PCS edventures!™

Experts in Hands-On STEM Education

Discover Drones

Grades 7-12

CURRICULUM SAMPLE

edventures.com

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(208) 343-3110

DRONES

CLUB

CLASSROOM

7 DRONE PREMIUM

10 DRONE PREMIUM

PCS edventures!™
Experts in Hands-On STEM Education

Discover Drones

GRADES: 7-12

STUDENTS
Varies by package

TIME
30+ Contact Hours

SUBJECTS
- Physical Science
- Technology

SETTINGS
- Before & After-school programs
- Out-of-school programs
- Tech Ed classrooms
- Robotics clubs
- Drone racing teams

Learners experience the world's fastest-growing technology with collaborative, **scaffolded** lessons in engineering and applied science. They'll build their own drone, learn safety regulations and experience UAV flight!

TECH REQUIREMENTS

Discover Drones incorporates three digital elements:
- *Droneology,* a web-based course compatible with all devices.
- *RubiQ Configurator - Flight Configurator,* available as an app for Windows or a Chrome browser extension for other operating systems and tablets. Requires a USB port.
- *FPV Freerider,* a flight simulator software compatible with Windows, OSX and Linux operating systems. **FPV Freerider is not compatible with iOS, Android, or Chromebooks. Requires a USB port.**

PRICING OPTIONS
- Club Base Package - 2 Drones: $3,995^{00}
- Classroom Base Package - 5 Drones: $8,995^{00}
- Premium Package - 7 Drones: $18,495^{00}
- Premium Package - 10 Drones: $25,995^{00}
- Custom Packages Available

SCAN OR CLICK QR CODE FOR:

PRODUCT ORIENTATION	FULL MATERIAL LIST	STANDARDS & ALIGNMENT

CONTACT US:
Call: **(208) 343-3110**
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Web: **edventures.com**

Rev: 12/18/25

INTRODUCTION

Welcome to the Wild West of winged robotics! Drones help fight wildfires, perform at the Super Bowl, inspect hundreds of miles of pipelines, film stunning moments of movie-making magic, thrill spectators in FPV racing, bring crucial supplies to hard-to-reach areas and even deliver pizzas in New Zealand. The world has fallen in love with them, and we're sure your students will too.

In this 3rd edition of the Discover Drones Instructor Guide, we've included brand new lesson plans and slides to enhance your teaching experience and provide even more tools to engage your students. These resources are designed to guide you through every step of your drone program, ensuring that your students develop both technical and creative skills with this exciting technology.

This educator guide is here to help as you launch your program, guide your students through the curriculum and maybe even build a drone racing team. Before getting started, you first need to introduce yourself to your drone, RubiQ, (**R**obotic-**U**nmanned-**B**ird), who joins RiQ, the Arduino-based PCS robot, and the EiQ engineering kit as the latest addition to the PCS Edventures iQ series. You and RubiQ will be getting very close over the course of *Discover Drones!* Additional details on RubiQ's flight control configuration, troubleshooting and more can be found at rubiq.edventures.com, as well as in the printed RubiQ Flight Manual that comes with each set of RubiQ parts.

If you ever need additional guidance or want to share the awesome work your students are doing, send us a message at rubiq.edventures.com/support. We'd love to hear from you!

Note: Before continuing, please make sure you have taken inventory of your materials and set up access to your digital resources! For detailed instructions, review the Discover Drones Getting Started Guide.

Scan the QR Code for a link to the Discover Drones Overview Video.

CURRICULUM OVERVIEW

The *Discover Drones* program breaks down into five main pieces: build and configure RubiQ, learn the basics of UAV operations through Droneology, train on the flight simulator, go out and fly and understand the STEM that makes it all possible. Rather than working through each part of the program sequentially, the LABCard curriculum takes an integrated approach, so, plan to dedicate at least this much time for each piece:

- Build and configure RubiQ: 3+hr
- Complete Droneology: 3-5 hr
- Train on the flight simulator: 7-9 hr
- Fly: At least 30 min per student
- Explore STEM: 2-3 hr

Note: The 2-3 hours estimated for STEM will give you just enough time to cover the material written into the LABCard curriculum. As students start asking their own questions, you'll probably end up wanting more time, and that's where you and your students can really make the program your own. Check out the Explore More sections in the Instructor Version of the LABCards (later in this guide) for resources and ideas to go deeper into STEM and UAV technology.

In its simplest form, *Discover Drones* is a 25-30 hr (depending on the size of your group) introduction to the world of UAVs. To go through the full curriculum outline in the pacing guide, plan on 50 hours for a smaller group of 10 or closer to 100 hours for a full class of 25. If you have more time, check out the optional End Design Projects at the end of each level for additional extension ideas, or consider expanding the time for student flight practice. The full curriculum breakdown includes 7 hours of simulator time and 3 hours of flight time for each student, but pilots will only keep improving with more time, whether on the flight simulator or with RubiQ. However, depending on how much time you have to work with, don't feel like you have to complete every project and every flight challenge. The end of the third level, Purple, is one natural stopping point. Each card of the fourth level, Blue, extends the curriculum further, but depending on the length of your program and the size of your group, it's okay if you don't get through them all. The most important thing is that your students have enough training to fly safely and have a positive experience with drones.

The following pages include a pacing guide for the entire curriculum, as well as several examples of how the *Discover Drones* resources could be adapted for several different teaching scenarios.

PACING GUIDE

YELLOW: 4.5-7 hr
Build RubiQ
Register for Droneology
Droneology: Introduction, Essential Knowledge & Laws, Regulations and Coordinating Groups

- **Card O:** 35–55 min
- **Card 1:** 65–90 min
- **Card 2:** 65–90 min
- **Card 3:** 55–80 min
- **Card 4:** 60–90 min

ORANGE: 7.5-10.5 hr
Configure RubiQ's radio controller and LED's
Droneology: Basic Piloting Skills & Ethical Operation
Begin flight simulator training

- **Card O:** 30–45 min
- **Card 1:** 90–120 min
- **Card 2:** 90–120 min
- **Card 3:** 110–160 min
- **Card 4:** 135–190 min

PURPLE: 10.5-14.5 hr + 1 hr per student
Configure RubiQ's motors and sensors
Droneology: Drones and the Future & Flight Safety
Continue flight simulator training
Begin RubiQ flight practice

- **Card O:** 65–88 min
- **Card 1:** 105–140 min
- **Card 2:** 110–140 min
- **Card 3:** 170–235 min + 30 min per student
- **Card 4:** 190–270 min + 30 min per student

BLUE: 17- 24.5 hr + 2 hr per student
Aeronautics flight experiments
Continue flight simulator training
Continue RubiQ flight practice

- **Card O:** 30–45 min
- **Card 1:** 210–320 min + 30 min per student
- **Card 2:** 260–360 min + 15 min per student
- **Card 3:** 260–360 min + 15 min per student
- **Card 4:** 265–400 min + 60 min per student

EXAMPLE CURRICULUM MAPS

45-HR UAV UNIT (1 hour a day Mon-Fri for 9 weeks)

The first three weeks of *Discover Drones* are primarily small-group, in-class activities as students build and configure their drones and progress through *Droneology*. Outdoor line-of-sight (LOS) piloting begins in Week 4. This activity is much easier to manage if you're able to bring out one student group at a time. If possible, partner with a librarian, aid or even administrator who would be willing to supervise the students who stay inside as they log time on the flight simulator and work on their end design projects. Check out the End Design Projects on the Overview card for each level and choose the one that best fits your program's objectives.

Week	Topics	Curriculum
1	RubiQ Build & Droneology	Yellow Cards O-4
2	RubiQ Configuration & Flight Simulator	Orange Cards O-3
3	RubiQ Configuration & Flight Simulator	Orange Card 4, Purple Cards O-2
4	Flight Simulator & LOS Piloting for 3 students	Purple Cards 3, 4
5	Flight Simulator, LOS Piloting (5 students) & End Design Project	Purple Cards 3, 4
6	Flight Simulator, LOS Piloting (5 students) & End Design Project	Purple Cards 3, 4
7	Flight Simulator, LOS Piloting (5 students) & End Design Project	Purple Cards 3, 4
8	Flight Simulator, LOS Piloting (5 students) & End Design Project	Purple Cards 3, 4
9	Flight Simulator, LOS Piloting (5 students) & End Design Project	Purple Cards 3, 4

FULL SEMESTER UAV COURSE (1 hour a day Mon. to Fri. for 18 weeks)

The first three weeks of *Discover Drones* are primarily small-group, in-class activities as students build and configure their drones and progress through *Droneology*. Outdoor line-of-sight (LOS) piloting begins in Week 4. This activity is much easier to manage if you're able to bring out one student group at a time. If possible, partner with a librarian, aid or even administrator who would be willing to supervise the students who stay inside as they log time on the flight simulator and work on their end design projects.

Week	Topics	Curriculum
1	RubiQ Build & Droneology	Yellow Cards O-4
2	RubiQ Configuration & Flight Simulator	Orange Cards O-2
3	RubiQ Configuration & Flight Simulator	Orange Card 3, 4,
4	RubiQ Configuration & Flight Simulator	Purple Card O-2
5	LOS Piloting (10 students), Flight Simulator & Video Project	Purple Card 3/EDP
6	LOS Piloting (10 students), Flight Simulator & Video Project	Purple Card 4/EDP
7	LOS Piloting (10 students), Flight Simulator & Video Project	Purple Card 4/EDP
8	Video Project	Purple EDP
9	FPV Piloting (10 students), Flight Simulator & FAA Project	Blue Card O, 1
10	FPV Piloting, Flight Simulator & FAA Project	Blue Card 1/Yellow EDP
11	FPV Piloting, Flight Simulator & FAA Project	Blue Card 2/Yellow EDP
12	FPV Piloting, Flight Simulator & Careers Project	Blue Card 2/Orange EDP
13	FPV Piloting, Flight Simulator & Careers Project	Blue Card 2/Orange EDP
14	FPV Piloting, Flight Simulator & Lab Reports	Blue Card 3
15	FPV Piloting, Flight Simulator & Lab Reports	Blue Card 3
16	FPV Piloting, Flight Simulator & Lab Reports	Blue Card 4
17	FPV Piloting, Flight Simulator & Lab Reports	Blue Card 4
18	Capstone Projects	Race or Alternate Ending (see Appendix)

DRONE CLUB (90 min. once a week for 18 weeks)

Week	Topics	Curriculum
1	Welcome to the World of Drones	Yellow Card O, 1
2	RubiQ Build Steps 1-4 & Droneology	Yellow Card 2
3	RubiQ Build Steps 5-7 & Droneology	Yellow Card 3
4	RubiQ Build Steps 8-11 & Droneology	Yellow Card 4, Orange Card O
5	Intro to Flight Simulator & Droneology	Orange Card 1 (all), Orange Card 2 C2
6	Intro to the RubiQ Configurator, Battery Safety & Flight Simulator	Orange Card 2 P1, P2, C1, Explore More
7	Radio Configuration & Flight Simulator	Orange Card 3 P1, P2, C1, Explore More
8	RubiQ Beeps and Blinks, Droneology & Flight Simulator	Orange Card 3 C2, Orange Card 4 P1, P2, C1, C2
9	Prepare to Fly Drones	Purple Card O
10	RubiQ Motor Configuration, Droneology & Flight Simulator	Purple Card 1
11	RubiQ Sensor Calibration, Droneology & Flight Simulator	Purple Card 2
12	RubiQ Pre-Flight Check & Flight Practice	Purple Card 3
13	Review Pre-Flight Check & More Flight Practice	Purple Card 3
14	Physics of Flight & Flight Practice	Purple Card 4
15	More Flight Practice	Purple Card 4
16	FPV Set-Up & Flight Practice	Blue Card O, 1
17	More Flight Practice & Prep for Final Competition	Blue Card 1
18	Final Competition	Race or Other Skills Showcase

DRONE CAMP (3 hours a day for 4 days)

DAY 1

Topics	Curriculum
Welcome to the World of Drones	Yellow Card O
Droneology: Introduction	Yellow Card 1 P1
Droneology: Essential Knowledge, Part One	Yellow Card 1 P2, C1, C2
RubiQ Build: Steps 1-4	Yellow Card 2 P1
Droneology: Essential Knowledge, Part Two	Yellow Card 2 P2, C1
Flight Simulator Practice	Orange Card O, 1 P1, P2, C1

DAY 2

Topics	Curriculum
Discussion: Can you name a job that has changed because of drones?	Orange Card O Slides
Droneology: Laws, Regulations & Coordinating Groups	Yellow Card 2 C2; Yellow Card 3 C1, C2; Yellow Card 4 C1, C2
RubiQ Build: Steps 5-7	Yellow Card 3 P1, P2
Droneology: Ethical Operations	Orange Card 2 C1, Orange Card 3 C1
FPV Freerider Tutorials	Explore More Resource in Educator Guide for Orange Card 1
Flight Simulator Practice	Orange Card 2 C2

DAY 3

Topics	Curriculum
Discussion: how do drones serve a purpose in society?	
Droneology: Drones and The Future	Orange Card 4 C1, Purple Card 1 C1
RubiQ Build: Steps 8-11	Yellow Card 4 P1, P2
Droneology: Piloting Skills	Orange Card 1 C2
Flight Simulator Practice	Orange Card 3 C1

With the shorter timeline, instructors need to configure the now-assembled RubiQ's prior to flight time on Day 4 (visit rubiq.edventures.com for step-by-step instructions).

DAY 4

Topics	Curriculum
Prepare to Fly Drones	Purple Card O
Droneology: Flight Safety	Purple Card 2 C1
RubiQ Flight Time	Purple Card 3 P1, P2, C1 - as group size allows

FULL SEMESTER UAV COURSE WITH PART 107 TEST PREP
(1 hour a day Mon. to Fri. for 18 weeks)

PCS Edventures partners with UAV Coach to offer prep courses for students looking to earn their Remote Pilot Certification. We recommend setting aside at least 30 hours of time for students to complete *Drone Pilot Ground School*. If possible, partner with a librarian, aid or even administrator who would be willing to supervise your students as they work through the self-paced online curriculum while you take small groups of students outside to log their flight hours and practice advanced piloting skills. Otherwise, replace the Blue Level of the LABCards with *Drone Pilot Ground School*, devote weeks 9-11 to the Orange EDP Drone Careers Project in class, then transition to full test prep for weeks 12-17.

Week	Topics	Curriculum
1	RubiQ Build & Droneology	Yellow Cards O-4
2	RubiQ Configuration & Flight Simulator	Orange Cards O-2
3	RubiQ Configuration & Flight Simulator	Orange Cards 3, 4
4	RubiQ Configuration & Flight Simulator	Purple Cards O, 1, 2
5	LOS Piloting, Flight Simulator & Video Project	Purple Card 3/EDP
6	LOS Piloting, Flight Simulator & Video Project	Purple Card 3/EDP
7	LOS Piloting, Flight Simulator & Video Project	Purple Card 4/EDP
8	LOS Piloting, Flight Simulator & Video Project	Purple Card 4/EDP
9	Video Project	Purple EDP
10	FPV Piloting, Flight Simulator & **Careers Project**	Blue Card O, 1/Orange EDP
11	FPV Piloting, Flight Simulator & **Careers Project**	Blue Card 1/Orange EDP
12	FPV Piloting, Flight Simulator & **Careers Project**	Blue Card 2/Orange EDP
13	FPV Piloting, Flight Simulator & **Drone Pilot Ground School**	Blue Card 2
14	FPV Piloting, Flight Simulator & **Drone Pilot Ground School**	Blue Card 2
15	FPV Piloting, Flight Simulator & **Drone Pilot Ground School**	Blue Card 3
16	FPV Piloting, Flight Simulator & **Drone Pilot Ground School**	Blue Card 3
17	FPV Piloting, Flight Simulator & **Drone Pilot Ground School**	Blue Card 4
18	FPV Piloting, Flight Simulator & **Drone Pilot Ground School**	Blue Card 4, Race and/or Part 107 Tests

Orange Card 2:

RubiQ Configurator & Batteries

TIME REQUIRED: 90–120 minutes

SCHEDULE

The lesson topics listed below follow the order in the accompanying slide presentations. In the slides, the lesson topics are divided into headings marked with title transition slides. Each title transition slide is a starting point for a new topic, task, or summary. Divide topics as needed for shorter durations.

Topics:

- ☐ Introduction: Lithium Ion Batteries (10-15m)
- ☐ P1 - Enter the Matrix: Flight Configurator Software (20-25m)
- ☐ P2 - Battery Safety: What makes batteries work (15-20m)
- ☐ C1 - Ethical Operations: Privacy and Publication (15-20m)
- ☐ C2 - Piloting Skills: Flight Simulator Challenge #2 (20-25m)
- ☐ Summary: Review and Key Terms (10-15m)

OBJECTIVES

- Open the section, "Connect to the RubiQ Configurator" in the online RubiQ Configuration Guide, explore the flight controller software and check the LiPo battery voltage.
- Explore the electrochemical science behind LiPo battery safety.

CARD 2

Drones

5 POINTS

CARD 2 OVERVIEW

RubiQ Configurator & Batteries

Without LiPo (lithium-ion polymer) batteries, drone technology wouldn't be possible. These special powerhouses produce more than double the charge of alkaline (AA, AAA, 9V) batteries, are much lighter than other rechargeable batteries (6 times lighter than Lead-Acid batteries) and they don't need to be fully discharged before recharging. LiPo batteries are also made of explosive and volatile chemicals, which means they need to be treated with caution. The LiPo batteries won't bite — just as long as you adhere to all safety precautions. With the wellbeing of the class in mind, it's time to power RubiQ up and begin configuration.

MATERIALS LIST:

- Droneology
- *FPV Freerider* & Flight Simulator Controllers
- LiPo Battery & Safety Goggles
- Online Configuration Guide & RubiQ Configurator
- RubiQ

SAFETY PRECAUTIONS:

- Keep props off.
- Attach antenna before powering up.
- Wear safety goggles when connecting the battery.

CAUTION

FIRE RISK

P1 **Enter the Matrix**

Open the section, "Connect to the RubiQ Configurator" in the online RubiQ Configuration Guide, explore the flight controller software and check the LiPo battery voltage.

Inside the PCB (printed circuit board) of any airborne UAV is a complex system of software and coding working together to keep the drone airborne. Even one miscalibrated setting can cause the drone to fly unpredictably. Before heading to the flight field, you'll need to check RubiQ's settings in the **flight configurator software**.

The USB cable that connects the drone to the computer provides 5V of power to the PCB. This is enough to power some electronic components such as the RX and built-in sensors, but others, like the LED's and motors, require power from the **LiPo** battery.

Before moving forward, watch the Droneology *Flight Safety* videos on *Protective Gear* and *How to Handle LiPo Batteries* to brush up on the best battery practices.

Now, head to the **Connect to the RubiQ Configurator** section in the online *RubiQ Configuration Guide* at rubiq.edventures.com and learn to log into the flight control software.

With RubiQ connected to the RubiQ Configurator, it's time to plug in the **LiPo**. Remember! Safety is paramount. Make sure the props are removed, the antenna is attached and your safety goggles are on. Now, bring RubiQ to life! SHE'S ALIVE! Doesn't she have a beautiful voice?

Now, direct your attention to the top of the screen in the RubiQ Configurator. This section gives a readout of the drone's sensors and settings.

When the **LiPo** is connected, the battery voltage will show in the green battery icon. Make sure to monitor the voltage as you configure over the next few cards. If it drops to 11.1V (3.7V per cell x 3 cells), the battery needs to be charged. Allowing the voltage to drop below this threshold reduces the life of the battery and may cause permanent damage. It also causes Rubi to start screaming. You can't miss it.

After checking its battery life, disconnect the LiPo and return it to the LiPo-safe storage container. Congrats! You've successfully powered up and shut down RubiQ for the first time!

Note: an inactivity alarm triggers when the drone is connected to power but its RX is not receiving commands. To reset the timer and stop the beeping, unplug the battery and plug it back in. Always disconnect batteries from RubiQ when not in use to avoid discharging to dangerously low levels.

MATERIALS

- Droneology
- FPV Freerider & Flight Simulator Controllers
- LiPo Battery & Safety Goggles
- Online Configuration Guide & RubiQ Configurator
- RubiQ

SAFETY PRECAUTIONS

- Keep props off.
- Attach antenna before powering up.
- Wear safety goggles when connecting the battery.

KEY TERMS

- **Configurator:** a software platform for adjusting the flight control settings programmed to a drone.
- **Electrolyte:** a solution that contains ions; because electrolytes can conduct electricity, they are often included in circuits.
- **LiPo (lithium polymer):** a type of rechargeable battery powered by lithium ions and a polymer electrolyte.
- **Voltage:** electric potential energy, or the difference in charge between two points; the amount of "push" available to motivate electrons to move through a circuit.

CARD 2

Drones

P2 Battery Safety

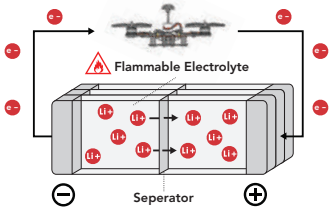
Explore the electrochemical science behind LiPo battery safety.

*Always charge and store batteries inside a fireproof storage container. **LiPo** (lithium polymer) batteries are chemically volatile and can be extremely dangerous if not handled properly. Lithium battery fires can create fireballs up to 1.8 m in diameter and burn at over 1000° C.*

FIRE RISK

So, what's actually going on inside a **LiPo**?

Behind closed curtains, batteries provide power in the form of electron flow. The heavy hitter, though, is lithium, a lightweight element more than willing to give up an electron to form a positively charged ion (Li+), which is important in an efficient battery.



A fully charged battery has a negative carbon terminal. This terminal is loaded with lithium. When the battery discharges, electrons happily split from the lithium, escaping the negatively charged anode to travel through the circuits of the drones. Meanwhile, moving parallel to each other, the lithium ions flow through a separator in the **electrolyte** solvent before reuniting at the cathode with their electrons. When the battery runs out of lithium to split, it runs out of power.

Charging the battery forces the lithium ions to travel back through the **electrolyte** and the electrons through an external circuit inside the charger, sending them back to the negative carbon terminal.

C1 Ethical Operations

Every drone pilot needs a solid grounding in the ethical operation of drones. Open *Ethical Operations* and watch *Privacy* and *Publication & Release of Data*.

C2 Flight Simulator Challenge

Start building muscle memory! Open *FPV Freerider* and complete 1 full lap through the Desert.

KEY TERMS

- **Configurator:** a software platform for adjusting the flight control settings programmed to a drone.
- **Electrolyte:** a solution that contains ions; because electrolytes can conduct electricity, they are often included in circuits.
- **LiPo (lithium polymer):** a type of rechargeable battery powered by lithium ions and a polymer electrolyte.
- **Voltage:** electric potential energy, or the difference in charge between two points; the amount of "push" available to motivate electrons to move through a circuit

DRONECOLOGY CHECKLIST

FLIGHT SAFETY
- *Protective Gear*
- *How to Handle LiPo Batteries*

ETHICAL OPERATIONS
- *Privacy*
- *Publication & Release of Data*

PCS eDventures! LABCards

ALIGNED STANDARDS

- ISTE.2.b Students engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.
- ISTE.3. Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
- ISTE.7.. Students explore local and global issues and use collaborative technologies to work with others to investigate solutions.
- 21st Century Skills: Creativity and Innovation. Media, Information, and Technology Literacy
- NGSS HS-PS3-3. Energy.
- NGSS Core Idea ETS1.A. Defining Engineering Problems.
- NGSS Core Idea ETS1.B. Developing Possible Solutions.
- NGSS Core Idea PS1.B. Chemical Reactions.
- NGSS Core Idea PS4.C. Information Technologies and Instrumentation.

STEP-BY-STEP INSTRUCTIONS

Whole Group

INTRODUCTION: Lithium Ion Batteries

- ☐ **Slide 3:** Opening question "What kind of devices have Lithium ion batteries?"
  - ☐ Guide students with questions such as "what devices do you charge and use daily?" and "What battery powered devices do you carry or wear on your person?"
  - ☐ Encourage students to come up with 5 or more examples. Handheld game consoles, wireless earbuds, cell phones, tablets, smart watches, electric cars, hoverboards, electric bikes, all may use LiPo batteries.
- ☐ **Slide 4:** Review the examples of LiPo batteries that are commonly found in everyday life.
- ☐ **Slide 5:** Explain the benefits of LiPo batteries, especially for making lightweight drones with lots of power.

Whole Group

AND

Small Groups

Individual

ENTER THE MATRIX: Flight Configurator Software

Students should individually or in small groups to interface with the RubiQ Configurator:

- ☐ **Slide 7:** Introduce the concept that the PCB running the code can be configured.
- ☐ **Slide 8:** Describe the differences between USB and LiPo battery. Additionally, call out that failure to connect via USB can be related to the USB cable itself.
- ☐ **Slide 9:** Display the instructions for students to complete the two Droneology videos on safety.
- ☐ **Slide 10:** Summarize the details from the video regarding battery safety. Additionally, express to students that if you observe someone else's error with batteries, proactively speak up for the purpose of safety. Especially if someone is about to plug in a damaged or puffy battery!
- ☐ **Slide 11:** In preparation to connect to the configurator, batteries may need to be charged. Follow the written instructions in the LiPo Battery charger Guide for RubiQ with this slide's summary as a reminder of key details.
- ☐ **Slide 12:** Display the instructions for students to perform the tasks to connect via USB. Express that this step is WITHOUT the battery attached.
- ☐ **Slide 13:** Direct students to attach their batteries while observing the safety guidance: protective eyewear in place and antenna attached before the battery. Have students locate the battery status in the configurator before disconnecting the battery.
- ☐ **Slide 14:** Clarify for anyone the reason why an alarm may have begun to sound if the inactivity alarm is triggered.

Whole Group

BATTERY SAFETY: What makes batteries work

- ☐ **Slide 16:** Introduce the question, "What is happening in these batteries that makes them so powerful and higher risk than a typical AA battery?" for this section.
  - ☐ Ask students what they know about regular batteries to make connections with new information
- ☐ **Slide 17–20:** Present the information about the workings of a lithium ion battery.
- ☐ **Slide 21:** Explain the degradation that takes place over time.
- ☐ **Slide 22:** Students may think electricity travels + to -, and therefore are confused by the diagram labeled - to +. This slide explains that electrons flow from - to +, however "conventional current" is often described in the opposite direction, flowing from + to -.

Small Groups OR Individual

ETHICAL OPERATIONS: Privacy and Publication

Break into small groups for the web resources or work through the content as a whole group:

- ☐ **Slide 24:** Display the instructions for students to complete the two videos on ethical operations.

Whole Group AND Individual

PILOTING SKILLS: Flight Simulator Challenges

Students should use FPV Freerider individually or work through the content as a small group:

- ☐ **Slide 26:** Display the instructions for selecting and preparing the Desert track. Self Leveling is On, and Low Rates are on, are selectable in the top left of the Desert level screen.
- ☐ **Slide 27:** Display slide while students independently work on Flight Simulator Challenges.
  - ☐ Students should continue progressing if they finish the on target challenge. Aim to finish Challenges 1-6, then students can revisit past challenges for faster times.

Whole Group

SUMMARY: Review and Key Terms

- ☐ **Slide 29–32:** Ask students review questions on the topics learned in Orange 2.
- ☐ **Slide 33:** Review key terms from Orange 2.
- ☐ **Slide 34:** Conclude with students writing notes for the EDP question prompt. Allow students time to work on their planned EDP.

CHECK FOR UNDERSTANDING

- **What are some benefits of lithium ion batteries?** (Small and lightweight for the amount of power from the battery, rechargeable, does not need to be fully discharged before recharging)
- **What are some signs that a battery may be unsafe to use?** (Punctures, puffy, or uncomfortably hot batteries should not be charged as they may cause a fire or other damage)

EXPLORE MORE

Information about LiPo Batteries

Over time, LiPo batteries experience degradation due to the bonding of lithium ions with the carbon in the anode during charge and discharge cycles. This bonding reduces the number of free lithium ions available for energy transfer, leading to decreased capacity and power output. Factors like high temperatures, which speed up internal chemical reactions and maintaining the battery at full or empty charge levels accelerate this degradation. For optimal longevity, LiPo batteries should be stored at about 3.8V per cell (40% charge) and kept in cool, dry conditions to minimize stress and self-discharge.

Safety is a significant concern with LiPo batteries, primarily due to the electrolyte solvent, which poses fire risks. Overcharging, rapid charging or short circuits can generate excessive heat, potentially igniting the solvent. A short circuit occurs when the separator between electrodes is damaged, allowing uncontrolled lithium ion flow and intense heat generation. In multi-cell batteries, this can cause a chain reaction, leading to a catastrophic failure. Proper handling, including using specialized chargers, managing temperatur and regular inspection for damage, is crucial to mitigate these risks and ensure safe operation.

- How do batteries work?
  https://learn.sparkfun.com/tutorials/what-is-a-battery
- Electricity Primer:
  https://learn.sparkfun.com/tutorials/voltage-current-resistance-and-ohms-law
- What should I know about working with LiPo batteries?
  https://rogershobbycenter.com/lipoguide/

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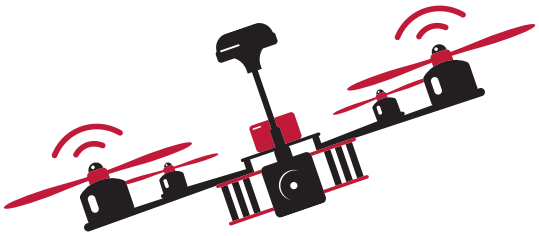

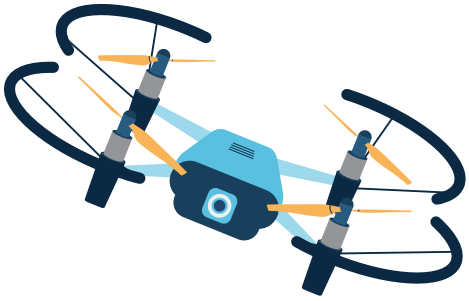

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