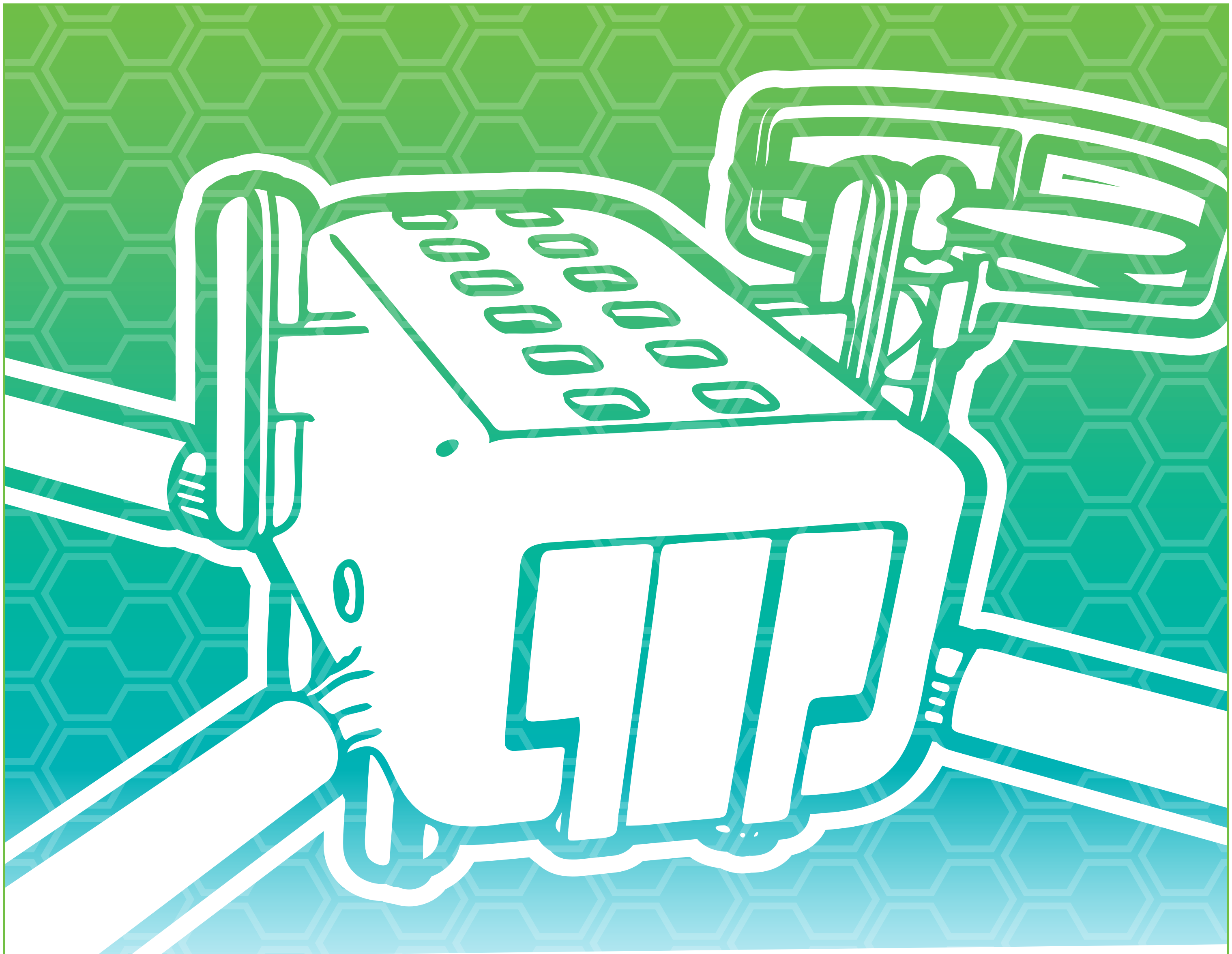

KNOW BEFORE YOU FLY

Discovery Drone Kit Lesson Plan

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TABLE OF CONTENTS:

Thank you to Rick Crosslin for assistance in developing this lesson plan.

1 INTRODUCTION

The Discovery Drone Kit is designed to take your students on an engaging, hands-on journey into the world of drone technology, aviation safety, and real-world problem solving. This project blends engineering, flight principles, and creative design challenges.

Students will:

- Assemble their own drone using step-by-step instructions while learning about components and construction techniques.
- Practice safe drone operations, learn essential pre- and post-flight procedures, and maintain flight logs to monitor performance.
- Develop flight skills through guided activities that explore aerodynamics, weight distribution, and control.
- Tackle real-world challenges that simulate drone delivery, payload lifting, and precision navigation.
- Innovate through redesign by modifying the drone's structure to enhance stability, speed, or visual appeal, encouraging creativity and engineering-based mindsets.
- Analyze and reflect using collected data.

Whether you're a seasoned Science, Technology, Engineering, and Math (STEM) educator or new to drones, the Discovery Drone Kit provides everything you need to ensure a successful and inspiring learning experience, from build instructions to troubleshooting tips. Let's get ready to build, fly, and discover!

2 SAFETY PRECAUTIONS

Before we launch into building and flying your drone, it's important to follow these drone safety guidelines to protect your school, equipment, and those around you.

DURING ASSEMBLY:

- Handle all drone parts with care. Be gentle when connecting parts—never force them together.
- Work on a clean, flat surface to prevent losing parts or tools.
- Give yourself enough time to complete the assembly.

BEFORE FLIGHT:

- Review the safety and regulatory information provided in the Discovery Drone Kit instruction manual.
- Keep fingers, hair, and loose clothing away from the propellers.

DURING FLIGHT:

- Check that the battery is properly connected and secure before taking off.
- Make sure the flight zone is clear of people, pets, and obstacles.
- Use goggles or safety glasses during flight activities.
- If the drone begins to fly out of control, land it immediately and troubleshoot.
- Only fly the Discovery Drone indoors.
- Never touch or catch a flying drone—always wait until it has landed and been disarmed.

REGULATORY NOTE: The drone in this kit should be flown indoors, without factors such as weather or airspace impacting your flight. However, it is important to be aware that if you do fly a drone outdoors, you'll need to follow certain rules and regulations. Those rules are set by the Federal Aviation Administration (FAA) and can evolve rapidly. For the latest information, visit www.faa.gov/uas.

faa.gov/uas

Discovery Drone Kit instruction manual

3 PREPARE: GETTING READY TO BUILD AND FLY

Before your students take to the skies, it's time to prepare for their drone-building journey! You'll be using the Discovery Drone Kit instruction manual to help you through every step of the process.

STEP 1: Introduce the Drone Parts to Your Students.

Start by exploring the instruction manual to help students identify and understand the parts that make up the Discovery Drone. These parts include:

- Propellers
- Propeller guards
- Motors
- Drone body/frame
- Batteries and connectors

Knowing each part is the first step in becoming a skilled drone builder!

STEP 2: Follow the Assembly Directions.

Materials:

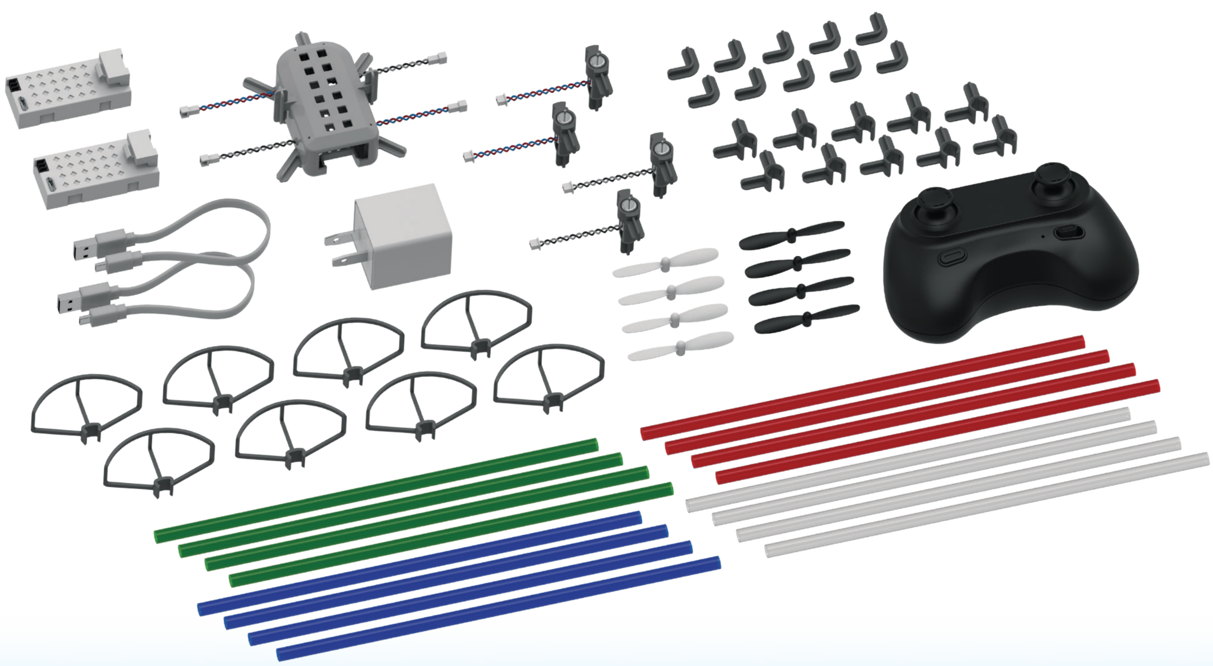
- Kit components (page 5 in the instruction manual)
- Rulers
- Scissors
- Markers

Using the detailed instructions in the manual, assemble the Discovery Drone.

Instruction manual and build video: knowbeforeyoufly.org/Discovery-Drone-Kit

STEP 3: Prepare a Flight Log.

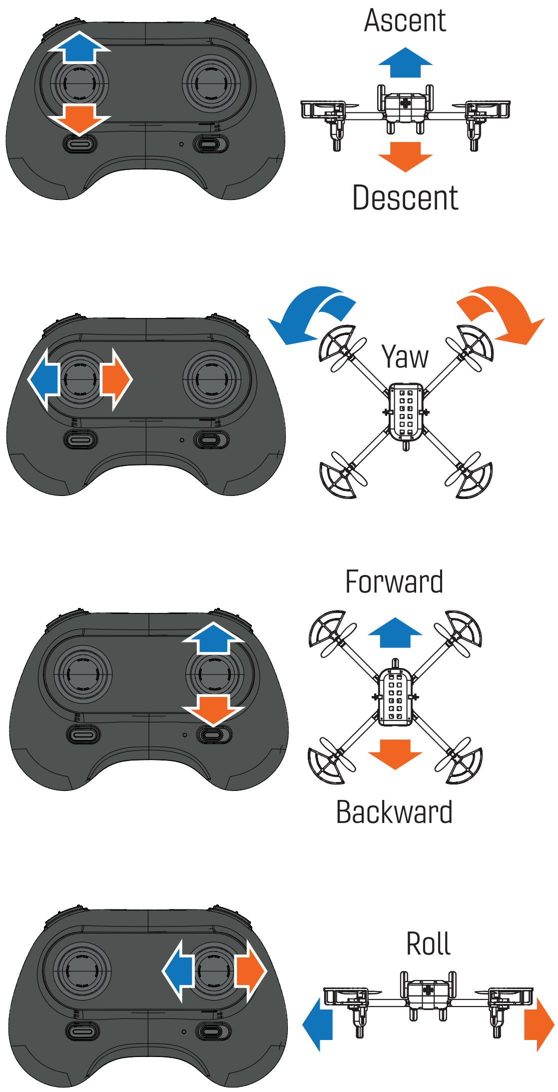
Students should keep a flight log that includes information about each flight activity they conduct. Have them complete the flight log located in the "Resources" section of this document to collect and analyze flight performance data.



STEP 4: Understand Controller Functions.

Once the drone is built, it's time to learn how to fly it! Page 8 of the instruction manual will help you get to know the drone controller and how each input affects the drone's movements.

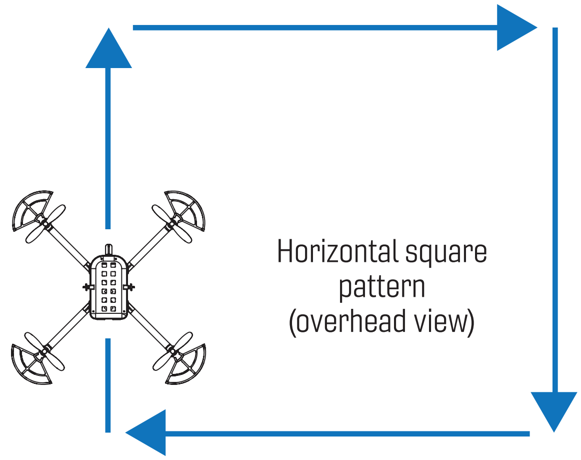
Mastering these controls will help students fly safely and confidently.

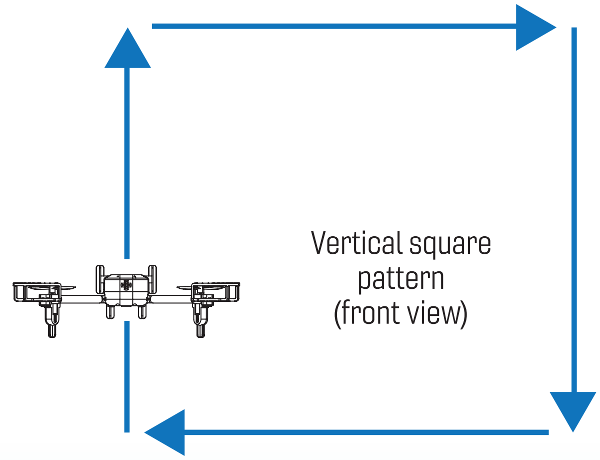


STEP 5: Commence Drone Flight.

Once students understand the controls, they'll be ready to fly.

- Pair the controller with the drone (page 10 of the instruction manual).
- Conduct a pre-flight check (page 11 of the instruction manual).
- Focus on basic movements and flight stability during the first flight. Instruct the students to fly in a horizontal, square pattern of an appropriate size based on your flight area. Next, fly in a vertical, square pattern.





4 FLIGHT ACTIVITIES AND INVESTIGATIONS

These hands-on challenges will put students' knowledge of engineering, aerodynamics, and technology to the test. Each activity encourages teamwork, critical thinking, and real-world STEM applications.

ACTIVITY 1: Precision Landing

Objective: Improve fine motor control and enhance flight accuracy.

Materials:

- Discovery Drone
- Colored paper, cardboard, or tape

Create landing zones of different sizes using colored paper, cardboard, or tape. Establish a flightline from which students will pilot the drones. They will attempt to land their drones on each zone. Score points based on how close they land to the center!

Discussion or Journal Prompt: How did you adjust the controls for a more accurate landing? What strategy helped most?

ACTIVITY 2: Payload Lift Challenge

Objective: Explore how adding weight impacts drone flight.

Materials:

- Discovery Drone
- Small, lightweight objects (e.g., paper clips and foam) to use as "payloads"
- Scale (optional)
- Timer (optional)

Tasks:

- Test how much weight the drone can lift without losing flight stability. Weigh the payload if possible, or measure using increments.
- Have students attach small, lightweight objects (e.g., paperclips and foam) to the drone as "payloads." Consider adjusting the location of the additional weight on the drone. Have fun experimenting with this!
- Observe the drone's flight behavior.
- Record the flight data with different payloads in the flight log (optional).

Discussion or Journal Prompt: What happened when you added more weight? How does this relate to lift?

ACTIVITY 3: Drone Mission

Objective: Apply drone navigation skills to solve a real-world problem.

Materials:

- Discovery Drone and charged batteries
- Small, lightweight materials to be retrieved
- Furniture or cones to act as obstacles
- Paperclips to use as hooks for transporting items (optional)

Tasks:

- Set up a "pick-up zone" using lightweight materials.
- Engineer a solution that utilizes the included connectors and body tubes to retrieve the objects you set out.
- Encourage students to navigate their drone through a course to locate and retrieve the target.
- Make the activity more challenging by incorporating time limits or added obstacles.

Discussion or Journal Prompt: Could drones be used in real-life pick-up and delivery missions? What skills were most important in this challenge?

5 DRONE REDESIGN AND INNOVATION CHALLENGE

Now that students have successfully built and flown the Discovery Drone, it's time to further develop their skills. In this challenge, students will apply their experience with drone structure and flight to develop a custom version of the Discovery Drone using different arm lengths.

Objective:

Solve a specific challenge to explore how changes in design affect flight by modifying the drone frame and testing new configurations.

Possible Challenges:

- Design the most stable drone.
- Design the nimblest drone.
- Design a drone that has the most lifting capacity.
- Design the most artistic-looking drone.

Materials:

- Discovery Drone Kit
- Rulers
- Scissors
- Markers
- Paper
- Pencils

Brainstorm and Sketch:

In groups or individually, students will:

- Brainstorm new frame designs using longer, shorter, or asymmetrical body tube lengths for the drone arms.
- Sketch design ideas.
- Label the measurements and key parts in their diagrams.

Collaborate and Share:

Students will present their sketches and ideas to their work groups for peer feedback and improvement suggestions. Groups choose one design to proceed with and give the drone a name that reflects its features or purpose.

Build and Test:

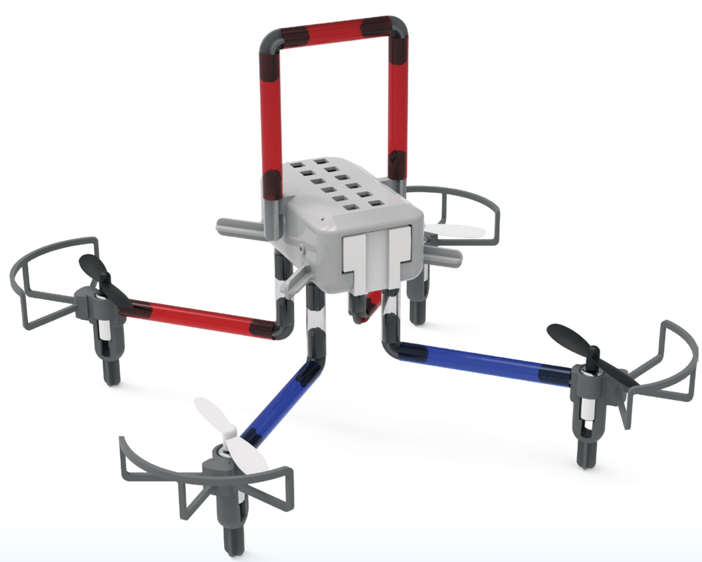
Students will measure, cut, and install body tubes to build the redesigned drone. Students should carefully assemble the frame, reattaching motors and propellers. Teams may then conduct test flights and record results in their flight log.

Compare and Reflect:

After testing, students will analyze how their new drone performs compared to their original version.

Discussion or Journal Prompt:

Is your redesigned drone more or less stable? Does it turn faster or slower? How does the new shape affect lift or speed?



6 TROUBLESHOOTING

Drone won't take off:

- Check the weight of your drone. The maximum weight that the drone motors can lift is between 65 and 75 grams (2.29-2.64 ounces). The drone with the battery in the lightest configuration weighs around 50 grams (1.76 ounces).
- The propellers are flipped. If the propellers 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 low, the drone will land automatically and won't take off.

Drone flips over when taking off:

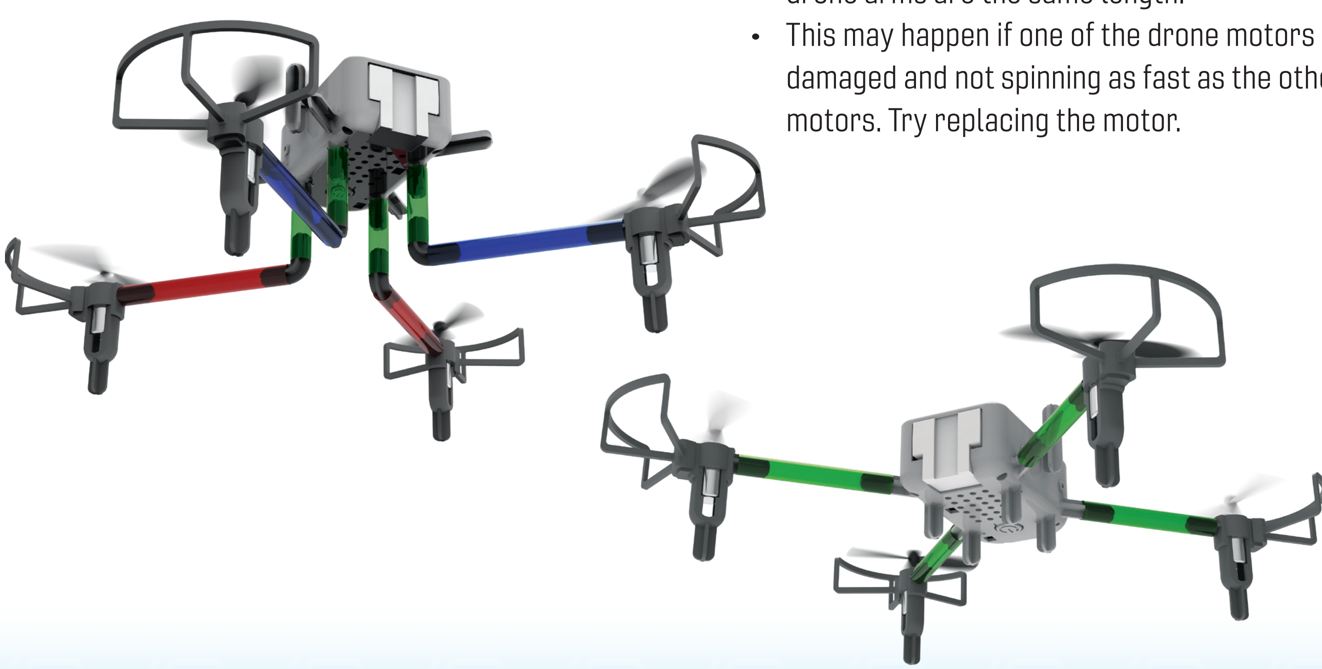
- Two of the propellers are not on the correct motors. The propellers must be on the correct motors; if one or more propellers are incorrect, the drone may flip over during takeoff.

Drone flies erratically after taking off:

- The motors might not be aligned correctly. If one or more motors are askew, 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. Align the motors and/or replace the damaged drone arm to fix the issue.
- The drone may not know what direction is up. When you pair the transmitter to the drone, be certain that the drone is on a level surface that is not moving. Power cycle the equipment to recalibrate and re-pair.

Drone drifts toward one of the motors:

- This may indicate that one of the arms of the drone is a different length than the others. The drone will be the most stable when all of the drone arms are the same length.
- This may happen if one of the drone motors is damaged and not spinning as fast as the other motors. Try replacing the motor.



7 RESOURCES AND NEXT GENERATION SCIENCE STANDARDS

GRADE LEVEL STANDARDS

Next Generations Science Standards (NGSS) & Common Core State Standards (CCSS)	
Enduring Understanding	• Flight is impacted by four forces of flight: lift, thrust, drag, and weight. These forces work together to create flight. • Technology and engineering helps us to find solutions for real-world problems through designing, testing, and careful improvement. • Collaboration, testing, and thinking outside the box are important to the engineering process.
Essential Questions	• How does making slight changes to a drone's design or payload affect its performance? • What forces affect how a drone flies? How can you use this knowledge to understand and operate your drone better? • What designs and changes can you make to your drone in order to complete real-world tasks? • What skills do you need to operate a drone and complete an assigned task safely and accurately?

GRADE 3

Next Generations Science Standards (NGSS) & Common Core State Standards (CCSS)	
Student Learning Objectives	• Improve fine motor control and enhance flight accuracy. (3-5-ETS1-3) • Apply drone navigation skills to solve a real-world problem. (3-5-ETS1-1), (3-5-ETS1-2) • Solve a specific challenge to explore how the changes in design affect flight by modifying the drone frame and testing new configurations. (3-5-ETS1-3)

NGSS Standards **Students who demonstrate understanding can:**	**Science & Engineering Practices With Additional Skills** **Students will know:**	**Disciplinary Core Ideas (DCI) With Extended Knowledge** **Students will be able to:**	**Cross-Cutting Concepts** **Students will apply:**
3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces	**Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.	**PS2.A: Forces and Motion** Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not	**Cause and Effect** Cause and effect relationships are routinely identified.

pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]	Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. ------------------------------- **Connections to Nature of Science** **Scientific Investigations Use a Variety of Methods** Science investigations use a variety of methods, tools, and techniques.	quantitative addition of forces are used at this level.)	
3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]	**Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. ------------------------------- **Connections to Nature of Science** **Science Knowledge is Based on Empirical Evidence** Science findings are based on recognizing patterns.	**PS2.A: Forces and Motion** The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)	**Patterns** Patterns of change can be used to make predictions.
3-5-ETS1-1 Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	**Asking Questions and Defining Problems** Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.	**ETS1.A: Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering	**Influence of Science, Engineering, and Technology on Society and the Natural World** People's needs and wants change over time, as do

	Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	their demands for new and improved technologies.
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.	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	**ETS1.B: Developing Possible Solutions** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	
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.	**Influence of Science, Engineering, and Technology on Society and the Natural World** Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.	**ETS1.B: Developing Possible Solutions** Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ETS1.C: Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	
Connections to other DCIs in this grade level: **N/A**			
Articulation of DCIs across grade bands: **K.PS2.A** (3-PS2-1); **K.PS2.B** (3-PS2-1); **K.PS3.C** (3-PS2-1); **K-2.ETS1.A** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **K-2-ETS1.C** (3-5 ETS1-2); **K-2.ETS1.B** (3-5-ETS1-2); **K-2.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3); **1.ESS1.A** (3.PS2-2); **4.PS4.A** (3-PS2-2); **5.PS2.B** (3-PS2-1); **MS.PS2.A** (3-PS2-1) , (3-PS2-2); **MS.ESS1.B** (3-PS2-1) , (3-PS2-2); **MS.ESS2.C** (3-PS2-1); **MS.ETS1.A** (3-5-ETS1-1); **MS.ETS1.B** (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3); **MS.ETS1.C** (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)			

Common Core State Standards Connections:

ELA/Literacy

R1.3.1	Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-PS2-1)*
W.3.7	Conduct short research projects that build knowledge about a topic. *(3-PS2-1), (3-PS2-2)*
W.3.8	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. *(3-PS2-1), (3.PS2-2)*

Mathematics

MP.2	Reason abstractly and quantitatively. *(3-PS2-1) , (3-5-ETS1-3)*
MP.4	Model with mathematics. *(3-5-ETS1-3)*
MP.5	Use appropriate tools strategically. *(3-PS2-1), (3-5-ETS1-3)*
3-5.OA	Operations and Algebraic Thinking *(3-ETS1-1)*
3.MD.A.2	Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. *(3-PS2-1)*

GRADE 4

Next Generations Science Standards (NGSS) & Common Core State Standards (CCSS)

Student Learning Objectives	• Improve fine motor control and enhance flight accuracy. (4-PS3-1), (3-5-ETS1-3) • Explore how adding weight impacts drone flight. (4-PS3-4), (3-5-ETS1-1) • Apply drone navigation skills to solve a real-world problem. (4-PS4-3), (3-5-ETS1-2) • Solve a specific challenge to explore how the changes in design affect flight by modifying the drone frame and testing new configurations. (3-5-ETS1-2), (3-5-ETS1-3)

NGSS Standards **Students who demonstrate understanding can:**	**Science & Engineering Practices With Additional Skills** **Students will know:**	**Disciplinary Core Ideas (DCI) With Extended Knowledge** **Students will be able to:**	**Cross-Cutting Concepts** **Students will apply:**
4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object. [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., measurements, observations, patterns) to construct an explanation.	**PS3.A: Definitions of Energy** The faster a given object is moving, the more energy it possesses.	**Energy and Matter** Energy can be transferred in various ways and between objects.

4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide. [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]	**Asking Questions and Defining Problems** Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.	**PS3.C: Relationship Between Energy and Forces** When objects collide, the contact forces transfer energy so as to change the objects' motions.	
4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Apply scientific ideas to solve design problems.	**PS3.B: Conservation of Energy and Energy Transfer** Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. **ETS1.A: Defining Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (secondary)	**Energy and Matter** Energy can be transferred in various ways and between objects. ------------- **Connections to Engineering, Technology, and Applications of Science** **Influence of Engineering, Technology, and Science on Society and the Natural World** Engineers improve existing technologies or develop new ones. ------------- **Connections to Nature of Science** **Science is a Human Endeavor** Most scientists and engineers work in teams. Science affects everyday life.

4-PS4-3 Generate and compare multiple solutions that use patterns to transfer information. * [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]		**PS4.C: Information Technologies and Instrumentation** Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. **ETS1.C: Optimizing The Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary)	**Patterns** Similarities and differences in patterns can be used to sort and classify designed products. ------------- **Connections to Engineering, Technology, and Applications of Science** **Interdependence of Science, Engineering, and Technology** Knowledge of relevant scientific concepts and research findings is important in engineering.
3-5-ETS1-1 Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	**Asking Questions and Defining Problems** Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	**ETS1.A: Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	**Influence of Science, Engineering, and Technology on Society and the Natural World** People's needs and wants change over time, as do their demands for new and improved technologies.
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.	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and	**ETS1.B: Developing Possible Solutions** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions.	

	predict phenomena and in designing multiple solutions to design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.	At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	
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.	**Influence of Science, Engineering, and Technology on Society and the Natural World** Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.	**ETS1.B: Developing Possible Solutions** Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ETS1.C: Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	

Connections to other DCIs in this grade level: **4-ESS3-2; 4.ETS.1.A**

Articulation of DCIs across grade bands:

K.PS2.B (4-PS3-3); **K.ETS1.A** (4-PS3-4), (4-PS4-3); **K-2.ETS1.A** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **K-2-ETS1.C** (3-5 ETS1-2); **K-2.ETS1.B** (3-5-ETS1-2); **K-2.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3); **2ETS1.B** (4-PS3-4), (4-PS4-3); **2ETS1.C** (K-PS4-3); **3.PS2.A** (4-PS-3-3); **5.LS1.C** (4-PS3-4); **MS.P3.A** (4-PS3-3), (4-PS3-4); **MS.PS3.A** (4-PS-3-1, 4-PS3-3); **MS.PS3.B** (4-PS3-3), (4-PS3-4); **MS.PS3.C** (4-PS3-3); **MS.PS4.C** (4-PS4-3); **MS.ETS1.A** (3-5-ETS1-1); **MS.ETS1.B** (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3), (4-PS4-3); **MS.ETS1.C** (3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3), (4-PS3-4)

Common Core State Standards Connections:

ELA/Literacy

RI.4.1	Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. *(4-PS3-1), (4PS4-3)*
RI.4.3	Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. *(4-PS3-1)*
RI.4.9	Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. *(4-PS3-1)*
W.4.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. *(4-PS3-1)*
W.4.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic. *(4-PS3-3), (4-PS3-4)*
W.4.8	Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. *(4-PS3-1), (4-PS3-3), 4-PS3-4)*
W.4.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. *(4-PS3-1), (4-PS4-3)*

Mathematics	
MP.2	Reason abstractly and quantitatively. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.4	Model with mathematics. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.5	Use appropriate tools strategically. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
3-5.OA	Operations and Algebraic Thinking *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
4.OA.A.3	Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. *(4-PS3-4)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

GRADE 5

Next Generations Science Standards (NGSS) & Common Core State Standards (CCSS)

Student Learning Objectives	• Improve fine motor control and enhance flight accuracy. (3-5-ETS1-3) • Explore how adding weight impacts drone flight. (5-PS2-1) (3-5-ETS1-1) • Apply drone navigation skills to solve a real-world problem. (3-5-ETS1-2) • Solve a specific challenge to explore how the changes in design affect flight by modifying the drone frame and testing new configurations. (3-5-ETS1-3)

NGSS Standards **Students who demonstrate understanding can:**	**Science & Engineering Practices With Additional Skills** **Students will know:**	**Disciplinary Core Ideas (DCI) With Extended Knowledge** **Students will be able to:**	**Cross-Cutting Concepts** **Students will apply:**
5-PS1-3 Make observations and measurements to identify materials based on their properties. [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.]	**Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	**PS1.A: Structure and Properties of Matter** Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

[Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]			
5-PS2-1 Support an argument with evidence, data, or a model. [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]	**Engaging in Argument from Evidence** Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Support an argument with evidence, data, or a model.	**PS2.B: Types of Interactions** The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	**Cause and Effect** Cause and effect relationships are routinely identified and used to explain change.
3-5-ETS1-1 Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	**Asking Questions and Defining Problems** Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	**ETS1.A: Defining and Delimiting Engineering Problems** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.	**Influence of Science, Engineering, and Technology on Society and the Natural World** People's needs and wants change over time, as do their demands for new and improved technologies.
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.	**Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Generate and compare multiple solutions to a	**ETS1.B: Developing Possible Solutions** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared	

	problem based on how well they meet the criteria and constraints of the design problem.	ideas can lead to improved designs.	
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.	**Influence of Science, Engineering, and Technology on Society and the Natural World** Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.	**ETS1.B: Developing Possible Solutions** Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ETS1.C: Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	

Connections to other DCIs in this grade level: **N/A**

Articulation of DCIs across grade bands:

K-2.ETS1.A (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **K-2.ETS1.B** (3-5-ETS1-2); **K-2.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3); **2.PS1.A** (5-PS1-3); **3.PS2.A** (5-PS2-1); **MS.PS1.A** (5-PS1-3); **MSPS2.B** (5-PS2-1); **MS.ESS1.B** (5-PS2-1); **MS.ESS2.C** (5-PS2-1); **MS.ETS1.A** (3-5-ETS1-1); **MS.ETS1.B** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3)

Common Core State Standards Connections:

ELA/Literacy

RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-PS2-1), (3-5-ETS1-3)*
RI.5.1	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(3-5-ETS1-2)*
RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. *(5-PS2-1), (3-5-ETS1-3)*
W.5.1	Write opinion pieces on topics or texts, supporting a point of view with reasons and information. *(5-PS2-1)*
W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. *(5-PS1-3), (3-5-ETS1-1), (3-5-ETS1-2)*
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(5-PS1-3), (3-5-ETS1-1), (3-5-ETS1-2)*
W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-1), (3-5-ETS1-2), (5-PS1-3)*

Mathematics

MP.2	Reason abstractly and quantitatively. *(3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3), (5-PS1-3)*
MP.4	Model with mathematics. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3), (5-PS1-3)*
MP.5	Use appropriate tools strategically. *(3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3); (5-PS1-3)*
3-5.OA	Operations and Algebraic Thinking *(3-5-ETS1-1), (3-5-ETS1-2), (3-5-ETS1-3)*

FLIGHT LOG

KNOW BEFORE YOU FLY
Discovery Drone Kit Lesson Plan

PRE-FLIGHT CHECK LIST

- ☐ Make sure the drone, controller, and batteries are fully charged.
- ☐ Inspect the drone, controller, and batteries for damage. If a drone component is visibly broken, do not use it. If a battery is puffy or swollen, do not use it.
- ☐ Check the wires to be sure they are connected.
- ☐ Be sure the motors are straight and not tilted.
- ☐ Make sure the arms are not loose.
- ☐ Check that the propellers have not come loose and are clear of debris like hair or dirt.
- ☐ Ask an adult if you have any questions before you fly.

	Date	Pilot Name	Flight Time	Task	Issues/Notes
1					
2					
3					
4					
5					

POST-FLIGHT CHECKLIST

- ☐ Make sure the drone is disarmed.
- ☐ Remove the battery.
- ☐ Check the wires to be sure they are connected.
- ☐ Be sure the motors are straight and not tilted.
- ☐ Make sure the arms are not loose.
- ☐ Check that the propellers have not come loose and are clear of debris like hair or dirt.

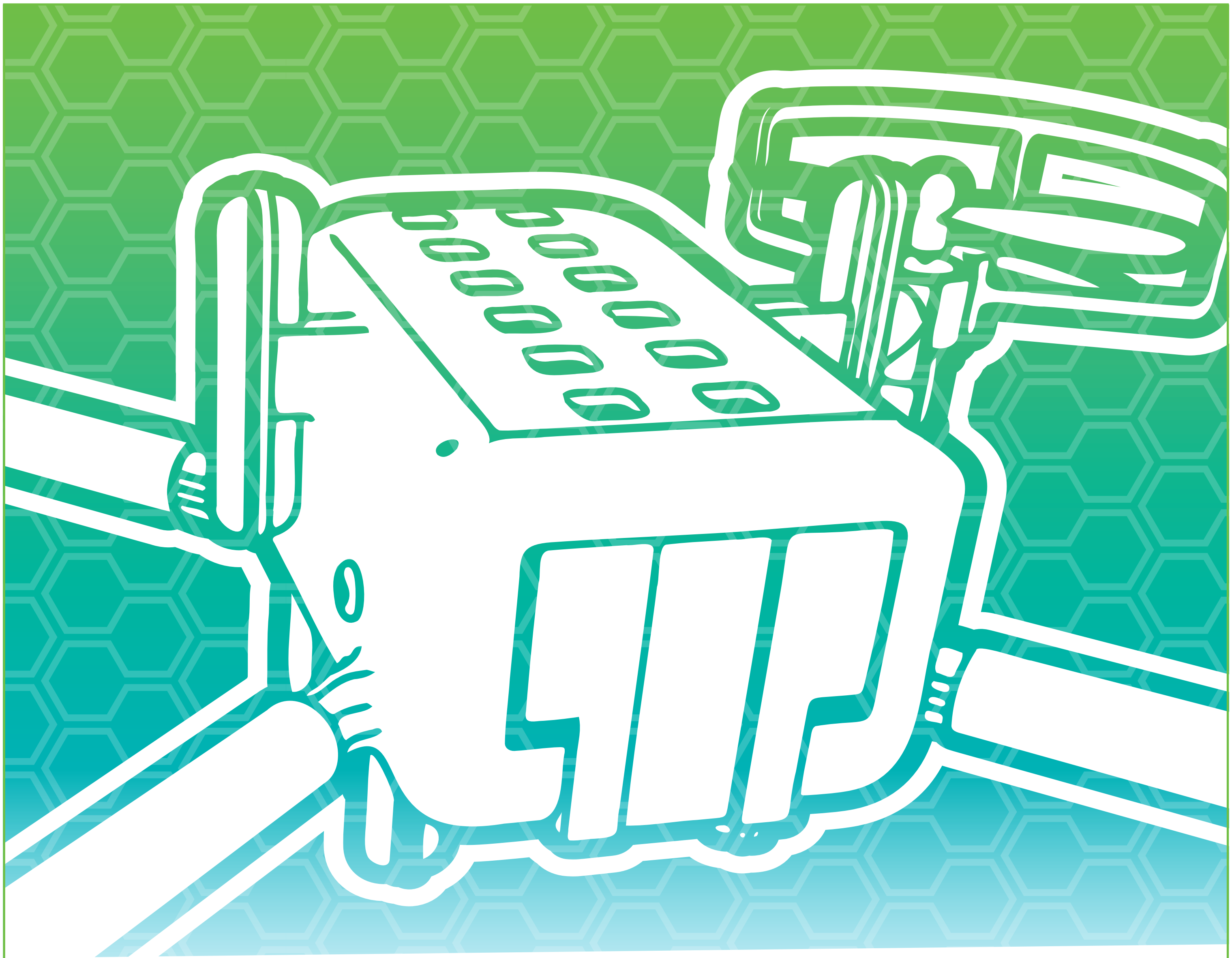
KNOW BEFORE YOU FLY

Discovery Drone Kit

The Discovery Drone Kit instruction manual, educational lessons, flight log, and teacher training and resources are available at

https://knowbeforeyoufly.org/Discovery-Drone-Kit

knowbeforeyoufly.org/
Discovery-Drone-Kit



PITSCO
EDUCATION

Have questions about the drone components?
There are a variety of ways to get in touch with Pitsco, the manufacturer:

800-774-4552 support@pitsco.com www.Pitsco.com/Support

pitsco.com/products/
drone-maker-kit

Replacement parts:

To order replacement components or additional kits,
visit the manufacturer's website at

www.pitsco.com/products/drone-maker-kit