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ROBOTICS

Soaring High: Integrating Drones into STEAM E

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Soaring High:

Integrating Drones into STEAM Education for Piloting and Coding

Anabel Basualdo
Curriculum Support Specialist
Miami-Dade County Public Schools
basualdo@dadeschools.net

For information concerning Ideas with IMPACT opportunities including Adapter and Disseminator grants, please contact:
The Education Fund
305-558-4544, Ext. 113
Email: audrey@educationfund.org
www.educationfund.org

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1. Goals and Objectives

This curriculum empowers students to:

- **Understand and apply the fundamentals of drone piloting and block-based coding.**
- **Integrate STEAM concepts through hands-on, project-based learning.**
- **Demonstrate safe drone operations and knowledge of FAA guidelines.**
- **Explore real-world STEAM careers connected to drone technology.**
- **Engage in collaborative problem solving, design thinking, and critical reflection.**

By the end of the unit, students will be able to:

- **Pilot a drone safely and accurately in a designated zone.**
- **Program drones using block-based logic to complete flight missions.**
- **Apply the engineering design process to develop drone-based solutions.**
- **Analyze flight performance data and reflect on mission outcomes.**
- **Articulate how drone technology is used in various industries.**

2. Florida Standards

Mathematics Standards (B.E.S.T.)

Grade 6 – Geometry and Measurement

MA.6.GR.4.1
Plot, identify and describe ordered pairs in all four quadrants of the coordinate plane.

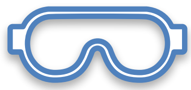
- **Students apply coordinate graphing skills to move the drone to specific locations.**

High School – Geometry (Grades 9–12)

MA.912.GR.7.1
Apply geometric concepts to model and solve real-world problems involving area, surface area, circumference, volume, and angle measures.

- **Students use spatial reasoning and distance estimation to model flight paths and navigate accurately within a mapped space.**

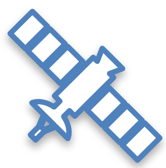
Science Standards (NGSSS)



Grade 6 – Nature of Science

SC.6.N.1.1
Define a problem, plan and carry out scientific investigations.

- Students approach drone navigation as an iterative scientific process involving testing and refinement.



Grade 6 – Physical Science

SC.6.P.12.1
Measure and graph distance versus time for an object moving at a constant speed. Interpret this relationship.

- The drone's motion can be graphed and analyzed for time-distance relationships.

Grade 7 – Nature of Science

SC.7.N.1.6
Explain that a scientific theory is a well-supported and widely accepted explanation of nature and is not simply a guess or hunch.

- Students can discuss how theories (e.g. flight, motion) are based on repeated evidence from investigations such as drone performance.

High School – Nature of Science

SC.912.N.1.3
Recognize that the strength of scientific claims is based on empirical evidence from observations and data.

- Students collect drone navigation data (e.g., time, distance, errors) and analyze performance to support conclusions.

ELA Standards Alignment (Florida B.E.S.T. – Grades 6–8)

1. ELA.6.C.1.4 – Write expository texts about a topic, using multiple sources and including an organizational structure, relevant elaboration, and varied transitions.

✍ Students explain their drone’s backstory and purpose using clear, structured writing.

2. ELA.6.C.1.3 – Write to narrate a fictional or autobiographical experience using a logical sequence of events, appropriate descriptions, and transitional words and phrases.

🚁 Students create a fictional persona for their drone and write its "origin story."

3. ELA.7.C.1.5 – Improve writing by planning, revising, and editing with guidance.

✨ Students refine their drone's introduction and flight narrative through peer feedback.

4. ELA.8.C.4.1 – Conduct research to answer a question, drawing on multiple reliable sources, and refocusing the inquiry when appropriate.

🔍 Optional: Students could research real-world drone use to inspire their drone's name/purpose (e.g., search & rescue, delivery, filmmaking).

5. ELA.7.V.1.3 – Use context clues, figurative language, word relationships, reference materials, and/or background knowledge to determine the meaning of academic and domain-specific words.

Computer Science Standards (Florida CSTA-Aligned)

Grades 6–8

- **SC.68.CS-CS.1.2: Create a program using sequencing, selection, and repetition.**

Students use loops and conditionals to build navigation code.

- **SC.68.CS-CS.2.4: Debug and revise programs to ensure accuracy and efficiency.**

Students test and refine their drone flight programs based on target accuracy.

- **SC.68.CS-CS.3.1**

Demonstrate how automation impacts everyday life.

Students simulate autonomous navigation, modeling real-world drone applications.

Career & Technical Education (CTE)

Middle School – Introduction to Technology (Course Code: 0103010)

- **Standard 04.0: Use tools and processes to complete a design project.**

Students design and test flight algorithms to solve a spatial problem.

- **Standard 06.0: Understand technological systems including transportation, communication, and manufacturing.**

Students explore how drones function as transportation systems within modern technology.

Middle School – Creativity & Design Thinking

- **TE.6.CG.1.2: Evaluate how advancements in technology have impacted the way humans design, produce, use, and assess products and systems.**

Students examine how drones and automation have transformed delivery, surveying, and emergency response systems.

Middle School – Engineering & Entrepreneurship

- **TE.8.EE.3.1: Apply a design process to solve a problem and detail the steps followed in the process.**

Students follow the engineering design process: define the goal (coordinate target), plan, code, test, and reflect.

3. Course Outline / Overview

This project empowers educators to integrate drones into STEAM curriculum. Students will learn to safely pilot drones and code flight sequences while applying engineering design thinking, mathematical reasoning, and scientific principles. The program nurtures hands-on learning, critical thinking, creativity, and exposure to STEAM careers. Designed for students in grades 6–12, blending theory and practice through real-world applications in drone piloting and coding.

What Students Will Do:

- Learn about drone mechanics, components, and functions
- Study the science behind flight: aerodynamics, thrust, and stability
- Engage in safe piloting practice using CoDrone EDU indoors
- Code drone flight missions using block-based platforms (Blockly or DroneBlocks)
- Apply the engineering design process to plan and execute custom drone missions
- Analyze performance data from drone flights
- Research and present on drone applications across industries
- Compete in drone design challenges or simulations (optional: school/district events)

Instructional Approach:

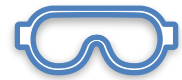
- Project-Based Learning (PBL)
- Cross-curricular integration (science, math, tech, art)
- Student-centered collaboration
- Focus on real-world relevance and career pathways
- Scaffolded piloting and coding instruction — no prior experience required

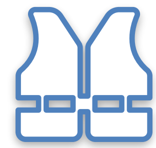
Connection to Student Outcomes:

- This course fosters critical thinking, digital fluency, teamwork, and problem-solving. Students build confidence through iterative learning, learn to work within safety and legal constraints, and gain insight into high-demand career fields in robotics, automation, aviation, and environmental science.

4. Lesson Plans

TOOLBOX LESSON 1: First Flights & Flight Safety





Grade Level: 6–12
Duration: 60 minutes

Materials Needed:

- CoDrone EDU drones (1 per 2–4 students)
- Charged tablets/Chromebooks with Blockly
- FAA Quick Guide (printed or projected)
- Drone Safety Checklist (printed handout)
- Tape or cones to mark flight zones
- Whiteboard or projector
- Student Flight Log template

OBJECTIVE:

Students will demonstrate safe drone piloting techniques, identify the main components of a drone, and reflect on the importance of safety protocols in accordance with FAA recreational guidelines.

STEP-BY-STEP IMPLEMENTATION

1. Welcome & Safety Hook (5 min)

- Project an image or short video clip of a drone malfunction or fail. Ask:
  "What went wrong here? Could this happen to us?"

- Let students guess and spark interest in safety. Introduce the day's objective.

2. Drone Safety Protocol Walkthrough (10 min)

- Distribute or project the Drone Safety Checklist and FAA Quick Guide.
- Lead a whole-class walkthrough of the checklist:
  - Battery charged?
  - Propellers secure?
  - Takeoff zone clear?
  - Hands off until flight command is issued

- Add classroom-specific rules like: “No flying above waist height,” or “Only one drone flying per team.”

Optional: Have students initial or check off each item as they prep.

3. Introduction to the Drone (10 min)

- Hold up a CoDrone and point out key components:
  - Motors
  - Propellers
  - Battery pack
  - Sensors
  - LED lights
- Ask students to sketch their drone and label each part in a mini anchor chart.

4. Setup Indoor Flight Zones (5 min)

- Use masking tape or safety cones to mark:
  - Launch/landing pads
  - No-fly boundaries
  - Safe waiting area
- Assign roles within each team (Pilot, Safety Monitor, Observer, Programmer)

5. First Flight Challenge (20 min)

- Launch the Blockly coding environment: https://codrone.robolink.com/edu/blockly/
- Click on the How to Connect link at the bottom of the page and watch the video. Follow instructions to connect your drone to Blockly.
- Model a simple block sequence:
  Takeoff → Hover → Land
- Have students replicate, test, and then modify with small changes (e.g., hover time or forward movement)

Beginner Tip: Use the “launchpad” approach—everyone takes off from the same square, hovers in place, then lands again.

6. Reflect & Log (5–10 min)

- Ask students:
  “What went well? What surprised you? How did you feel during flight?”

- Students complete a Flight Log Entry:
  - Today's flight goal
  - Flight steps/code
  - Safety success
  - Areas for improvement

ASSESSMENT CHECKPOINTS

- Observed student use of safety protocols
- Participation in setup, flight, and cleanup
- Completion of safety checklist
- Reflection entry in Flight Log

Extension Activity: Name That Drone!

Objective:
Build ownership, creativity, and engagement by having students name their drone and program it to perform a short "hello" flight sequence.

Instructions (for students):

1. Give your drone a name and write a quick backstory:
   - Why did you choose that name?
   - What kind of personality would your drone have?
2. Program a "hello" flight:
   - It can be a short spin, hop, wave, or circle pattern.
   - Keep it under 15 seconds for safety.
3. Test your code, then present your drone's name and intro sequence to the class or group.
4. Reflection (optional):
   - What did your drone "say" with its flight?
   - What commands did you use?

LESSON 1 Handouts and Worksheets

FAA Safety Handout for Educators

Drone Safety & FAA Quick Guide for Educators

Quick Safety Rules

- Keep drones away from faces and hair,
- Fly only within marked flight zones.
- Always have a designated spotter.
- Use a pre-flight checklist (power, calibration, battery).
- Rotate *Pilot*, Coder, and Spotter roles for safe teamwork.

FAA Basics

- Drones under 0.55 lbs (like CoDrone EDU) do not require registration when used indoors or in schools.
- Outdoor use must folow FAA recreational rules (below 400 ft, line of sight, no crowds, avold airports).
- Teachers don't need a Remote Pilot Certificate for indoor use, but awareness of airspace rules is encouraged.

Resources

- FAA Drone Zone for Educators
- Know Before You Fly
- Robolink EDU Safety Guide
- TRUST Test (Free)

"Teachers will receive a brief overview during the live session, with this guide and resource links included for in-depth reference."

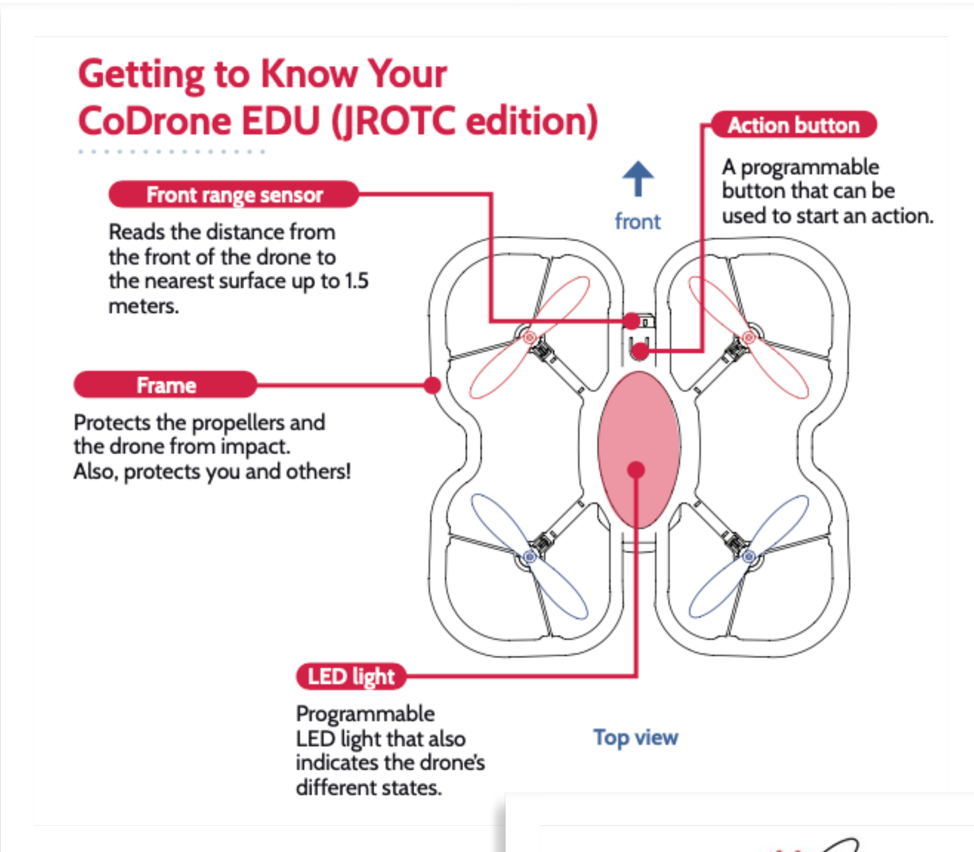
Drone Safety Checklist

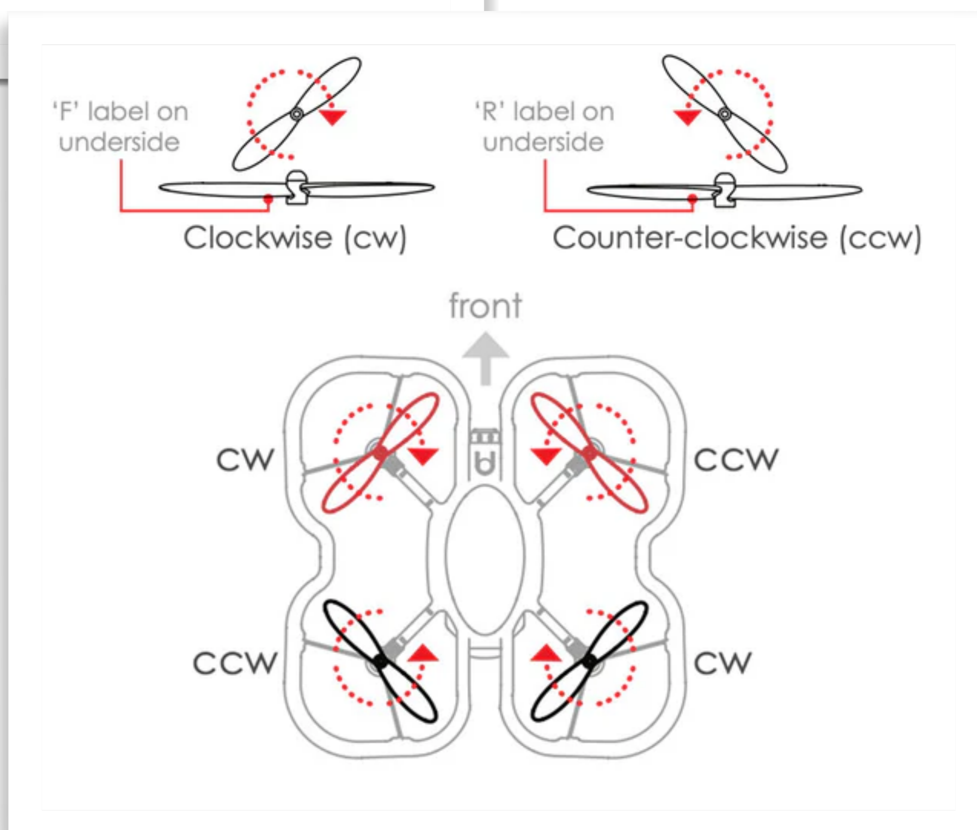
Complete this checklist with your team before each flight session.

- ✓ **Battery is fully charged**
- ✓ **Propellers are securely attached**
- ✓ **Flight zone is clear of obstacles and people**
- ✓ **Launch and landing zones are marked**
- ✓ **Hands off the drone until permission is given**
- ✓ **Drone and tablet are paired correctly**
- ✓ **All team members know their roles (Pilot, Programmer, Safety Monitor, Observer)**
- ✓ **Tablet is connected and coding program is open**
- ✓ **No flying above waist height**
- ✓ **Safety goggles on (if required by your teacher)**

Drone Diagram Activity

Label the parts of the drone based on your teacher's demonstration. Use the space below to draw and label your drone.





Flight Log Entry

Use this log to reflect on your drone piloting experience.
Date: ___________________________
Team Members:
____
Flight Goal:
____
Flight Code/Steps (list or describe the commands used):

____
____
____
____

What went well during your flight?

____
____

What will you improve next time?

____
____

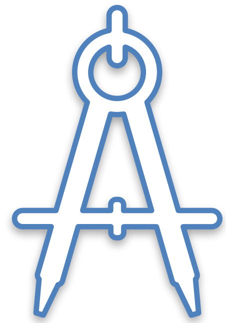
Team Roles Reference Sheet

Each team member has an important job to keep flights smooth and safe.

- Pilot – Controls takeoff, landing, and basic movements during practice.
- Programmer – Builds the code blocks in DroneBlocks or Blockly for the drone's flight.
- Safety Monitor – Makes sure rules are followed and no one is in the flight zone during launch/landing.
- Observer – Keeps notes, takes video (if allowed), and watches for successful movement or errors.

TOOLBOX LESSON 2: Drone Geometry Missions

Grade Level: 6–12
Duration: 60 minutes
Materials Needed:



- CoDrone EDU
- DroneBlocks or Blockly coding platform
- Chart paper or projector
- Student worksheet: Drone Geometry Mission Log
- Measuring tape or pre-marked floor space
- Whiteboard & markers
- Optional: protractors, string, floor grid

OBJECTIVE:

Students will apply geometric concepts such as perimeter, angles, area, and distance by coding drones to fly specific 2D shapes and calculating geometric properties of the path flown.

STEP-BY-STEP IMPLEMENTATION

1. Warm-Up & Geometry Review (5–10 min)

- Ask students:
  "What do a square, triangle, and rectangle all have in common in terms of angles and sides?"

- Review basic formulas for:
  - Perimeter
  - Area
  - Internal angles (90°, 60°, etc.)
- Project or draw examples of shapes with their measurements.

2. Introduce the Mission (5 min)

- Tell students they will code their drone to fly a shape and calculate the geometry of that flight path.
- Each team will receive a shape challenge (square, triangle, rectangle, etc.).

Optional Challenge Cards:

- Square (60cm sides)
- Rectangle (80cm x 40cm)
- Equilateral Triangle (50cm sides)
- Custom "L" shape

3. Break Down the Flight Code (10 min)

- Model how to use roll and yaw to code a square path:
  - Move forward (roll)
  - Turn 90° (yaw)
  - Repeat 4x
- Explain turning angles with visual aids:
  - Right turn = yaw(90)
  - Triangle = 120° turns for equal sides

Math tie-in:
If you fly 4 sides of 60 cm each, what is your total perimeter?
What angles are required to form the corners?

4. Mission Build & Flight Test (20–25 min)

- Teams:
  - Select their shape
  - Measure the required distance per side (you can use tape marks or estimate timing)
  - Code the full path using blocks
  - Test and debug their flight
- Encourage them to document how many seconds = approx. how many cm for calibration.

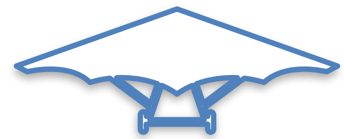
5. Debrief & Geometry Calculation (10 min)

- Each team fills out the Drone Geometry Mission Log:
  - Shape flown
  - Side lengths
  - Total perimeter
  - Internal angles
  - Area (if applicable)
  - Code used
- Discuss:
  "How did your drone demonstrate geometry?"
  "What adjustments did you have to make for accuracy?"

ASSESSMENT CHECKPOINTS

- Accuracy of shape flown
- Team documentation in mission log & Participation and reflection
- Application of correct geometry formulas

TOOLBOX LESSON 3: Engineering Design Challenge – Drone Rescue Mission



Grade Level: 6–12
Duration: 2 class periods (or one extended session, ~90–120 minutes)

OBJECTIVE

Students will apply the engineering design process to collaboratively design, program, and execute a drone mission that solves a simulated real-world rescue problem. Emphasis is placed on teamwork, iteration, problem-solving, and reflective thinking.

MATERIALS

- CoDrone EDU (1 per team)
- Charged devices with coding platform (DroneBlocks or Blockly)
- Engineering Design Organizer (graphic organizer/worksheet)
- Small props (mini figurines, paper "supplies," blocks, etc.)
- Tape/cones to simulate obstacles or terrain
- Whiteboard/projector
- Flight Logs

STEP-BY-STEP IMPLEMENTATION

1. Set the Scenario (10–15 min)

Create a dramatic problem to hook students. For example:
"There's been an earthquake in a remote area. Roads are blocked, and a drone must deliver a supply package to survivors stranded at a known location."
You can simulate:

- Landing pads (marked with an "X")
- "Obstacles" (cones or chairs)
- Rescue items (LEGO people, tokens, or printed images)

Tips:

- Project a simple map layout with coordinates
- Use storytelling and visuals to bring the scenario to life

2. Review the Engineering Design Process (10 min)

Break down the 5 steps and display a poster or slide:

Step	Description
Ask	What is the problem? What are the constraints?
Imagine	Brainstorm possible flight paths or delivery strategies
Plan	Sketch flight route; list code blocks to try
Create	Build and test your flight plan
Improve	Debug, revise, and optimize your solution

Distribute the Engineering Design Organizer for students to complete during the process.

3. Design & Code (30–40 min)

In teams, students:

- Ask: What's the goal? What must the drone avoid or deliver?
- Imagine: Draw multiple path ideas or drop techniques
- Plan: Sketch chosen route and annotate coding logic
- Create: Begin coding the mission
  (e.g., takeoff → fly forward → yaw → hover → land on "rescue zone")

Encourage teams to test in stages, not all at once.
Remind students to update the Engineering Design Organizer and Flight Log.

4. Mission Execution (15–20 min)

Each team takes a turn completing their drone rescue challenge.

- Use a countdown or mission timer
- Let students narrate their thinking during the flight
- Optional: score points for precision, timing, or creative solutions

5. Reflection & Share-Out (15 min)

Teams complete the final portion of their Flight Logs and design organizers.
Prompts for group discussion:

- What was your greatest design challenge?
- How did you adapt your plan?

- What real-world skills did you use?

Each team gives a 1–2 minute summary of their design process and lessons learned.

ASSESSMENT CHECKPOINTS

- Completion of Engineering Design Organizer
- Effective teamwork and collaboration
- Accuracy of flight execution
- Reflective writing in Flight Logs
- Verbal presentation of problem-solving process

FOLLOW-UP OPTIONS

- Redesign with constraints: Add wind simulation (fan), limited code blocks, or shorter time limits
- Study real-world cases: e.g., Zipline drone delivery in Rwanda, Search & Rescue drones in natural disasters
- Invite guest speaker or show short documentary: “How drones are saving lives”

LESSON 3 Handouts and Worksheets

Engineering Design Organizer – Drone Rescue Mission Student Handout

1. ASK: What is the problem?

What are you trying to accomplish with your drone?

What are the constraints (e.g., obstacles, timing, safety rules)?

2. IMAGINE: Brainstorm solutions

Sketch or describe different possible flight paths or strategies.

3. PLAN: Choose and outline your solution

Sketch your final plan and list code blocks or steps needed.

4. CREATE: Begin building and testing

List test results, notes from trial flights, and what worked well.

5. IMPROVE: Revise your design

What did you change and why?

Final version success summary:

TOOLBOX LESSON 3: Drone Rescue Mission- Student Handout

Objective: Your mission is to use the engineering design process to solve a real-world problem using a drone. You'll design a rescue flight plan, code your drone, and test your solution in a real-world simulation!

Materials You'll Use:

- CoDrone EDU
- Chromebook or tablet with DroneBlocks or Blockly
- Engineering Design Organizer
- Small props (mini 'survivors', blocks, supplies)
- Flight Logs
- Tape/cones to mark landing zones and obstacles

Step-by-Step Mission Guide

1. Set the Scene: Listen to your teacher describe the drone rescue scenario. Take note of the problem, obstacles, and your drone's mission.

2. Use the Design Process:

Complete your Engineering Design Organizer:

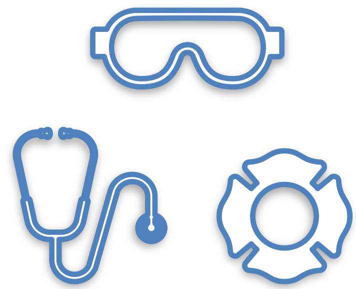
- Ask: What is the challenge?
- Imagine: Brainstorm different flight plans
- Plan: Sketch and list your code
- Create: Build and test your plan
- Improve: What did you revise and why?

3. Code Your Mission:Work in teams to write code that solves the rescue challenge. Use DroneBlocks or Blockly to fly over, land, or drop supplies on the target.

4. Test Your Flight: Carefully run your rescue mission. Take turns flying. Use tape to mark the safe zones. Keep track of how well your code works.

5. Reflect & Present: Write in your Flight Log and prepare to share your results with the class. What was hard? What worked? What would you do differently next time?

TOOLBOX LESSON 4: STEAM Careers & Presentation Prep



Grade Level: 6–12
Duration: 1–2 class periods

OBJECTIVE

Students will explore real-world careers that involve drone technology across various industries (e.g., environmental science, film, agriculture, public safety, and engineering). They will prepare and present short presentations or digital posters highlighting one career, its responsibilities, and how drone tech is used.

MATERIALS

- Laptops or tablets with internet access
- Career Research Guide (worksheet or digital doc)
- Sample drone industry videos (e.g., Zipline, [NASA drones], [AgEagle drones], etc.)
- Slide or poster template (Google Slides, Canva, or PowerPoint)
- Rubric (optional, for formal assessment)

STEP-BY-STEP IMPLEMENTATION

1. Kickoff Discussion (10–15 min)

Prompt students:
“Where have you seen drones used in real life or on TV?”
“What kind of jobs might involve drones?”
Facilitate a discussion and build a class brainstorm list, grouping responses by field:

- 📷 Media/Filmmaking
- 🌱 Agriculture
- 🌍 Environmental Monitoring
- 🚁 Public Safety/Rescue
- 📦 Delivery & Logistics
- 🔬 STEM Research & Data Collection

Show a short video (2–5 min) of real-world drone use to inspire ideas.
Options:

- Drone delivery in Rwanda (Zipline)
- Firefighting drones
- Wildlife conservation drones
- Drone cinematography in film production

2. Research Activity (20–30 min)

Distribute the Career Research Guide, which includes:

- Career Title
- Industry/Sector
- Drone Use in this Career
- Daily Responsibilities
- Tools & Skills Required
- Education/Training Needed
- Why This Career Interests Me

Let students choose a career path to research (individually or in pairs).
Encourage reliable sources:

- CareerOneStop.org
- Company websites
- News articles or STEM career profiles

3. Create a Presentation (25–35 min)

Using a slide template or blank canvas, students create a:

- Mini slideshow (3–5 slides)
- OR Digital poster

Each should include:

- Career name & industry
- Visual of a drone in use
- Summary of job and tech tools
- At least one fact about how drones enhance or change that field
- A short reflection: "Would you do this job? Why or why not?"

Teacher Tip: Provide a slide scaffold or example model to guide students.

4. Peer Review or Gallery Walk (15–20 min)

Choose a sharing format based on class size:

- Peer Review – Students trade devices and complete a short feedback form
- Gallery Walk – Presentations are displayed on desks or digitally, and students circulate, leaving comments or stickers
- Student Voice Choice – Present to small groups or do 1-minute live pitches

Optional Rubric Elements:

- Clarity and depth of research
- Visuals and presentation design
- Accuracy of drone connection
- Creativity and engagement
- Reflection and connection to self

FOLLOW-UP OPTIONS

- Invite a guest speaker from a drone-related field or conduct a short virtual career interview
- Flight Log Reflection Prompt:
  "Which career using drones do you find most interesting? How do drones improve the way people work in that job?"

- Create a STEAM Career Wall or Bulletin Board
  - Print slides/posters or compile into a class-wide digital showcase
  - Add QR codes linking to student videos or resources

7. Resource List

Curriculum & Official Guides

- FAA Recreational Drone Safety – https://faa.gov/uas/recreational_fliers
- CoDrone EDU Guides – https://learn.robolink.com/product/codrone-edu/
- Discovery Education – Design Process Resources

Books, Devices, Apps, and Websites

- CoDrone EDU kits – https://robolink.com
- Tablets or Chromebooks – to access block-based coding platforms
- Robolink Blockly – for drone programming
- FAA.gov & KnowBeforeYouFly.org – for legal and safety information
- YouTube – drone mission examples & search/rescue simulations

Organizations and Field Trip Ideas

- Frost Science Museum (Miami)
- Miami-Dade Youth Fair – Drone Competition
- REC Foundation Aerial Drone Competition
- Drones in School

Optional Guest Speakers

- Local drone pilots
- Environmental mapping experts
- Agricultural surveying specialists
- Aerial photography or cinematography professionals

8. Additional Ideas for Student Activities

1. **Code the Maze:**
   Students design and code a sequence that autonomously navigates a drone through a maze using directional blocks and timing commands.

2. **Drone Design Challenge:**
   Teams identify a real-world problem (e.g., disaster relief, crop inspection) and create a drone-based solution with a coded flight plan and mission narrative.

3. **Flight Log Journaling:**
   Students maintain logs that document their piloting experiences, code changes, mission results, and reflections on growth.

4. **STEAM Career Research Presentations:**
   Students research and present on careers involving drones (e.g., cinematography, logistics, engineering) using visuals and short pitches.

5. **Drone Showcase:**
   End-of-unit event where student groups demonstrate missions, explain code, and reflect on what they learned.

9. 🎖️ Student Competitions & Recognition

🚀 Miami-Dade County Youth Fair: Drone Coding & Piloting Competition

Local opportunity for middle and high school teams to compete in mission-based drone challenges involving both coding and piloting. Students demonstrate problem-solving, teamwork, and STEM integration by navigating obstacle courses, performing precise landings, and executing programmed flight paths in a timed and judged setting.

🛸 REC Foundation Aerial Drone Competition (VEX Drone Competition)

A national-level, structured competition hosted by the REC Foundation and VEX Robotics. Students complete autonomous and manual drone missions involving mission planning, target landings, geometry navigation, and reflective presentation. This challenge fosters hands-on learning, design thinking, and STEM career readiness—all aligned directly with classroom activities like your geometry, rescue, and design missions.