FOR THE WIN ROBOTICS

RURAL DELIVERY

LESSON PLAN | VERSION 2

LESSON OVERVIEW

Prerequisite Knowledge

- Build Essentials
- Fly Essentials
- Code Essentials
- Degrees in a circle
- Properties of regular polygons

Materials Needed

- Hopper(s)
- safety glasses
- FTW CODE device(s) with Bluetooth capabilities (such as iPads or laptops)
- tape (for the floor)
- measuring tape (up to 20')
- landing pads
- writing utensils

Time Allotment

Lesson: 1 hour (or 1 − 2 class periods), Setup: 20 minutes

Documents

- Package Delivery Slide Deck II
- Package Delivery Student Workbook

Vocabulary

- Variable – a place with a name that stores information
- Equidistant – having the same distance

In this Lesson...

Students learn about and discuss the use of drones in healthcare, specifically in rural locations. Then, they code Hopper using a variable to deliver time-sensitive medications from a medical center to remote islands.

Learning Objectives

- Participate in a group discussion about the delivery of healthcare supplies, especially to rural and remote locations.
- Use knowledge of the properties of regular polygons to assist in any necessary computations.
- Accurately write a single code using a variable that commands Hopper to deliver time-sensitive medications to any of the eight equidistant islands.
- Use the Engineering Design Process (EDP) and STEM practices to redesign Hopper's code as needed.

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 II and have the first slide up as the students walk in. Encourage students to think about the bell ringer question: "How can drone delivery provide healthcare to patients?" 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 Rural 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 20 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 computer programming terms such as algorithm, command, bug, and variable as students write code. Implement the extension if time permits. Use the questions provided on page 7 to lead a group discussion with the students. Have them fill out a row in their flight log in their Package Delivery Student Workbook. See page 8 for the answer key to the Package Delivery Student Workbook page.	45 minutes

ACTIVITY SCENARIO

There is a medical center on an island that is surrounded by smaller islands that do not have any medical facilities. The medical center on the larger island uses Hopper to deliver time-sensitive medications to the residents of the smaller islands when there is an emergency.

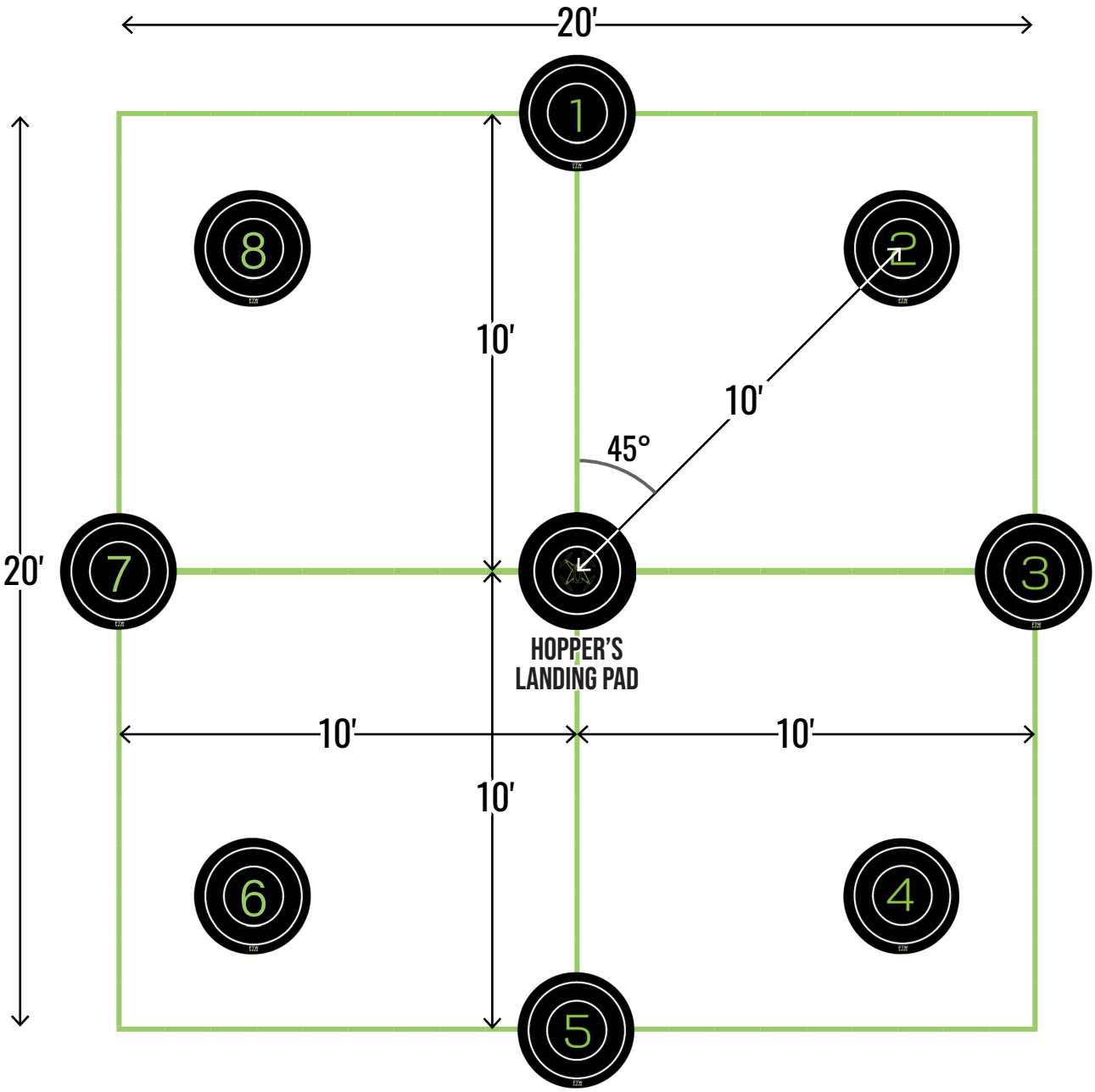
Each island is equidistant (the same distance) from each other. Hopper's starting position on the larger island is strategically placed so that it's equidistant from each smaller island.

Once an emergency is called in, Hopper needs to deliver medication to that island as soon as possible. You will write a single code with a declared variable that can efficiently be defined with a value that corresponds to that island.

ACTIVITY SETUP

Tape a 20' × 20' square on the ground which represents the fly zone. Tape two lines each across the 20' × 20' square so that there are four 10' × 10' squares. Place Hopper's starting landing pad at the center of the 20' × 20' square. Place the landing pads 1 through 8 number side up each 10 feet away from Hopper's landing pad. The numbered landing pads should be placed at approximately a 45° angle from each other as shown below. **The grid from the For Delivery Activity can be used instead to make the Organ Delivery Activity setup easier.**

An example of the setup is shown below.

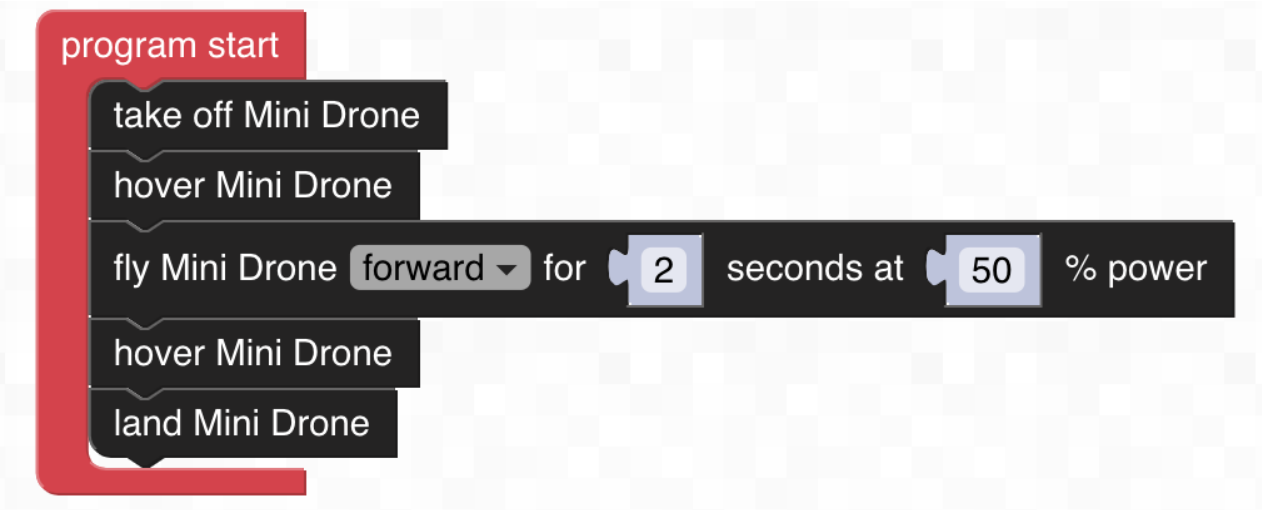


ACTIVITY IMPLEMENTATION

Have each team find Hopper's approximate speed when coded to fly at a certain power percentage and for a certain number of seconds. It is recommended to stay at 50% power or below.

A team's power percentage should stay *roughly* the same throughout this activity.

To stabilize Hopper after takeoff and before landing, it is recommended to command Hopper to hover. An example of a code students could write is shown below.



The takeoff and landing spots of Hopper should be measured.

Then, have each team use the formula rate = $\frac{\text{distance}}{\text{time}}$ to find the rate (speed) in feet per second of Hopper at the power percentage they chose.

Review with students that the formula for finding the rate is derived from the well-known formula:

$$\text{distance} = \text{rate} \times \text{time}$$

ACTIVITY IMPLEMENTATION

Activity Facilitation

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

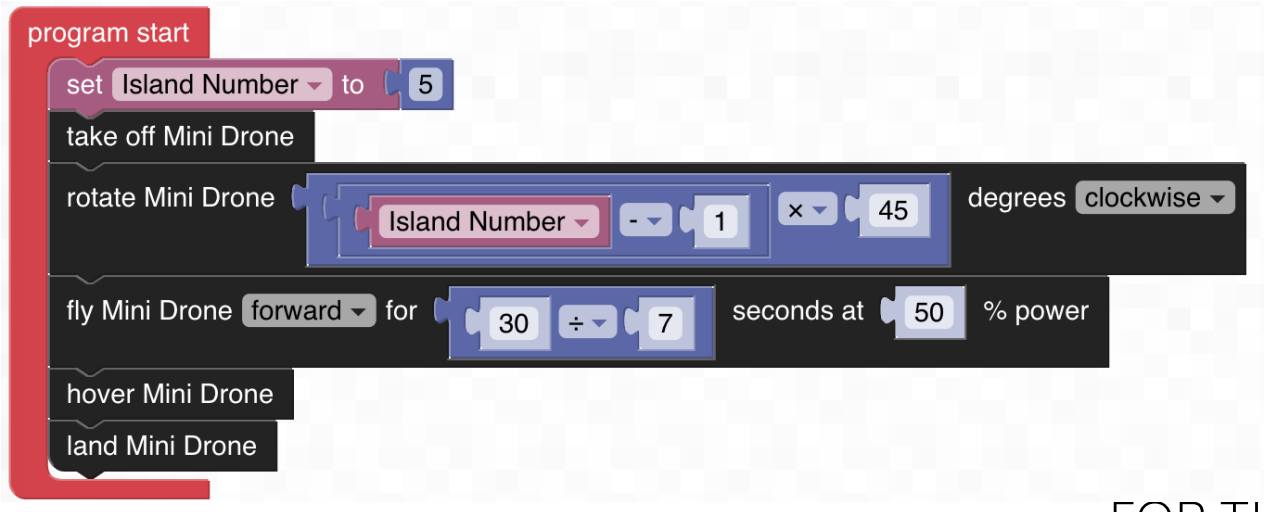
1. Have students work in their groups to complete the Rural Delivery page in the Package Delivery Student Workbook. Assist as needed. The answer key page is on page 7 of this guide.
2. Place Hopper on Hopper's landing pad in front of the tower on the left. Make sure Hopper's eyes are facing forward, toward Island 1. Then, have each team code Hopper to rotate, fly forward, and land on one of the landing pads representing an island using a variable in the code. This single code must work for Hopper to land on any of the eight landing pads.

   Encourage students to draw and label where they want Hopper to go, and to write down what they want Hopper to do in words before coding as needed. They can keep the answers to any calculations they do in exact form for coding. They can use the operation command in the Math tab for improper fractions, or they can convert to decimals.

   Students will use the Variables tab to name, declare, and define their variable representing the island number.
3. Teams can test their code by being given at least two islands that Hopper must land on by either the facilitator or another team. After a successful first attempt, Hopper can be picked up and brought to the central landing pad to attempt to land on the second island.
4. If a team was not successful in the accuracy of coding Hopper, have them adjust their code and try again. If Hopper ever flies outside of the 20' × 20' square, the student should click on the red Emergency Land button.

Coding Example

Sample Code to Land Hopper on Island 5



ACTIVITY IMPLEMENTATION

Extension

If time permits, challenge the students to take their existing code and add commands to fly Hopper back to the central island/landing pad after delivering the medication.

Post-Activity Discussion Questions

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

1. Did you keep your calculated values as simplified, improper fractions? Why or why not?
2. Did you write down or draw your code before creating it in FTW CODE? If so, what did you create and how was it helpful?
3. Compare the code from your group to the codes that other groups wrote. Are they different? If so, how?
4. Was using a variable helpful while completing this activity? Why or why not? How could using one or more variable be useful in longer or more complex code?

Flight Log

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

Date	Drone Model	Location	Flight Time	Notes
04/02/2025	Hopper	Bernstein High School Gymnasium	12 minutes	My partner Kevin and I used a variable in our code to fly Hopper from the central island to any of the islands forming a regular octagon. We took 360° and divided it by 8 to find the number of degrees to rotate Hopper before flying forward.

STUDENT PAGE

1. How many degrees are there in a circle? 360°

2. What regular shape do the smaller islands create? octagon

3. Draw and label on the graphic below according to the following directions:
   - Connect the black dots to form a regular polygon. Use a straightedge (such as a ruler) as needed.
   - Draw lines from the center of the regular polygon (the red dot) to each corner (the black dots) and label the distance measurement. Use a straightedge (such as a ruler) as needed.
   - Label the degree measurement between two of the lines drawn from the center of the regular polygon.