This is followed by a 'repeat 9 times' loop block. Inside the loop is a 'do' block containing several steps: 'set gimbal-pitch' (with a tooltip 'Sets this variable to be equal to the input.'), 'set distance to' (using a 'cos' block and a 'gimbal-pitch' block), 'set altitude to' (using a 'sin' block and a 'gimbal-pitch' block), 'set fly to' (using a 'temp-distance' block and a '-' block), 'set temp-distance to' (using a 'distance' block), 'change altitude to' (using an 'altitude' block and 'ft'), 'fly forward' (using a 'fly' block, 'ft at 12 mph'), 'pitch gimbal to' (using a 'gimbal-pitch' block and 'degrees'), and finally another 'take photo' block.

Takeoff

Navigation

Camera

Loops

Logic

Math

Variables

Land

take photo

repeat 9 times

do

set gimbal-pitch Sets this variable to be equal to the input.

set distance to \cos gimbal-pitch

set altitude to \sin gimbal-pitch

set fly to temp-distance -

set temp-distance to distance

change altitude to altitude ft

fly forward fly ft at 12 mph

pitch gimbal to gimbal-pitch degrees

take photo

**How would you use Robots and
Drones with your students?**

Skills that children develop thanks to educational robots



Creativity and imagination



Pro-active spirit



Teamwork



Adapting to the future



Learning from mistakes



Self-assesment of their own performance



Self-esteem



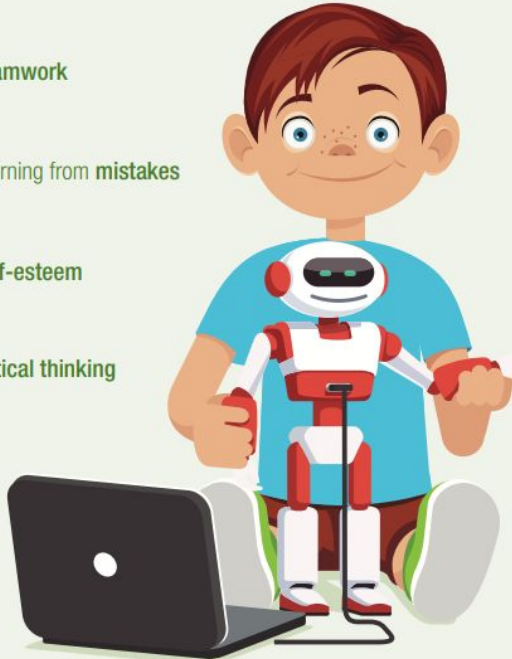
Motivation for learning



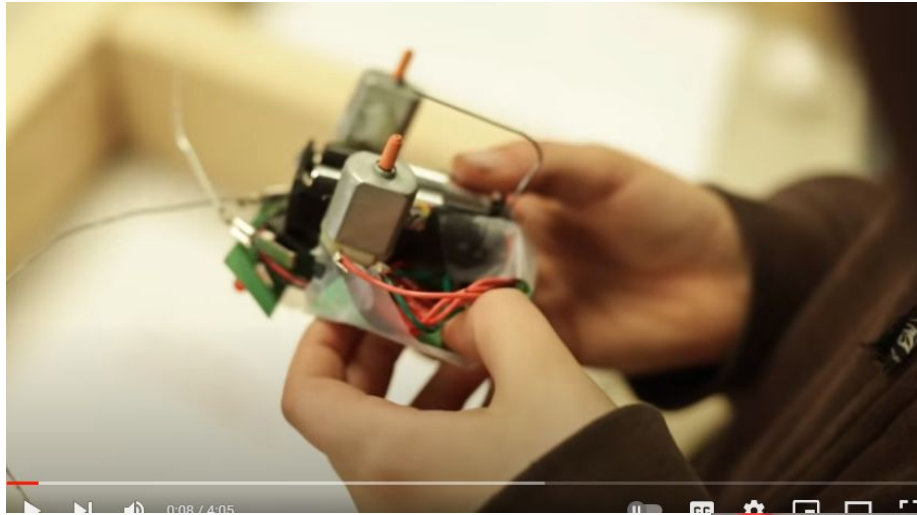
Critical thinking



Developing new ways of communication



Classroom Curriculum



Robots



<https://www.youtube.com/watch?v=OIYwHNKN-qw>

<https://twitter.com/i/status/1585416732025683975>



Drones with your Students - demos and ideas

- MS Snips - <https://www.youtube.com/watch?v=g3GwdvacAuc>
- Drones in STEAM - <https://www.youtube.com/watch?v=RgQZtiFBEgw&t=242s>
 - Drone legends curriculum
- DIY Drone - <https://www.youtube.com/watch?v=irFBko3k49w>
- MATH integration with aviation - Kelly Remijan - https://digitalcommons.imsa.edu/pfs_pr/41/
- Green Leaf Project - <https://greenleaf.unl.edu/> (drought)
- Harvard Forest Canopy Camera -
<https://harvardforest.fas.harvard.edu/news/harvard-forest-forest-canopy-camera-installed>
 - <https://harvardforest.fas.harvard.edu/webcams>
- FEMC - https://www.uvm.edu/femc/data/archive/project/webcams_monitor_leaf_phenology



History, Geography, Geology -> MAPS

Drone Mapping

- <https://yourdronereviews.com/best-free-drone-mapping-software>
- <https://www.suasnews.com/2022/10/skyebrowse-to-offer-free-3d-modeling/>

Q&A plus Wrap-up



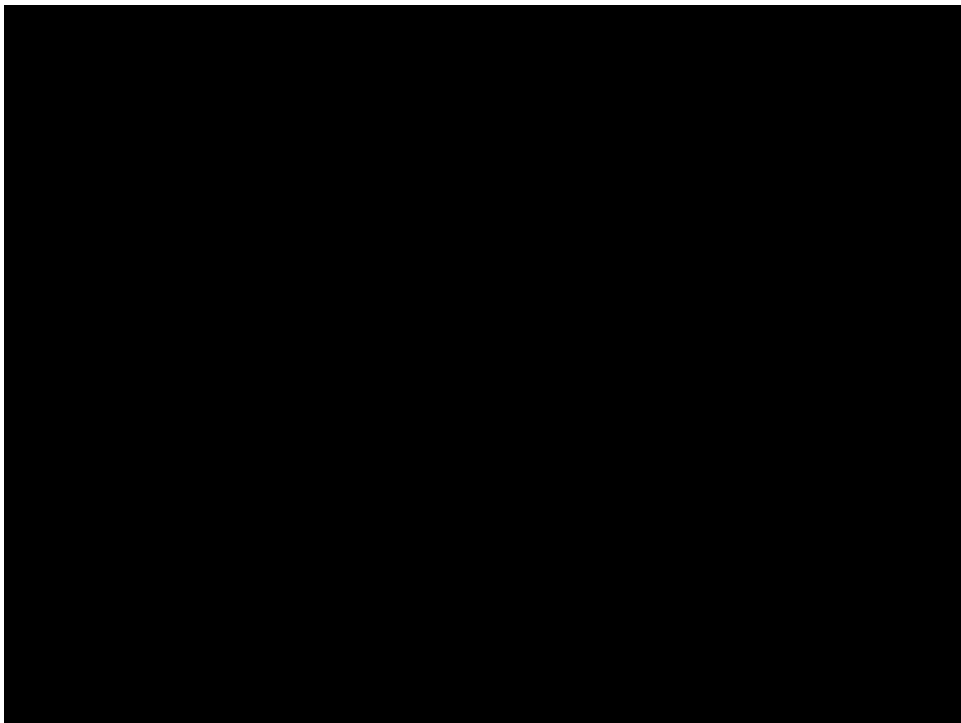
Extra Slides follow from here. They're from the LTC presentation which was drones only and a half day session.

They contain high interest drone videos and a wealth of links to drone resources.

Uses For Drones

- Flying for fun
- Drone racing
- Aerial photography
- Forest Firefighting
- Building/Tower inspections
- Bridge inspections
- Shark spotting
- Police/Fire Department use
- Search and Rescue
- Crop inspections
 - DJI Agriculture App
- Aerial mapping
- Hospital blood/organ delivery
- Amazon Drone Delivery
- Many, many more





[Drones for Spraying Part 137 Information](#)









Drones in the Classroom Resources

LTC Resources

Drones in the Classroom For Teachers

As you or your district considers bringing drones into the curriculum, please take advantage of these curated resources.



Safety Guidelines and Certifications

- [Academy of Model Aeronautics](#) - Safety guidelines from the AMA for all drone users
- [List of Drone Laws for the USA](#)
- [Educational Guidelines](#) - Amended guidelines for Educators
- [The Recreational UAS Safety Test](#) - Test Required for all drone pilots
- [FAA Certified Remote Pilot 107 Certification](#) - Certification for commercial drone piloting
- [Illinois Specific Drone Laws](#)

Drones in the Classroom Resources


- [Drone Pilot Ground School Partners with Pleasant Valley High School to Launch Afterschool Drone Program](#) - Drone Pilot Ground School
- [Drone Pilot School Part 107 training for students](#) - Resource
- [Drones in Education](#) - Chris Carnahan
- [Teach STEM Drone Racing Curriculum](#)

Drone Uses

- Flying for recreation
- [Drone racing](#)
- [Aerial photography](#)
- [Forest Firefighting](#)
- [Building/Tower inspections](#)
- [Bridge inspections](#)
- [Shark spotting](#)
- [Police/Fire Department use](#)
- [Search and Rescue](#)
- [Crop inspections](#)
- [Aerial mapping](#)
- [Hospital blood/organ delivery](#)

- [Know Before You Fly](#) - Online Drone Learning Resource
- [AMA Flight School](#) - Self-paced course for learning about drones
- [Lesson Plans for Drones](#) - Article
- [Robotics Education Takes Flight](#) - Article
- [Drones Take Their Place in the K-12](#)

Tips

- 
- Start With Realistic Expectations
 - Spend Only What You Can Afford to Lose
 - Become a Skilled PIC
 - Practice and Fly Regularly Even as an Expert
 - Hobby First, Curriculum Next
 - Buy Extra Batteries, Propellers, and Guards
 - Use YouTube for your Specific Drone(s)
 - Join a Community and Share
 - Research, Research, Research
 - Follow All Safety Rules


Apps to Download



- a. [Tello App](#) - iOS
 - i. [Tello](#) - Android (be sure to go to the DJI site linked here as it will take you to the newest version of the app.)
- b. [Drone Blocks](#) - iOS
 - i. [Drone Blocks](#) - Android
 - ii. [Drone Blocks](#) Chrome Extension
- c. [Aloft](#) - iOS
 - i. [Aloft](#) - Android

Rules for Flying

What are the safety guidelines for sUAS recreational users?

- 
- Follow community-based safety guidelines, as developed by organizations such as the [Academy of Model Aeronautics](#) (AMA).
 - Fly no higher than 400 feet and remain below any surrounding obstacles when possible.
 - Drones cannot fly faster than 100 mph
 - Keep your sUAS in eyesight at all times, and use an observer to assist if needed.
 - Remain well clear of and do not interfere with manned aircraft operations, and you must see and avoid other aircraft and obstacles at all times.
 - Drones cannot be flown at night

Recreational Safety 2

- Do not intentionally fly over unprotected persons or moving vehicles, and remain at least 25 feet away from individuals and vulnerable property.
- Use Aloft to confirm you can fly within range of an airport or heliport. (Read about best practices [here](#))
- Do not fly in adverse weather conditions such as in high winds or reduced visibility.
- Do not fly under the influence of alcohol or drugs.

[Full set of FAA Operating Rules](#)

Recreational Safety 3



- Ensure the operating environment is safe and that the operator is competent and proficient in the operation of the sUAS.
- Do not fly near or over sensitive infrastructure or property such as power stations, water treatment facilities, correctional facilities, heavily traveled roadways, government facilities, etc.
- Check and follow all local laws and ordinances before flying over private property.
- Do not conduct surveillance or photograph persons in areas where there is an expectation of privacy without the individual's permission (see AMA's [privacy policy](#)).



What is a commercial use of UAS?

Any commercial use in connection with a business, including:

- Selling photos or videos taken from a UAS
- Using UAS to provide contract services, such as industrial equipment or factory inspection
- Using UAS to provide professional services, such as security or telecommunications
- Using UAS to monitor the progress of work your company is performing



What are some examples of commercial uses of UAS?

- Professional real estate or wedding photography
- Professional cinematography for a film or television production
- Providing contract services for mapping or land surveys

Using Aloft to Confirm a Flight Plan



Get to know the Tello



Coding the Tello!



Let's go fly!



Possible Next Steps



Cost Factors in Drones

- Size
- Weight
- Camera
- Battery Time
- Autopilot
- Return To Home (RTH)
- Wind Tolerance
- Payload
- GPS

Drone Options

Starter Drones

[Ryze Tech Tello](#) - \$149.99

[UDI U818A-HD](#) - \$43.99

[RoboMasterTT](#)

[Class Set of Drones](#)

Racing Drones

[Tinyhawk 2](#) - \$129.99

Coding Drones

[CoDrones](#) - \$215

Mid Level Drones

[DJI Mini 2](#) - \$499

[DJI Mini SE](#) - \$299

High Level Drones

[DJI Mavic Air 2](#) - \$999

[DJI Phantom 4 Pro](#) - \$1,599

[DJI Mavic 3](#) - \$2,199