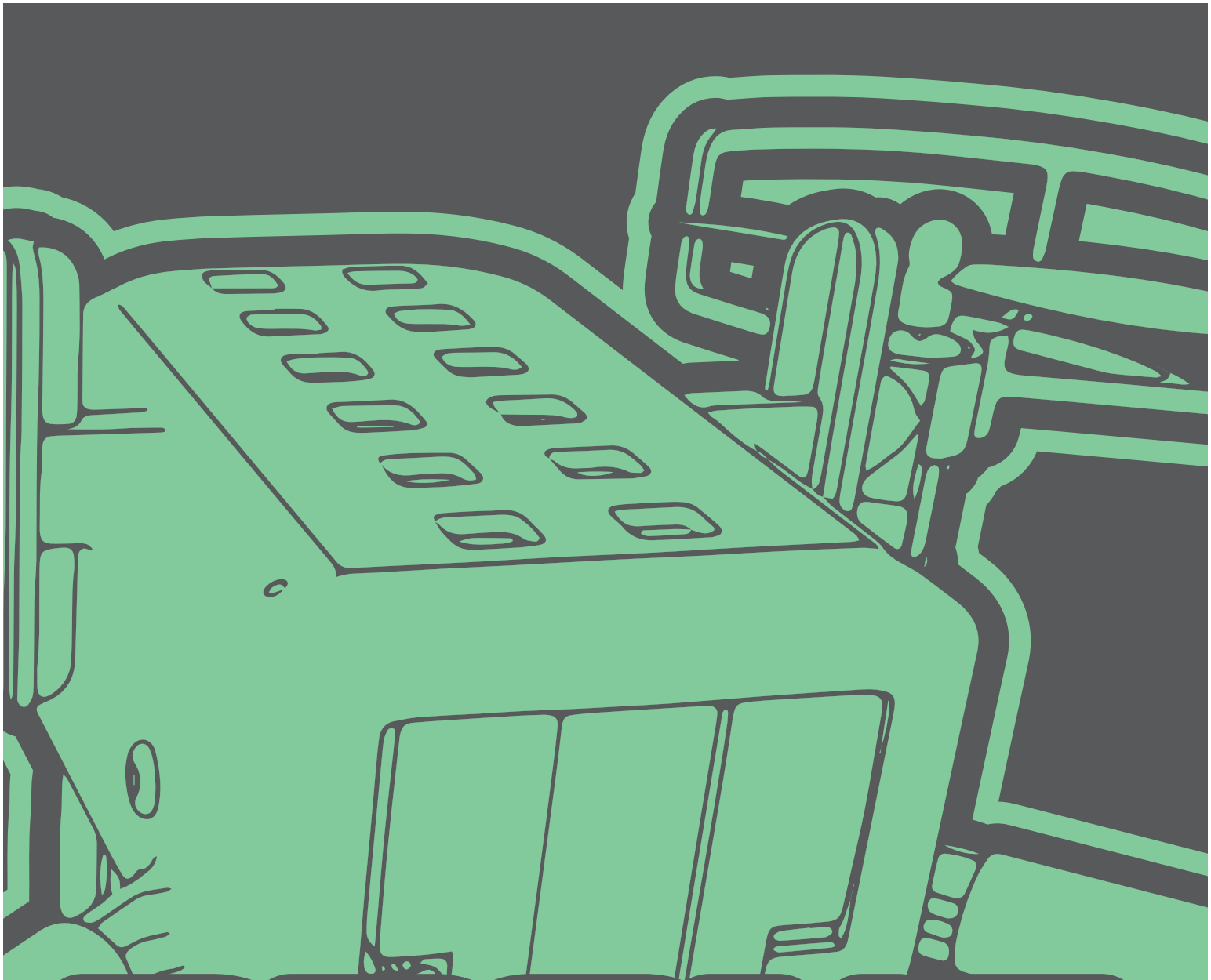

DRONE MAKER

Teacher Guide

PITSCO EDUCATION

92369

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TEACHER NOTES

Introduction

The Pitsco Drone builder system is designed for students to be able to rapidly iterate designs for drones. Pitsco has created this with the NGSS Engineering Design Standards in mind for Grades 3-5 and Grades 6-8. You should encourage your students to explore different drone designs, and plan time for the students to experience failure in the early stages of the design process. Some questions to ask when the class is together as a group are:

- What design ideas worked best for you?
- How would you have designed differently?
- What would you like to have tested that you weren't able to?

Do not feel that you are limited to these questions, these are just a starting point.

Some considerations to keep in mind are students have a limited number of the mylar body tubes, so encourage them to be economical with their use and reuse parts when possible.

Before Starting

Students will need a way to cut the mylar tubes when building their drones. Scissors work well for this, however, the tubes might have a tendency to fly off if not held when cutting. You will want to make sure you have scissors available for all of the students.

Students will need a place to plug in their battery chargers and charge their batteries. It takes approximately 30 minutes to fully charge the batteries. The flight time for a basic drone configuration on a fully charged battery is about 7-8 minutes.

You need to develop a system for students to pair their drones to their remotes. If all students turn on their drones at the same time and try to pair their remotes, you can experience cross pairing, where one student's drone can pair with another student's remote. To prevent this, have students turn their drone on and pair with their remote one at a time.

Student Pages

Following the Troubleshooting section on the next page are reproducible student pages for you to use with your students.

Troubleshooting

Following are some common design issues students will experience. Be sure to keep an eye out for these.

Problem	Possible Solutions
Drone won't take off.	The drone is too heavy. The maximum weight the drone can lift is between 65 and 75 grams. The drone with the battery in its lightest configuration is about 50 grams. The props are flipped. If the A and B props are on the wrong motors, they will push down instead of up, preventing the drone from taking off. The battery is too low. When the battery is critically low, the drone will land automatically and will not take off.
Drone flips over on the ground when taking off.	Two of the props are not on the correct motors. The A and B props must be on the correct motors; if two are correct and two are incorrect, the drone will flip over during takeoff.
Drone flies erratically or spins after taking off.	The motors might not be aligned correctly. If one or more of the motors is not aligned in the same plane as the others, the drone will fly erratically, drift, or fly in circles after takeoff.
Drone drifts toward one of the motors.	This usually indicates that one of the arms of the drone is a different length than the others. You should ensure all the drone arms are the same length. This issue can also happen if one of the drone motors is damaged and not spinning as fast as the other motors. The only solution to this is replacing the motor.

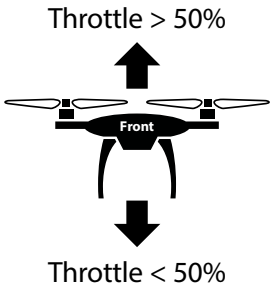
NGSS Standards Addressed
3-5-ETS1 Engineering Design
3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
MS-ETS1 Engineering Design
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Earning Your Wings
Pilot Ground School

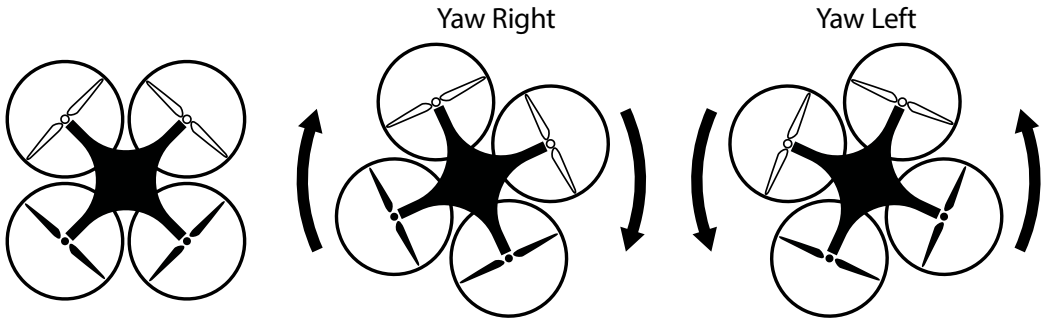
Vocabulary

Before you start to earn your wings, here are a few words you will need to know.

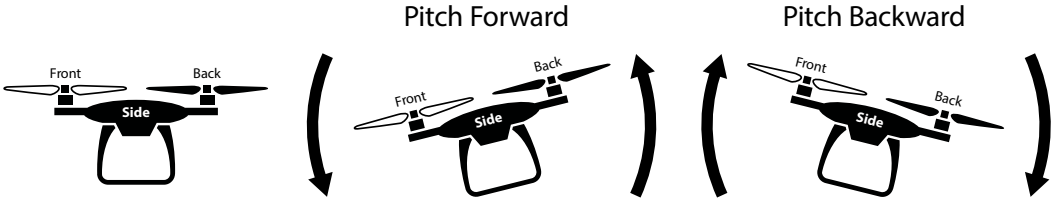
1. ***throttle*** – controls the speed of the motors. Speeding up causes the drone to go straight up; slowing down causes the drone to go straight down.



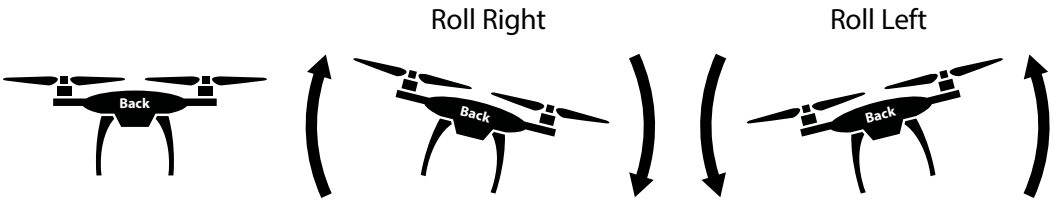
2. ***yaw*** – the direction the front of your drone is pointing. The yaw of the drone is changed by rotating the drone in one direction or the other.



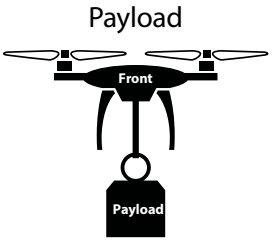
3. ***pitch*** – the tilt of the drone forward or backward. If the drone tilts forward, it moves forward; if it tilts backward, the drone moves backward.



4 ***roll*** – the tilt of the drone to the left or right. If the drone tilts to the right, it moves to the right; if it tilts to the left, the drone moves to the left.



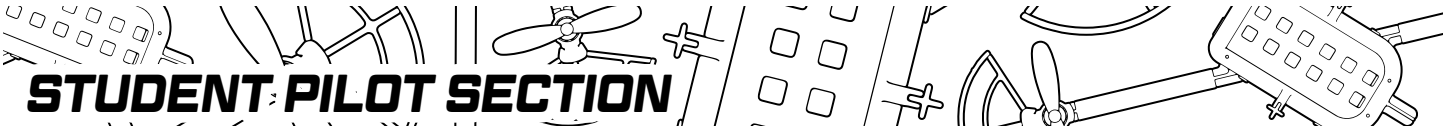
5 ***payload*** – the weight of anything a drone carries in addition to its own weight.



6 ***prop*** – short for *propeller*. It is a flat, tilted blade attached to the motor that spins to lift the drone into the air.

7 ***prop guard*** – a cage surrounding a prop that protects it from being damaged, tangled, or causing an injury.

8 ***VTOL*** – vertical takeoff and landing. This means the drone can take off by flying straight up and land by flying straight down.



STUDENT PILOT SECTION

Let's talk about a drone. These are officially called unmanned aerial vehicles (UAV). For the rest of this book, we will refer to it as a drone. However, the official name does let you know what makes it what it is:

- **U**nmanned: People don't ride on it; this is mainly because it is too small.
- **A**erial: It flies through the air.
- **V**ehicle: It moves from one location to another.

Introduction

The characteristics of drones are what make them useful in our world. For example, drones can be used to look at an area that might be difficult or dangerous for a person to go, such as at the top of a tower or above a house that is on fire. Drones can also be used to deliver things over short distances efficiently. Movie producers and photographers use drones to take video and pictures for their projects. Industry uses drones for aerial mapping and scanning of areas to find resources that are needed.

There are different types of drones, each of which is unique. The following table compares these drones so you have an idea of why and how each of them is used.

Type of Drone	Costs	Common Uses	Positives	Negatives
Fixed wing	$25->$100,000	Aerial mapping Power line inspection Crop inspection	Increased range Long flight times Faster flight speeds Less energy use	Launch and recovery space needed No VTOL No hover Difficult to fly
Single rotor	$25->$300,000	Surveying Construction payload lifting Long-distance mapping	VTOL Hovering Long flight times Heavy payload capacity	More dangerous to operate Difficult to fly
Multi-rotor	$25->$50,000	Photography and videography Law enforcement Home inspections	Ease of use VTOL Hovering Camera control Operates in small spaces	Short flight time Small payload capacity
Hybrid VTOL	$500->$50,000	Package delivery Real-time 3-D mapping Emergency response	VTOL Hovering Long flight times	Inefficient vertical flight Inefficient horizontal flight

As you work through the activities in this book, you will be working with multi-rotor drone kits.

Rules and Regulations

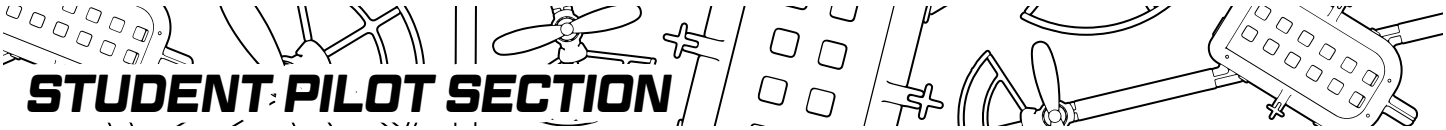
The Federal Aviation Administration (FAA) is the part of the government that writes rules and regulations about any vehicle that operates in the airspace in the United States (US). The rules that govern drones specifically are called Part 107.

The Part 107 rules require that drones with a weight of more than 0.55 pounds, or about 250 grams, must be registered with the FAA before operating in US airspace. Also, if you operate any drone in US airspace, you must have a Part 107 pilot license or be under the direct supervision of a licensed Part 107 pilot while operating the drone. So, what is US airspace? US airspace is anywhere outdoors within a 12-mile distance of the coastline of any US state. This means if you take your drone outdoors, you have to meet the Part 107 rules. You can find out more about the Part 107 rules and drones at the FAA's website.

Preflight Inspection

Before operating your drone, you should always complete a preflight inspection to make sure the drone is not damaged and is safe to operate. In the back of this guide, you will find a preflight inspection checklist you should use before operating your drone on any flight. Following are the items you will check.

1. Fly Conditions: Is the space you are operating your drone free from obstacles that would make flying unsafe? Or, are you aware of existing obstacles and how you will fly to navigate them?
2. Batteries Charged: Are the batteries you will need to complete your mission completely charged and ready?
3. Drone Structure: Because you are assembling your drone, it is important to inspect all the parts to make sure it is flight worthy. You will need to specifically look at the following:
    a. Flight controller – Are all connections to the flight controller secure and connected correctly?
    b. Body tubes – Are all body tubes securely connected to the motor mounts and flight controller hub?
    c. Motor mounts – Are motor mounts oriented correctly and connected correctly to the flight controller?
    d. Wires – Are all wires correctly secured and connected and safe from becoming tangled in the motors or propellers when operating?
    e. Props – Are props all mounted correctly and secure on the motors?
    f. Prop guards – Are prop guards in place to protect the props, people, and objects in the environment from accidental damage?



Flight Log

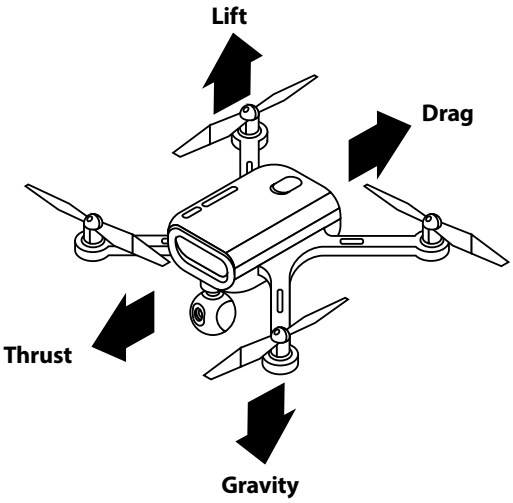
Flight logs are used by pilots to provide a record of important information such as the maintenance and flight time of a drone, safety issues related to a particular drone or pilot, and log records of experience and efficiency of flights.

In the back of this guide, you will find a flight log page to log each flight that you make with your drone. You should record all flights you make and note anything that matters, including any work you have to do to the drone or any crashes or other safety issues you have.

Flight Engineer School

Principles of Flight

In general, flight is governed by four forces: lift, drag, thrust, and gravity. When these four forces are balanced (or in equilibrium), the vehicle is at a stationary point – it is not moving in any direction. This is known as hovering. When the forces are not balanced, the vehicle will move in one or more of the following directions: up, down, forward, back, left, or right. On airplanes, these forces are controlled by the thrust of the engines, lift from the wings, and control surfaces such as vertical and horizontal stabilizers and flaps.



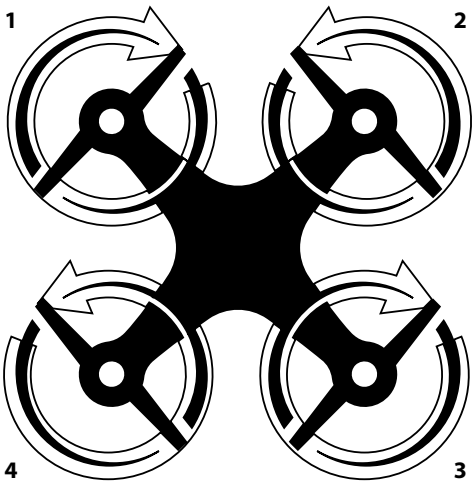
Principles of Quadcopter Flight

The same four forces that govern flight in general govern drone flight as well. However, drones use completely different mechanisms to hover and move through the air. A drone's motion can be described in terms of the following movements.

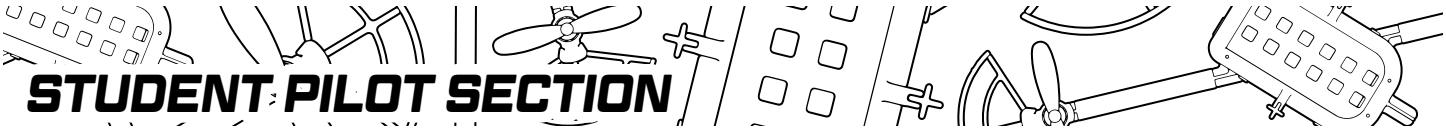
- *Vertical movements* include climbing, hovering, and descending.
- *Rotational movements* involve the drone turning.
- *Horizontal movements* include actions to the left, right, forward, and backward.

The four motors of a quadcopter turn very fast. Two of the motors are spinning their propellers clockwise while the other two motors are turning their propellers in the opposite direction, counterclockwise.

Notice in the pictured diagram how the motors are oriented – like directions are diagonally across from each other. The propellers diagonally across from one another (1 and 3; 2 and 4) should match and be opposite the other set of propellers on the drone.



The movements of the drone (rotational, vertical, and horizontal) are controlled by the speeds of the various motors. Changing one or more motor speeds (and each motor speed may change to be faster or slower) will affect the flight of the drone.



The physics behind the cause and effect due to changes in motor speed is a little complex. The complexity increases as the drone does maneuvers that combine two or more movements simultaneously. In fact, controlling the motor speeds to obtain any of the desired actions requires the use of a microcontroller that can handle multiple motor speeds in very short time frames.

Fortunately, drones have built-in microcontrollers to take care of the hundreds of changes of motor speeds that occur during a flight. If you listen closely, you can hear the changes occurring in motor speeds as the drone changes its flight pattern. Some motors are increasing in speed while others are decreasing in speed – but the outcome is a change in the movement of the drone.

There are a few terms associated with drone flight that you will need to know:

- *Throttle* controls up and down movement.
- *Yaw* controls rotation, determining the direction the drone is facing.
- *Pitch* controls the forward and backward movement.
- *Roll* controls the sideways (left and right) movement.

Your Building System

Design and Iterate

You have a system for building and adding to your drone that makes it quick and simple to make changes to the basic design of the drone. This will enable you to design, build, and test a drone and then make improvements to test the drone again. This design, test, and redesign process is known as iteration. Depending on the time you have available, the system you have will enable you to compare multiple possible solutions to a problem based on how well each one of them is likely to meet the parameters that have been set.

Pilot Training

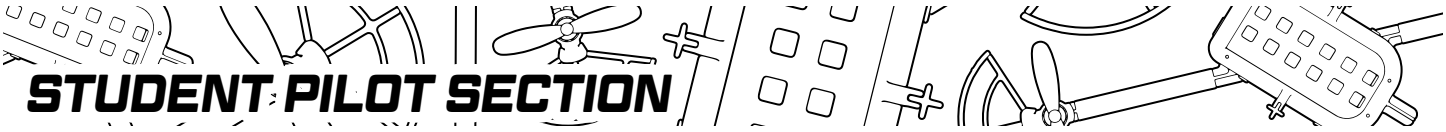
Stage 1

Let's get into the air and test a few things. You are going to build drones with three different arm lengths and then test them to see how they behave differently during flight. Construct a drone with 3 cm arms, a drone with 6 cm arms, and a drone with 9 cm arms. Fly each drone in a series of tests to compare each of the drone arrangements. Record all your flights and their results in your Flight Log the same way a UAV pilot would record their flight information.

Career Connection: UAV Pilot

UAV pilots are the people who operate drones in the airspace. They are responsible for the safe operation of the drone as well as the successful completion of the mission objectives. Career opportunities for UAV pilots are expected to grow faster than many other careers in the next 10 years. You can find out more about UAV pilots at https://www.grupooneair.com/drone-pilot-jobs/

Before each flight, be sure to complete a Preflight Inspection checklist. After flight operations, be sure to complete a Flight Log entry for each flight. Note any differences in how the drone flies or handles after each configuration change.



Stage 2

Now, let's see what this thing can do. Configure the drone with 6 cm arms for the following operation. Design and construct a method for carrying paper clips for payload by connecting the paper clips to the body of the drone. A few things to consider for how to create a design to solve this problem are as follows:

- You must use materials from the kit.
- You must be able to easily add and remove the paper clips.
- Understand the time constraints for the project.
- Understand the weight distribution of the paper clips on the drone.
- Understand the effect of the weight on the flight time of the drone. The more weight you add, the less time the drone will be able to fly.

These are all considerations an aerospace engineer must make when designing an aircraft.

Career Connection: Aerospace Engineer

Aerospace engineers design and build aircraft and aircraft components to accomplish certain tasks. They do all the math and science to make sure that an aircraft can meet all of the criteria for success within all of the constraints on time, materials, and costs. You can find out more about aerospace engineers at https://www.careeronestop.org/site-search.aspx?keyword=aerospace%20engineer

Before each flight, be sure to complete a Preflight Inspection checklist. After flight operations, be sure to complete a Flight Log entry for each flight. Note any differences in how the drone flies or handles after each configuration change.

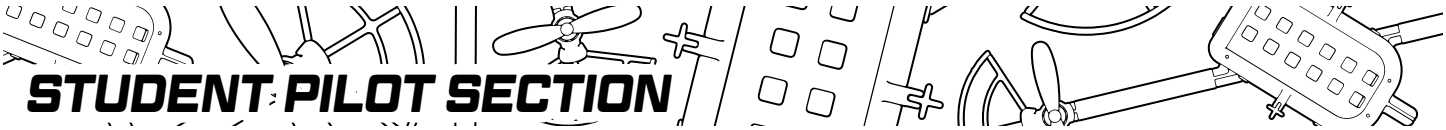
Stage 3

Now, you need to figure out a delivery system. The goal is to try and figure out the fastest way to deliver the paper clip payloads from one point to another. You should have a designated area with a starting point and a delivery point. Your task is to figure out the fastest way to get paper clips delivered from the starting point to the delivery point. Design and build your drone to accomplish this task. You are well on your way to being a successful drone technician at this point.

Career Connection: Drone Technician

Drone technicians are the people who work on the drone's electronic, mechanical, and structural parts to ensure the drone is flight worthy. They perform the regular maintenance and fix any problems that might be discovered during a preflight inspection so that a mission can be carried out. You can find out more about drone technicians at https://www.bls.gov/ooh/installation-maintenance-and-repair/aircraft-and-avionics-equipment-mechanics-and-technicians.htm

Before each flight, be sure to complete a Preflight Inspection checklist. After flight operations, be sure to complete a Flight Log entry for each flight. Note any differences in how the drone flies or handles after each configuration change.



STUDENT PILOT SECTION

Mission: Medical Supply Delivery

You and your drone have been called into action! Medical supplies (paper clips will represent the payload) are desperately needed in a remote location, and the fastest way is to deliver them by drone. Your task is to design and equip your drone to deliver the medical supplies to the remote location in the most efficient manner possible. Efficiency means that you can get the most supplies to the location in a specified amount of time. Everything you have been learning up to this point has prepared you for this. Good luck!

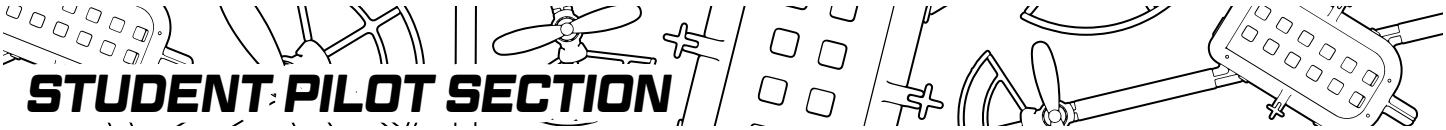
Before each flight, be sure to complete a Preflight Inspection checklist. After flight operations, be sure to complete a Flight Log entry for each flight. Note any differences in how the drone flies or handles after each configuration change.

Preflight Inspection

Complete the following checklist each time before operating your drone.

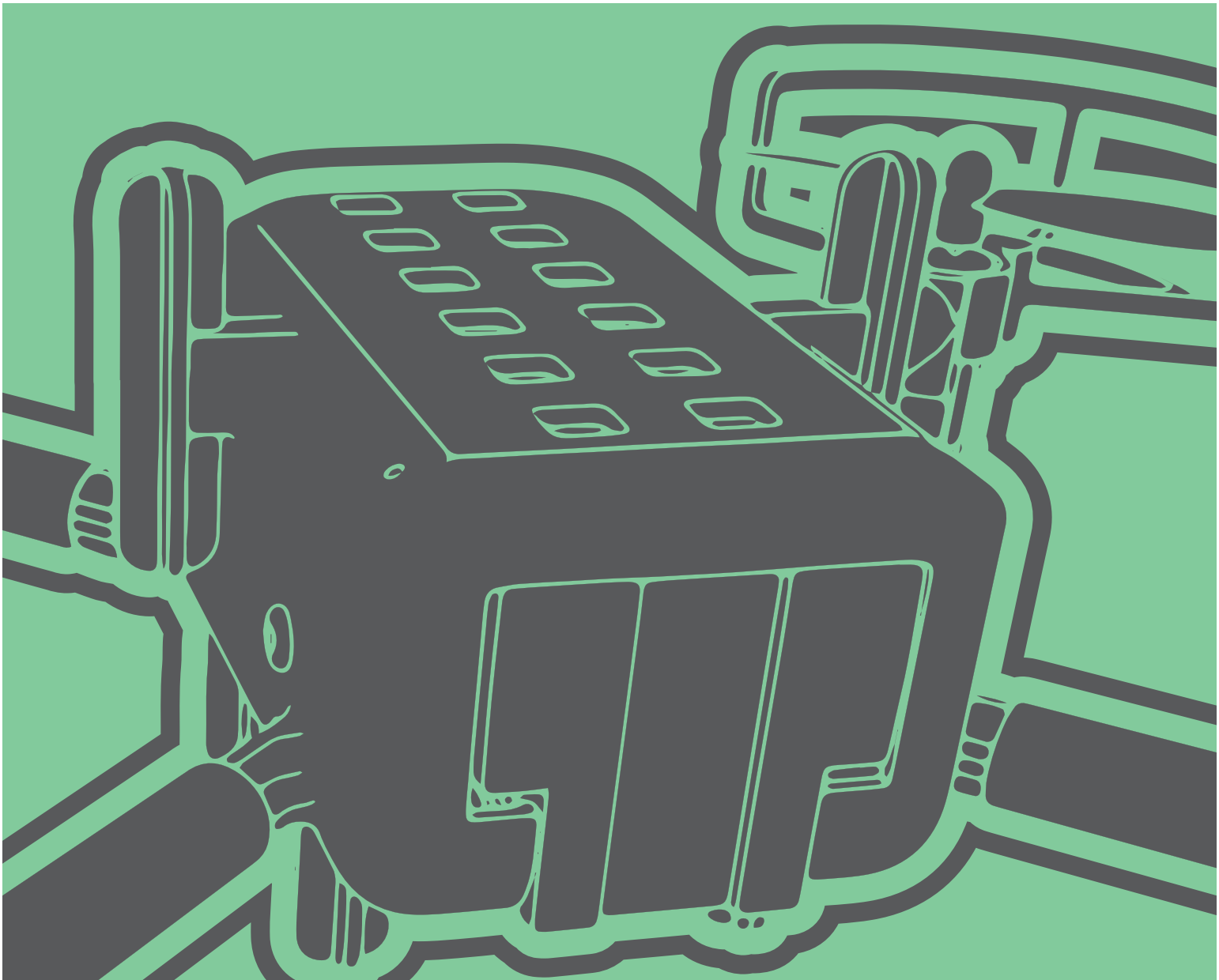
Checklist items

- ❑ Flight Conditions: Clear
- ❑ Flight Conditions: Obstacles to be aware of
- ❑ Batteries charged
- ❑ Flight controller connected and secure
- ❑ Body tubes secured
- ❑ Motor mounts secured and leveled
- ❑ Wires connected and free from tangling
- ❑ Props mounted and secure
- ❑ Prop guards in place



Flight Log

Name:					
Date	**Flight #**	**Drone ID**	**Location**	**Duration**	**Notes**



DRONE MAKER

User Guide

PITSCO EDUCATION

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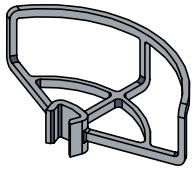
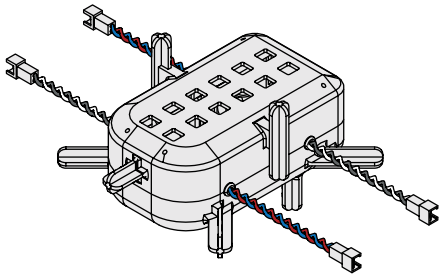
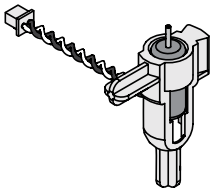
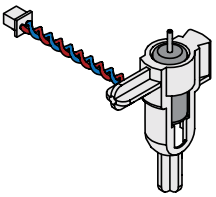
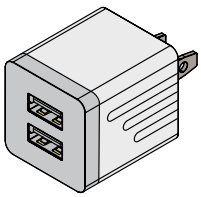
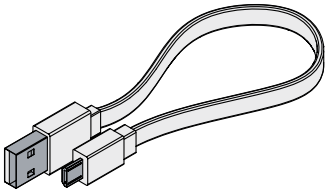
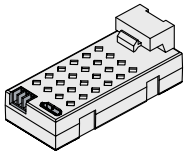
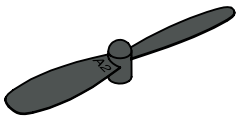
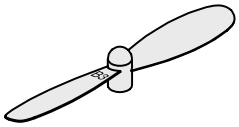
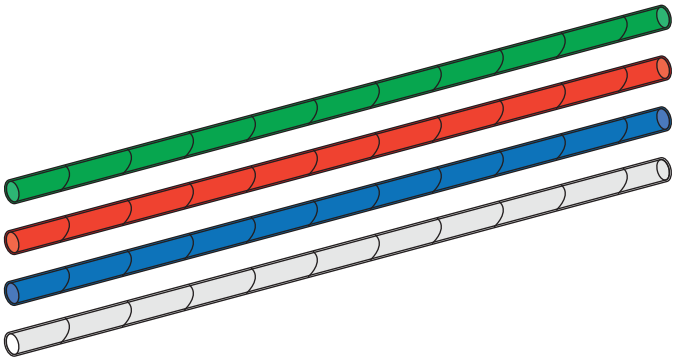
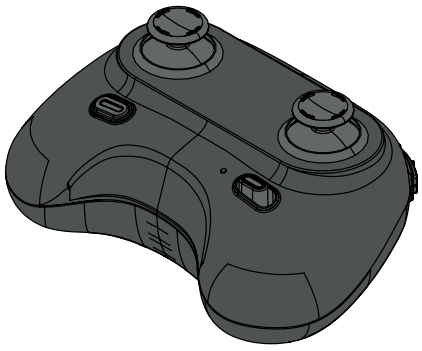
DRONE PARTS

Part	Part Name	Quantity
	90-degree connector	10
	90-degree through connector	10
	Propeller guard	8
	Drone body	1
	Motor mounts with black and white wires	2
	Motor mounts with red and blue wires	2
	Charger	1

Part	Part Name	Quantity
	Micro USB cable	2
	Battery	2
	Propeller A	4
	Propeller B	4
	Body tube (colors vary)	16
	Remote control	1

Drones in the Air

Up, up, and away! Drones have taken everybody's imagination by storm in recent years. Promises of packages being delivered to your door with everything from hot fresh pizza to a new item from your favorite retailer, as well as the ability of first responders to reach remote locations with lifesaving equipment in a moment's notice – these are the dreams of a future with drones. But what is needed for any of this future to happen, engineering drones for these and other tasks? Welcome to the world of **aerospace engineering**, you now have the opportunity to figure out this future!

Did You Know?

In remote areas of Africa, drones are used for delivering medical shipments because it would take longer to deliver the items over land. You can read more about this lifesaving use for drones here: https://dronedj.com/2022/02/18/zipline-expands-drone-deliveries-of-medical-supplies-to-kenya/.

Design and Iterate

You have a system for building and adding to your drone that makes it quick and simple to make changes to the basic design of the drone. This will enable you to design, build, and test a drone and then make improvements to test the drone again. This design, test, and redesign process is known as **iteration**. Depending on the time you have available, the system you have will enable you to compare multiple possible solutions to a problem based on how well each solution is likely to meet the parameters that have been set.

GLOSSARY TERMS:

Aerospace Engineer – an engineer who works with designing, building, and testing aircraft, including drones, to meet goals

iteration – refining a product or process by tweaking the later version and then starting over

Batteries and Charging

In order for your drone to operate at maximum capacity, the batteries should be fully charged. Locate the charger, Micro USB cable, and batteries. Plug these in while building your drone.

Building a Basic Drone

What You'll Need

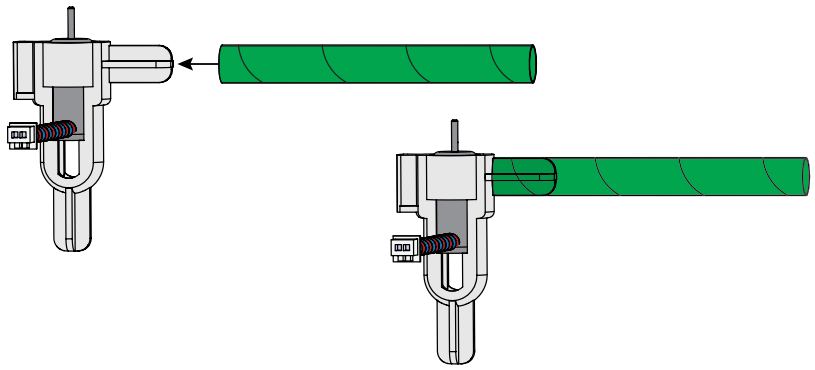
The following is the list of parts you will need to build the basic drone.

Drone Parts

Part Name	Quantity
Propeller guard	4
Drone body	1
Motor mounts with black and white wires	2
Motor mounts with red and blue wires	2
Battery	2
Propeller A	2
Propeller B	2
Body tube	4
Remote control	1

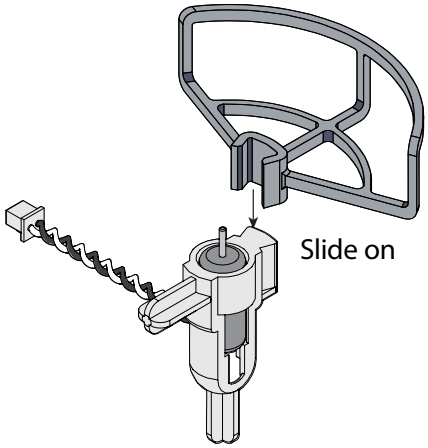
Putting Your Drone Together

Cut four body tubes to equal lengths. Start with lengths of 45 mm for each tube. The tubes will attach to the drone body and motor mounts by sliding snugly over the connection points.



Propeller and Propeller Guard

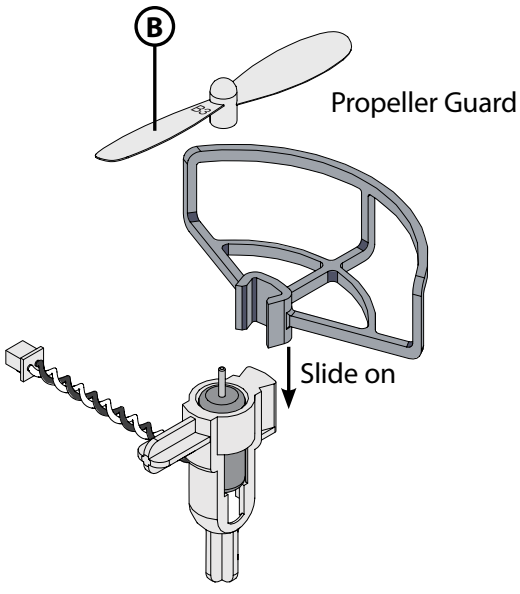
Before mounting the props, you should slide the propeller guards onto the motor mounts from the top.



Motor/Propeller/Guard Assembly

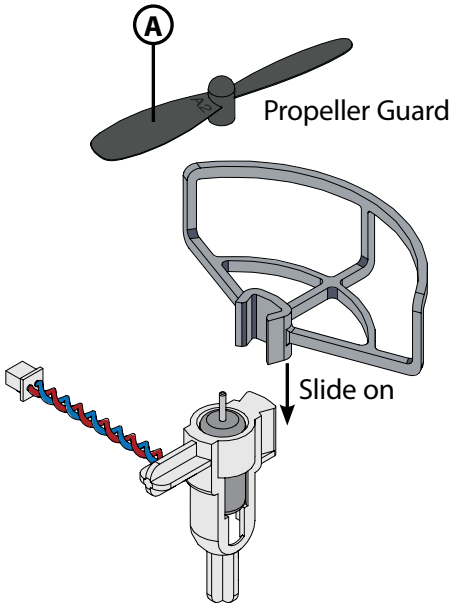
The props need to be pressed onto the motor axle. You should match the props to the motors first. The props labeled "A" should be mounted on the red-and-blue wired motors, and the props labeled "B" should be mounted on the black-and-white wired motors.

Counterclockwise Propeller Mark



Counterclockwise Motor
(black and white wires)

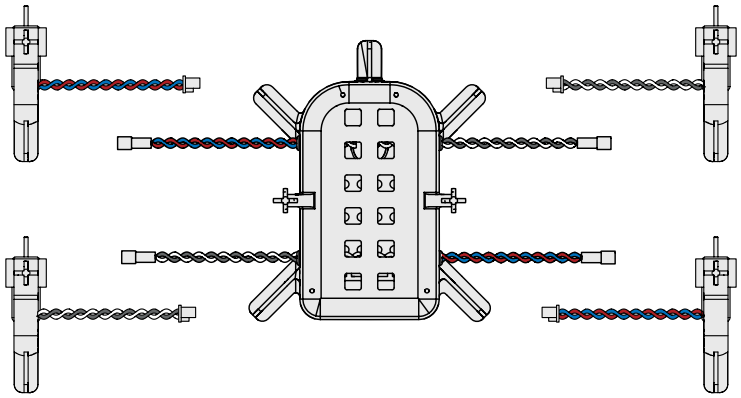
Clockwise Propeller Mark



Clockwise Motor
(red and blue wires)

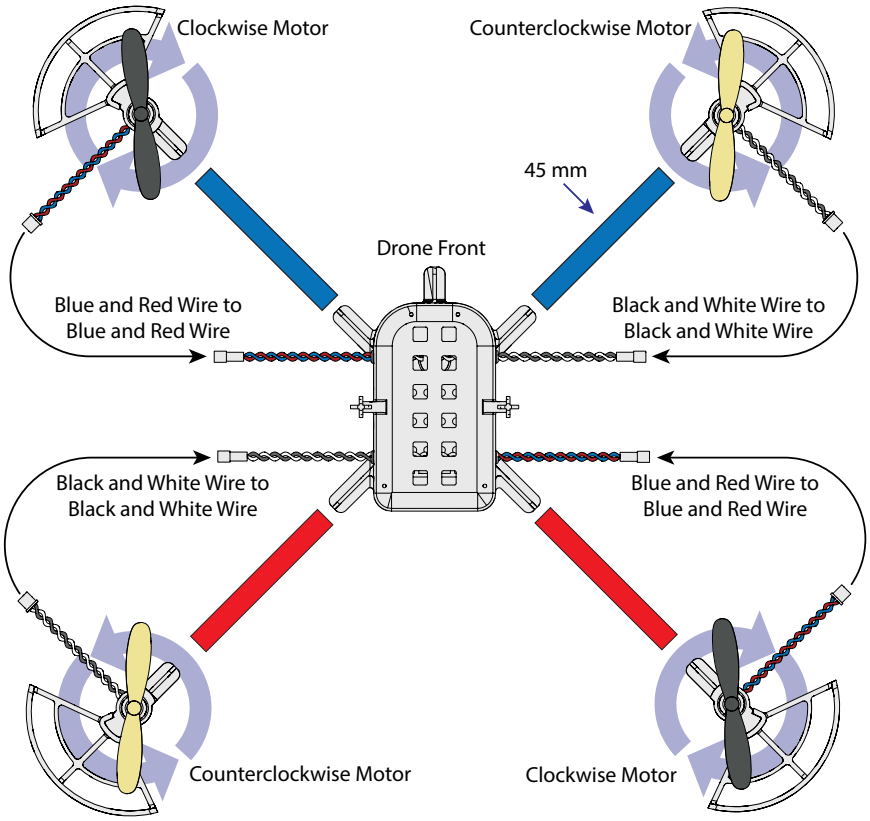
Aligning the Motors and Drone Body

When connecting the motors to the drone body, it is important to align them correctly. The motor wire coloring should match the wire coloring coming from the drone body. This is because the motors spin in opposite directions. Be careful when connecting and disconnecting the wires to prevent them from breaking. You will want to ensure that the motors are aligned with the body because any deviations can cause a reduced flight time from the batteries or an inability to take off.



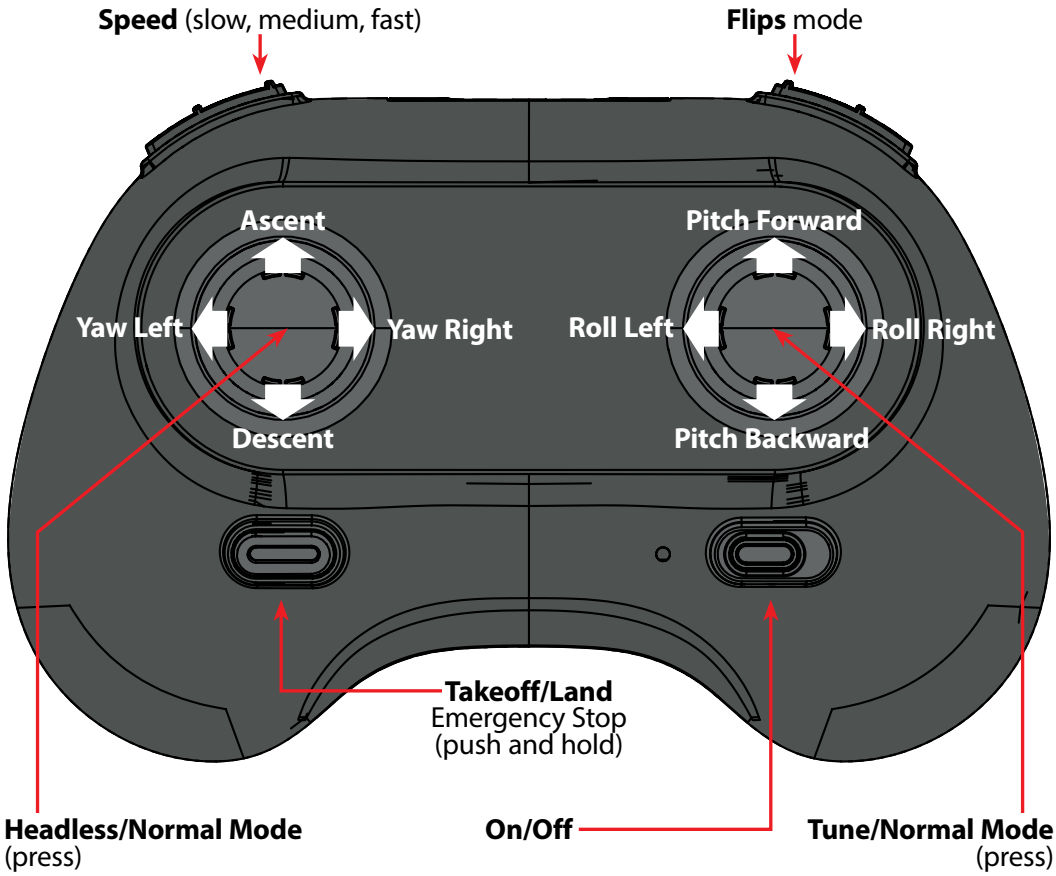
Basic Drone Design

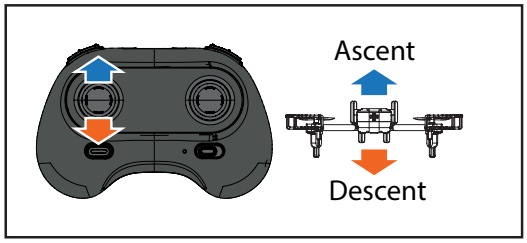
To build a basic drone that will fly, use the following diagram.

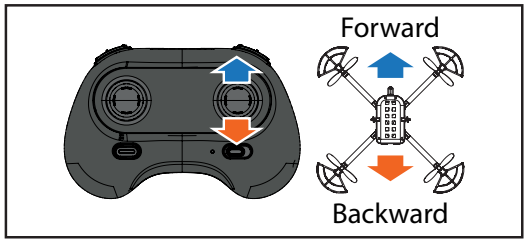


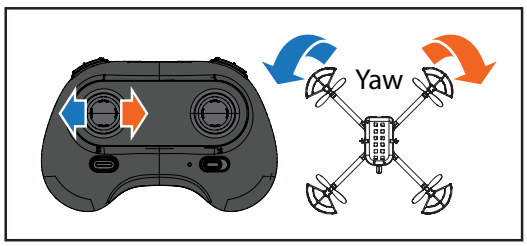
Drone Controller Functions

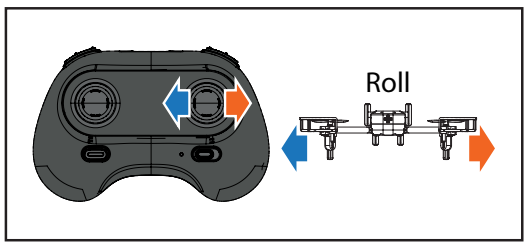
Refer to this diagram for the functions on the drone controller included with your kit.











Speed – The drone's responsiveness to the controller's commands is adjusted into three different modes by pressing and releasing this button.

- *Slow* – The drone operates more gently to the commands input at the controller. This mode is recommended for a beginner drone pilot.
- *Medium* – The drone operates intuitively to the commands input by the controller. This mode is recommended as you gain experience as a drone pilot.
- *Fast* – The drone operates rapidly to any commands input by the controller. This mode is recommended only after extensive experience as a drone pilot.

Flips – When this button is pressed, the drone enters flip mode. While in flip mode, the right joystick on the controller can be used to perform a flip by pressing one of the four directions forward, backward, left, or right.

Ascent/Descent – This is the throttle; it controls the speed of the motors. Pushing up causes the drone to go straight up; pushing down causes the drone to go straight down.

Yaw Left/Yaw Right – Rotates the drone around the center of the drone body. It is used to change the direction the drone is pointing. Pushing left rotates the drone to the left; pushing right rotates the drone to the right.

Pitch Forward/Pitch Backward – Tilts the drone forward or backward. Pushing up tilts the drone forward, and it moves forward. Pushing down tilts the drone backward, and the drone moves backward.

Roll Left/Roll Right – Tilts the drone to the left or right. Pushing right tilts the drone to the right, and it moves to the right. Pushing left tilts the drone to the left, and the drone moves to the left.

Takeoff/Land – Pushing and releasing this button will make the drone take off when not flying and land when flying. Pushing and holding when the drone is in flight will activate the emergency landing feature, and the drone's motors will immediately stop spinning, and the drone will fall directly to the ground.

Power On/Off – Pushing and releasing this button will turn the remote on or off.

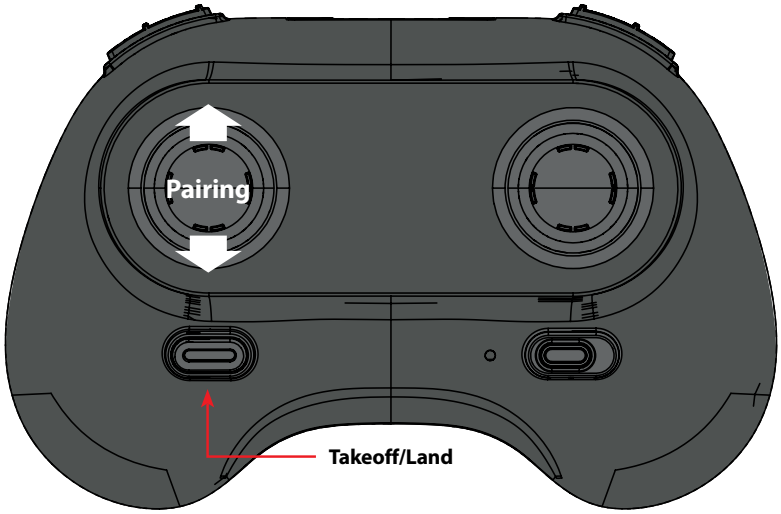
Headless/Normal Mode – In normal mode, left and right are always in reference to the drone's left and right. In headless mode, left and right are in reference to the controller's left and right when facing the drone.

Tune/Normal Mode – In normal mode, the controls operate the motors to cause movement in the drone. In tune mode, the power sent to each of the motors is adjusted to balance the flight characteristics of the drone. Each time the drone is restarted, the previous tuning returns to the default.

Pairing the Remote and Taking Flight

Follow these steps to pair your remote and fly it. Remember to wear safety glasses when operating the drone.

1. After the drone is built, make sure the battery is fully charged before flying. Then, insert the battery into the drone body.
2. After the battery is in place, press and hold the power button on the bottom of the drone to power up the drone. The LED lights on the bottom will flash when the drone is powered up.
3. Turn on the drone and place it on a level surface. The drone indicator lights will blink slowly, which indicates it is waiting for pairing.



4. Power on the remote. The remote will beep once.
5. To pair, push the left joystick fully upward until you hear a beep and then fully downward until you hear a second beep. The indicator lights on the drone will change from blink to solid indicating a successful pair.
6. Press the Takeoff/Land button to start flight. The motors will begin spinning and the drone will rise one meter above the surface and hover.
7. Use the left and right joysticks to control the flight.
8. Flight time is approximately six to seven minutes depending on weight of drone.
9. Drone lights will blink to indicate low battery.
10. Drone will land automatically when battery is depleted, or press the Takeoff/Land button to land the drone.
11. Have a safe flight!

First Flight Activity

You're ready to fly! Use the following checklist to check off when you practice each of the skills as you practice flying your drone. Rate your skill from one to five on each skill. As with any skill, practice makes you better, so don't be discouraged if you aren't a five the first time. You might need to align your motors when taking off for the first time. Make sure the props on the motors are aligned with the drone's body. (**Hint:** You can use the connectors on the motor mounts and drone body to help you line up the motors and the body.) If the drone flies unpredictably or not at all, see the troubleshooting section of this guide for help.

Skill	**Status**
Pairing	1 2 3 4 5
Takeoff	1 2 3 4 5
Landing	1 2 3 4 5
Yaw left 180°	1 2 3 4 5
Yaw right 180°	1 2 3 4 5
Ascend one meter	1 2 3 4 5
Descend one meter	1 2 3 4 5
Roll left one meter	1 2 3 4 5
Roll right one meter	1 2 3 4 5
Pitch forward one meter	1 2 3 4 5
Pitch backward one meter	1 2 3 4 5
Navigate around an obstacle in Slow Speed Mode	1 2 3 4 5
Navigate around an obstacle in Medium Speed Mode	1 2 3 4 5
Navigate around an obstacle in Fast Speed Mode	1 2 3 4 5

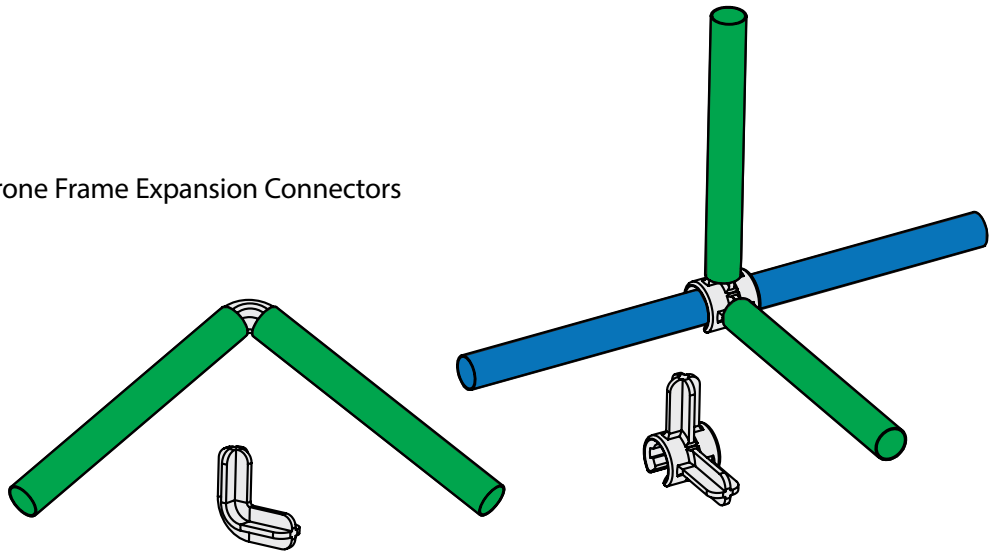
Activity Extension

Find a way to construct the drone to make it easier to tell which is the front of the drone and which is the back of the drone when it is in flight. What's the biggest drone you can build and get in the air? What's the smallest drone you can build and get in the air?

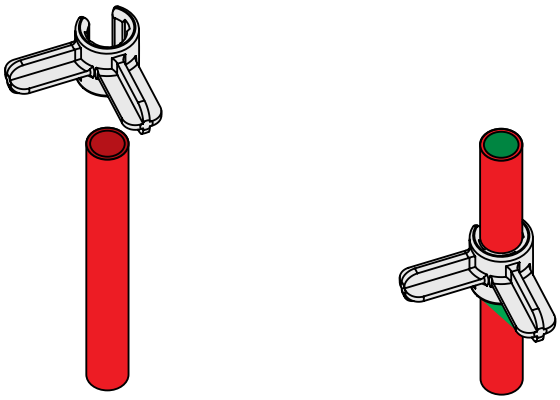
Do Some Engineering!

On the drone body and the motor mounts are connection points where you can attach additional support beams. You can use these to engineer supports for carrying packages for delivery or adding landing struts to the drone. Your imagination is your limit! You also have some frame expansion connectors you can use to help design and build other capabilities into your drone.

Drone Frame Expansion Connectors



The tubes will also fit snugly into the through portion of the 90-degree through connectors. These connectors can be used to create extensions for the drone. These extensions can be used to create drone features designed to carry payloads, extend the drone's landing footprint, or add accessories.



Design and build a drone to deliver some objects. But be careful – the more weight you add, the less flight time your drone will have. After you are successful, try and improve your design and make changes to your drone to make it more efficient in carrying the load.

Problem	Possible Solutions
Drone won't take off.	The drone is too heavy. The maximum weight the drone can lift is between 65 and 75 grams. The drone with the battery in its lightest configuration is about 50 grams. The props are flipped. If the A and B props are on the wrong motors, they will push down instead of up, preventing the drone from taking off. The battery is too low. When the battery is critically low, the drone will land automatically and will not take off.
Drone flips over on the ground when taking off.	Two of the props are not on the correct motors. The A and B props must be on the correct motors; if two are correct and two are incorrect, the drone will flip over during takeoff.
Drone flies erratically or spins after taking off.	The motors might not be aligned correctly. If one or more motors are not aligned in the same plane as the others, the drone will fly erratically; drift left, right, forward, or backward; or fly in circles after takeoff. This can also happen if one or more drone arms are damaged or bent. This will require replacing the damaged drone arm to fix.
Drone drifts toward one of the motors.	This usually indicates that one of the arms of the drone is a different length than the others. You should ensure all the drone arms are the same length. This issue can also happen if one of the drone motors is damaged and not spinning as fast as the other motors. The only solution to this is replacing the motor.

HAVE QUESTIONS?

There are a variety of ways to get in touch with us:

Call us at 800-358-4983.

Email us at support@pitsco.com.

Chat with us on Pitsco.com/Support.

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