

Lesson 6: Drone Flight Academy 2

In this lesson, cadets will learn about drone controls and how to connect to the drone with their mobile devices. Cadets will fly their drones outside, using the PCB and cardboard arms that they made in Lesson 5, and perform several test maneuvers. Cadets should take note of their flights in their flight logs.

Key Concepts:

- digital literacy - learning new software
- spatial perception and orientation
- problem solving

Objectives:

- Cadets will complete flight maneuver checklist.
- Cadets will take flight log notes.
- Cadets will become familiar with the pre-flight check procedure.

Instructor Background:

Flying Safety Recap

Review these safety procedures to the students again.

- Always keep a flying drone in sight. Don't lose track of the drone.
- Keep the drones off the ground when not in use (to prevent them from being stepped on).
- Always keep a clear flying zone.
 - Try to keep a 10 ft radius clear of people and objects while flying the drone
- Do not fly in adverse weather conditions, such as in high winds or reduced visibility.
 - Your Circuit Scribe Drone weighs 3.3 oz., making it light enough for wind to blow them away. A strong enough gust of wind can even blow your drone right at you or your cadets.
- Do not touch the motors after the drone has been in flight, as they may be hot to the touch.
- Never leave the battery plugged in for extended periods of time or overnight.
- The cadet in the "engineer" role must always turn off the drone before fixing or putting anything back together.

Group Member Roles

The cadets must have a Drone Learners Permit in order to fly. The Drone Permit proves that the student has went over and learned all the safety rules and mechanics of a drone from the previous lessons. Each member will have a chance to become a pilot and fly the drone (if time allows it), so cadet must have their own battery. The pilot uses their battery for their respective test flights. The role of the engineer is to fix the drone and put it back together in case the pilot crashes their drone. The cadet with the "Engineer" role must turn off the drone before conducting any maintenance. The cadet with the "Project Manager" is in charge of safety; they

must advise the pilot if they are getting too close to anyone or if the group breaks any safety rules.

Safety is the utmost priority for Circuit Scribe and it is the teacher's job to enforce safety and revoke any permits for the day if any safety rules are violated.

The roles are switched each time the drone battery dies. From a full charge, the battery lasts for approximately 5 minutes of constant flight time, not including any crashes or repairs.

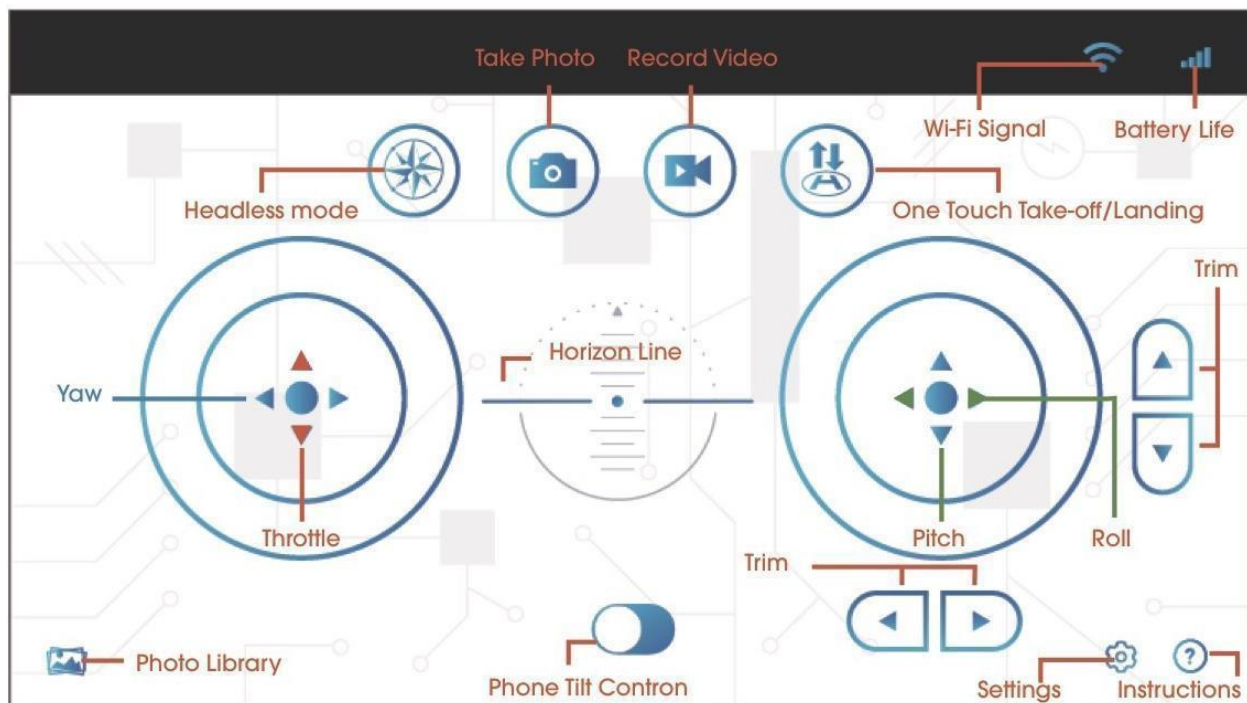
Drone Connection and Controls:

Connecting to the Drone

Before connecting to the drone, make sure the drone is built and the battery is installed in the drone hub. Install the 'CS Pilot' app in the iOS App Store or Android's Google Play Store. To turn on the drone, press and hold the black button underneath the drone until the RED LED is blinking.

Go to the phone's Wifi Settings and select the drone's Wifi Hotspot. Once connected, go to the 'CS Pilot' app. The RED LED should stop blinking when the 'CS Pilot app' is open and the drone is connected. If the RED LED keeps blinking, the battery may not be charged.

App Overview



For more information over drone controls, refer to Lesson 4 and the Lesson 4 handout.

At the beginning of class, each group member should be assigned a role assignment (engineer, pilot, project manager) at random, to prevent any disputes within the group of who gets to go first.

The students should each have their own custom arms made from Lesson 5. Each group should have their flight log with them before heading outside for a test flight. Each cadet is responsible for their own battery. To prevent any unauthorized drone flying in the classroom, the cadets must understand that turning on the drones in the middle of the classroom will result in their permit being revoked and prevent them from flying for that lesson.

Pre-Flight Check Procedure

Before the flight test, the cadets should log the current conditions of the flying zone and the drone into the flight log. That includes the type of wing arms the drone is using, the weather conditions, and the length of the flight time.

Maneuver Lessons

1. Test the new drone arms by taking off and landing. Check if propellers are functioning correctly.
2. Moving the drone forward and backwards, left and right. Watch if the drone is leaning to one side.
3. Flying around in a circle, free-flying the drone to test the drone's robustness.

Landing Procedure (End of Class/Lesson)

At the end of the lesson or class, each group should place the flight logs and other materials back into the portfolio. Have each group disassemble their drone for the next class period or lesson. The engineer of each group is in charge of collecting and charging the batteries at the designated charging station in the classroom.

Activity 1: Drone Flight Academy Day 1 (Outside)

Materials:

- Drone Permit
- Flight Log
- Custom-made arms for Drone
- Cones or indicating markers
- Conductive ink pens
- Multimeter
- Timer/stopwatch
- Clipboard for flight log (optional)

Time:

30-45 min.

Description:

Cadets fly their drones with their custom-made arms after reviewing safety guidelines and the drone application in class.

Plan Ahead:

Designating a Fly Zone

For the most optimal flying conditions, find a flat, open field away from any cars, streets or obstacles. Using cones or indicating markers, place a cone at each corner of a 10x10 foot square. Make as many fly zones as there are groups and be sure to number them for each group. Be sure to keep the fly zones at a safe distance from any hazardous obstacles.

Avoid flying near any cars or a populated playground. The fly zones should be spaced out enough to prevent any rogue drone from crashing into other cadets.

Roles:

- Engineer – responsible for turning off the drone, which must be done before conducting any maintenance, fixing the drone and putting the drone back together, in case the pilot crashes their drone.
- Project Manager – responsible for safety. They advise the pilot if they are getting too close to anyone or if the group breaks any safety rules. They are also responsible for carrying the drone and necessary materials to the designated flying zone.
- Pilot - responsible for flying the drone and recording flight info into the flight log. They also complete a secondary safety check after being approved by the project manager and the pre-flight checklist.

Safety:

- Always keep a flying drone in sight. Don't lose track of the drone.
- Keep the drones off the ground when not in use to prevent stepping on them.
- Always keep a clear flying zone.

- Try to keep a 10 ft. radius clear of people and objects while flying the drone.
- Do not fly in adverse weather conditions such as in high winds or reduced visibility.
 - Your Circuit Scribe Drone weighs 3.3 oz., making it light enough for wind to blow them away. A strong enough gust of wind can even blow your drone right at you or your cadets.
- Do not touch the motors after the drone has been in flight as it may be hot to the touch
- Never leave the battery plugged in for extended periods of time or overnight
- The engineer role must always turn off the drone before fixing or putting anything back together.

Step-by-step:

1. Assign starting roles for each group member.
2. Instruct the **Pilot** to assemble their drone with their own custom-made arms.
3. Instruct the **Engineer** to check the Pilot's work when they are finished.
4. Instruct the **Project Manager** to checkout their battery and prepare their flight log.
5. Call an attention signal and review the safety guidelines again.
6. Go over the drone connection and controls as a class.
 - a.) Remind students that turning on the drone in the classroom will result in a penalty.
7. Practice/remind the students of the attention signal and continue outside to the designated flying zone.
8. Before having students split off in their groups into their flying zones, demonstrate the Pre-Flight Checklist and then the beginning practice maneuvers (i.e. takeoff/land, move around).
9. Instruct students to change roles when their battery is drained.
10. Monitor students as they complete safety checks and their pre-flight checklist.
11. Monitor the groups and have the roles switch each time a battery dies.
12. At the end of the lesson, have the groups clean up their designated fly zones. Continue back to the classroom
13. Instruct each group's engineer to disassemble the drones and return them, the project manager to gather their group's batteries and charge it at the designated charging station, and the pilot to fill out any flight log information needed

Discussion Questions: How did the custom-made arms function? Was it any different from the PCB or cardboard arms? Did the custom arms work the first time you turned on the drone? If not, how did you fix the arms to make your drone work?

Quick Step-by-Step Overview of Lesson**Day 1**

1. Assign roles for each group member.
2. Have the engineer assemble their drones with the custom arms.
3. Go over safety again. More information can be found in the 'Safety' section.
4. Go over the Drone Connection and Controls section.
 - a.) Remind students that turning on the drone in the classroom will result in a penalty.
5. Go over beginning practice maneuvers (i.e. takeoff/land, move around).
6. Make sure everyone meets the requirements in the checklist:
 - a.) Students must have a permit to fly.
 - b.) There must be designated fly zones set up outside; one for each group. More information on setting up a designated fly drone can be found in the 'Designated Fly Zone' section.
 - c.) Students must fill in the Pre-Flight Checks in their flight logs before flying the drones.
7. Monitor the groups and have the roles switch each time a battery dies.
8. At the end of the lesson, clean up the designated fly zones.
9. Each group needs to disassemble the drones, and the engineers need to gather their group's batteries and charge it at the designated charging station.