FOR THE WIN ROBOTICS

FOR DELIVERY

LESSON PLAN | VERSION 2

LESSON OVERVIEW

Prerequisite Knowledge

- Build Essentials
- Fly Essentials
- Coordinate grid quadrants

Materials Needed

- Hopper(s)
- safety glasses
- controller(s) **or** FTW Fly device(s) with Bluetooth capabilities (such as iPads or smart phones)
- FTW Fly device(s) with Wifi capabilities (such as iPads or laptops)
- tape (for the floor)
- measuring tape (up to 20')
- landing pads
- towers
- writing utensils

Time Allotment

Lesson: 1 hour (or 1 – 2 class periods), Setup: 25 minutes

Documents

- Package Delivery Slide Deck I
- Package Delivery Student Workbook

Vocabulary

- Remote Pilot in Command (RPIC) – the person flying the drone
- Visual Observer (VO) – the person maintaining visual contact with the drone and in communication with the RPIC
- Navigator – the person responsible for giving the RPIC directions on where to fly
- Visual Line of Sight (VLOS) – the *ability* of the RPIC to see their drone at all times during flight
- Beyond Visual Line of Sight (BVLOS) – the *inability* of the RPIC to see their drone at all times during flight

In this Lesson...

Students learn about and discuss some basic aspects of drone delivery. Then, they fly Hopper to simulate delivering a package to a customer while being in communication with other companies also delivering packages at the same time.

Learning Objectives

- Participate in a group discussion using existing knowledge of drone delivery and its current technologies.
- Understand the challenges of flying a drone BVLOS and available technologies to overcome those challenges.
- Work as a VO, navigator, or RPIC with teammate(s) to navigate Hopper together and practice drone flying skills.

LESSON STRUCTURE

Read through the following table before starting the lesson. Approximate times have been given for each section to help with scheduling and time management.

Lesson Section	Description	Approximate Time
Direct Teaching	Open the slide deck titled Package Delivery Slide Deck I and have the first slide up as the students walk in. Encourage students to think about the bell ringer questions: "Have you heard about drone delivery services? What items do they deliver?" Go through the rest of the slides of the slide deck with the students. Play any videos directly from the slides if possible (as opposed to going to the external website). Reference any presenter's notes as needed for each slide. The last slide presents the scenario of the For Delivery activity to the students.	15 minutes
Discussion & Activity	Ensure the activity is set up prior to the beginning of the lesson. Allow for up to 25 minutes to set up. Separate students into small teams. Choose team sizes based on how many students there are and how many drones are available. Ideally, there would be no more than 3 – 4 students per team. Encourage the use of the steps of the Engineering Design Process, and aviation terms such as roll, yaw, pitch, and altitude in the communication between the RPIC, navigator, and/or VO. Implement the extension if time permits. Use the questions provided on page 6 to lead a group discussion with the students. Have them fill out a row in their flight log in their Package Delivery Student Workbook.	45 minutes

ACTIVITY SCENARIO

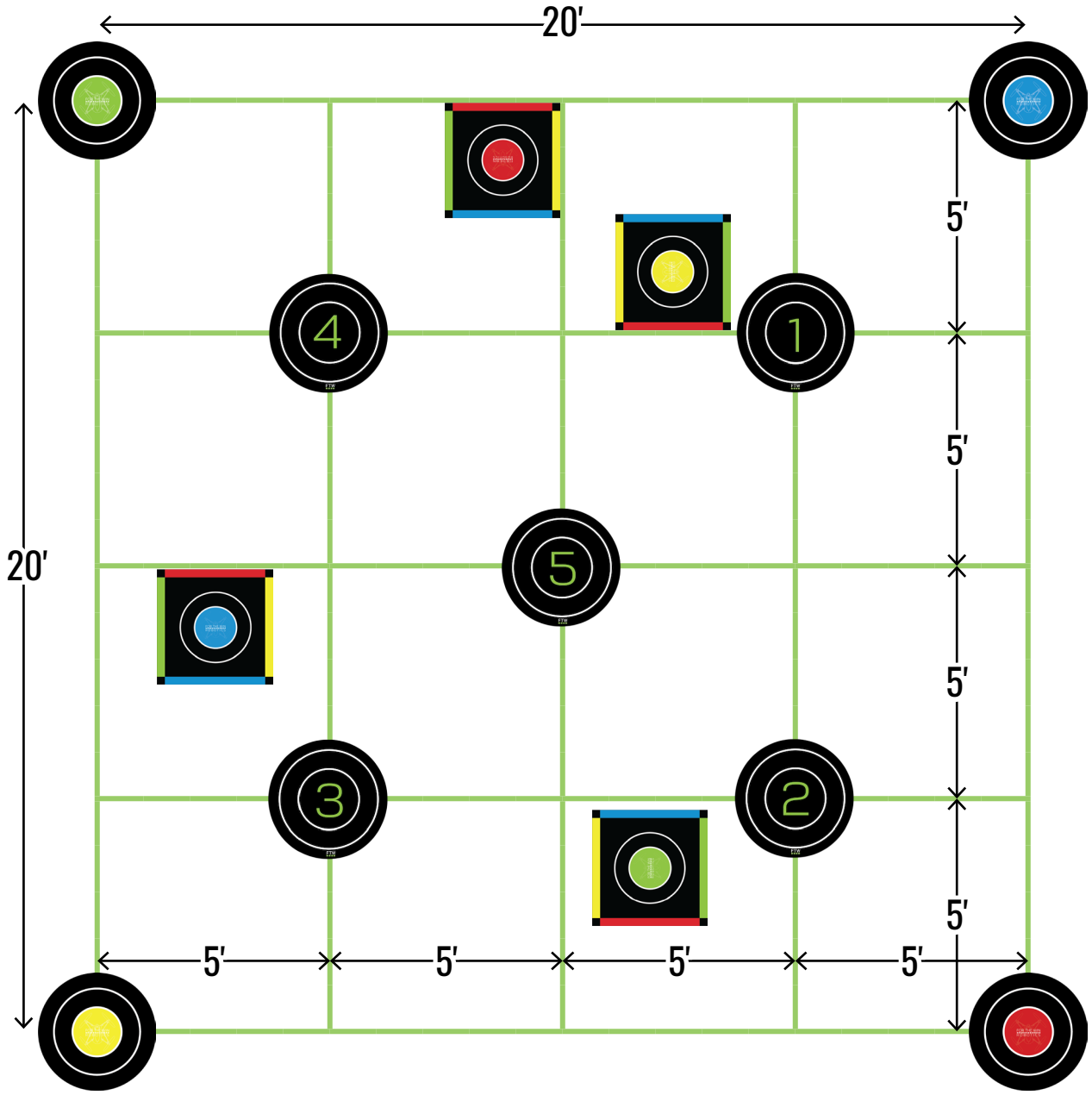
Four separate companies receive online orders for drone delivery simultaneously. The companies must communicate with each other before making deliveries to their customers homes to ensure safety and accuracy.

The delivery Hoppers will be beyond visual line of sight (BVLOS) so each RPIC will work with a navigator who will have access to Hopper's camera during the delivery. After the delivery has been made, each RPIC and navigator will need to get Hopper back to their takeoff location.

ACTIVITY SETUP

Tape a 20' × 20' square on the ground which represents the fly zone. Tape a 5' × 5' grid in this square. Place landing pads at each corner of the square with a different color side up for each one. These landing pads with colors are where the delivery drones will take off and land. Place landing pads number side up for each of the four quadrants of the coordinate plane. Place the number 5 landing pad at the origin (center). The teams will place the activity towers.

An example of the setup is shown below. Activity towers are set at the 5' height setting.



ACTIVITY IMPLEMENTATION

Activity Facilitation

Go through the following steps with the students to facilitate the activity.

1. Assign one team member to be the RPIC (remote pilot in command) and another to be the navigator. The remaining team member(s) are the VOs (visual observers).
2. Assign each team a color and let each team place another team's corresponding color activity tower anywhere in the fly zone other than atop of any of the landing pads. Once their team's activity tower is placed, navigators can study its placement in relation to the four quadrants of a coordinate plane as labeled by the numbered landing pads. It can also be helpful to study the placements of the other teams' activity towers.
3. Before delivering their packages to their customers, all the teams' members must decide flying rules that everyone must abide by during flight to avoid collisions. Assist as needed. Some examples of this include:
   - Each team must fly at a different altitude with the exception of when they try landing on their activity tower.
   - Hopper can only fly in a clockwise direction.
   - Assign specific sections of gridlines to teams.
4. Have up to four teams place Hopper on their starting landing pad at a 45° angle toward the inside of the square. Then, have the RPICs and navigators turn away from the flying zone.
5. Have each team connect their controller or FTW Fly device to Hopper through Bluetooth and Wifi in the FTW Fly App. The RPIC will focus on flying Hopper while the navigator will focus on observing the camera feed. The VO(s) will retrieve and replace their team's Hopper as needed throughout the activity.
6. The RPICs will fly Hopper to their activity tower color, land on the delivery tower to deliver the package to their customer, then fly Hopper back to their landing pad color. Navigators should use the numbered landing pads as a reference when viewing Hopper's camera and directing the RPIC to their activity tower.
7. If a collision occurs, all RPICs must land their drones. Then, the VOs will retrieve their teams' Hopper and replace their Hoppers back at their teams' landing pad to start again. The teams can discuss and update the flying rules before trying again.
8. If a team crashes, a VO from that team must get a facilitator's permission to enter the fly zone and reset Hopper. The other teams can hover while this happens.
9. The activity is complete once each team has successfully landed on their activity tower and returned back to their landing pad with no collisions.

ACTIVITY IMPLEMENTATION

Extension

If time permits, challenge the students to try the activity again but with the addition of no-fly zones that the teams must avoid while delivering their packages. One or more 5' × 5' squares can be designated as these no-fly zones.

Post-Activity Discussion Questions

Use the following questions to lead a group discussion after implementing the activity.

1. How did the RPIC and navigator in your team communicate with each other? What words did the navigator use to communicate where the RPIC should fly Hopper?

2. Was it difficult to avoid other activity towers? Why or why not?

3. Were the agreed upon flying rules modified or updated during the activity? Why or why not? If so, what changes were made?

Flight Log

Have students fill out a row in their flight log in their Firefighting Student Workbook. An example of what it could look like is shown below.

Date	Drone Model	Location	Flight Time	Notes
04/01/2025	Hopper	Bernstein High School Gymnasium	30 minutes	My partners Leah, Sally, and I worked together to fly Hopper to deliver a package to a customer while avoiding colliding with other companies' delivery drones.