FOR THE WIN ROBOTICS

# PARALLEL TRACK SEARCH

LESSON PLAN | VERSION 2

## LESSON OVERVIEW

### Prerequisite Knowledge

- Build Essentials
- Fly Essentials
- Code Essentials

### 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
- Wifi capable device(s) – **extension only** (such as iPads or laptops)

### Time Allotment

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

### Documents

- Search & Rescue Slide Deck I
- Search & Rescue Student Workbook

### Vocabulary

- Search and Rescue (SAR) – the process of locating and assisting individuals who are lost or are in danger
- Parallel Lines – lines that have the same distance apart at all times
- Parallel Track Search Pattern – an aerial search pattern consisting of parallel lines, useful when searching a large area of land and when the location of an individual is uncertain
- Loop – a command that directs the code it covers to repeat until certain conditions are met

### In this Lesson...

Students learn about and discuss some types of SAR operations, and the technology that can be used. Then, they code Hopper to fly in a parallel track search pattern to simulate an aerial search over a large area of land when the location of a lost individual is not known.

### Learning Objectives

- Participate in a group discussion about the basics of search and rescue.
- Accurately code Hopper to fly in a parallel track search pattern.
- Use the Engineering Design Process (EDP) and STEM practices to redesign Hopper's code as needed.

# LESSON STRUCTURE

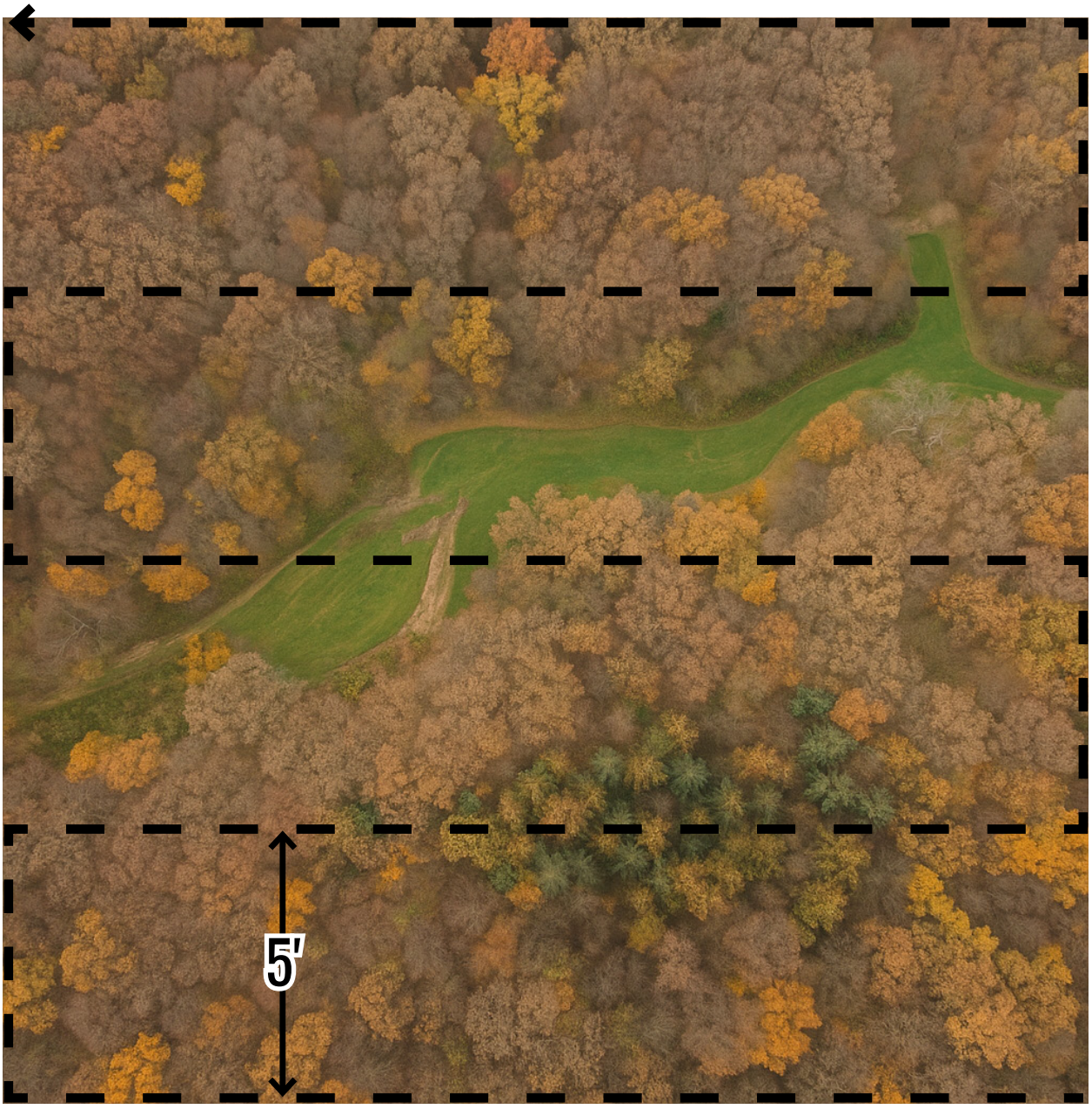
Read through the following table before starting the lesson. Approximate times have been given for each section to help with scheduling and time management.

| Lesson Section | Description | Approximate Time |
|---|---|---|
| Direct Teaching | Open the slide deck titled Search & Rescue Slide Deck I and have the first slide up as the students walk in. Encourage students to think about the bell ringer question:<br>"Have you ever heard of the phrase 'search and rescue' and if so, do you know what it means?"<br>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.<br>The last slide presents the scenario of the Parallel Track Search 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.<br>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.<br>Encourage the use of the steps of the Engineering Design Process, and computer programming terms such as algorithm, command, bug, and loop as students write code.<br>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 Search & Rescue Student Workbook.<br>Sample codes can be found on page 8. | 45 minutes |

# ACTIVITY SCENARIO

A lost dog wandered into a forest. The dog's location is uncertain so Hopper acting as an SAR drone will fly in a parallel track search pattern during an aerial search.

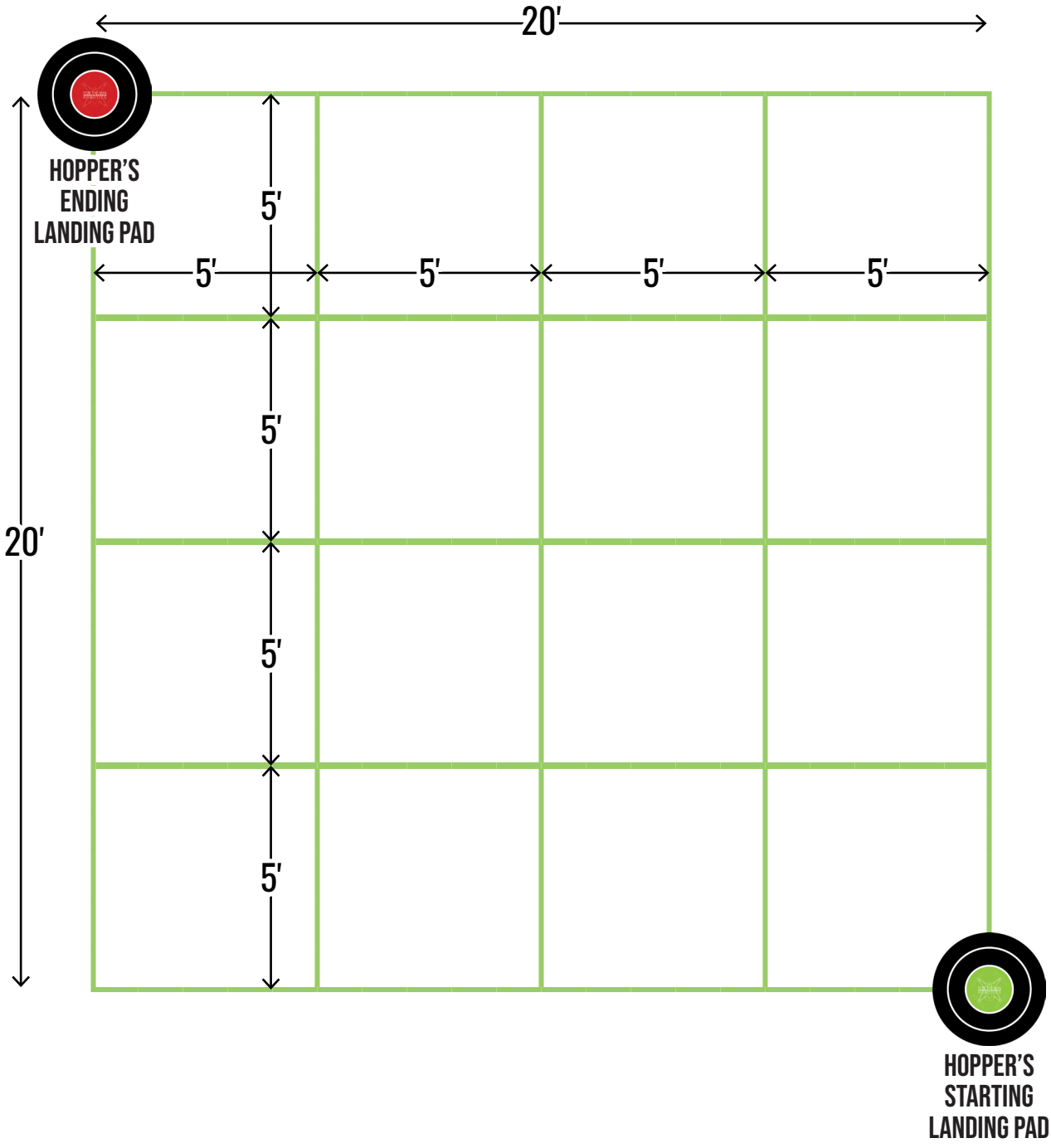
You will code Hopper to fly in a parallel track search pattern in lines that are 5 feet apart.



# ACTIVITY SETUP

Tape a 20' × 20' square on the ground which represents the search area. Tape a 5' × 5' grid in this square. Place two landing pads for Hopper that represent the starting and stopping points at the lower right corner and the upper left corner.

An example of the setup is shown below.

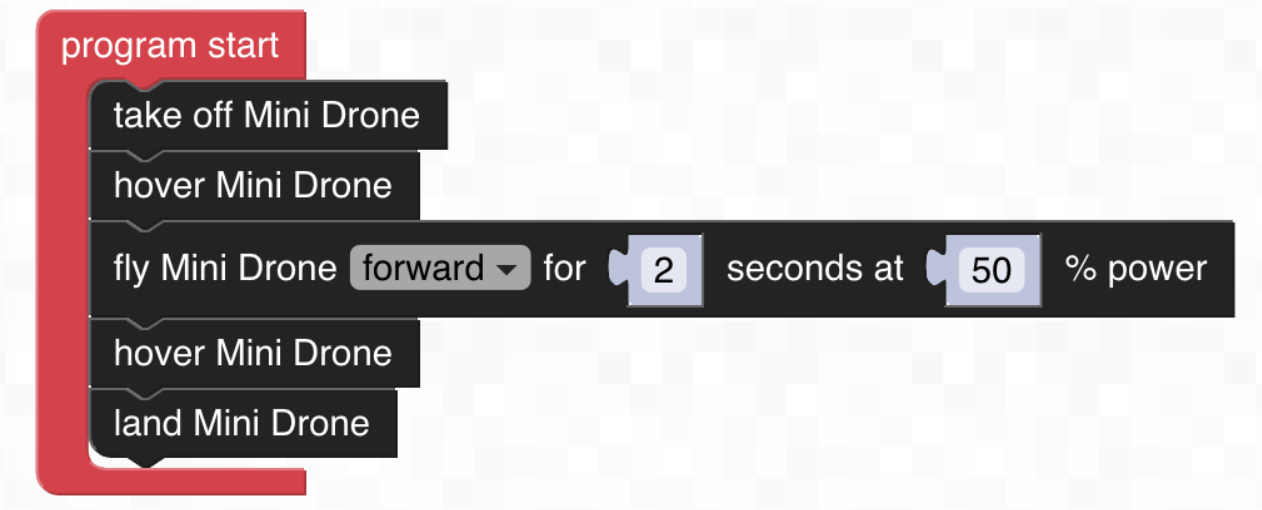


# ACTIVITY IMPLEMENTATION

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.

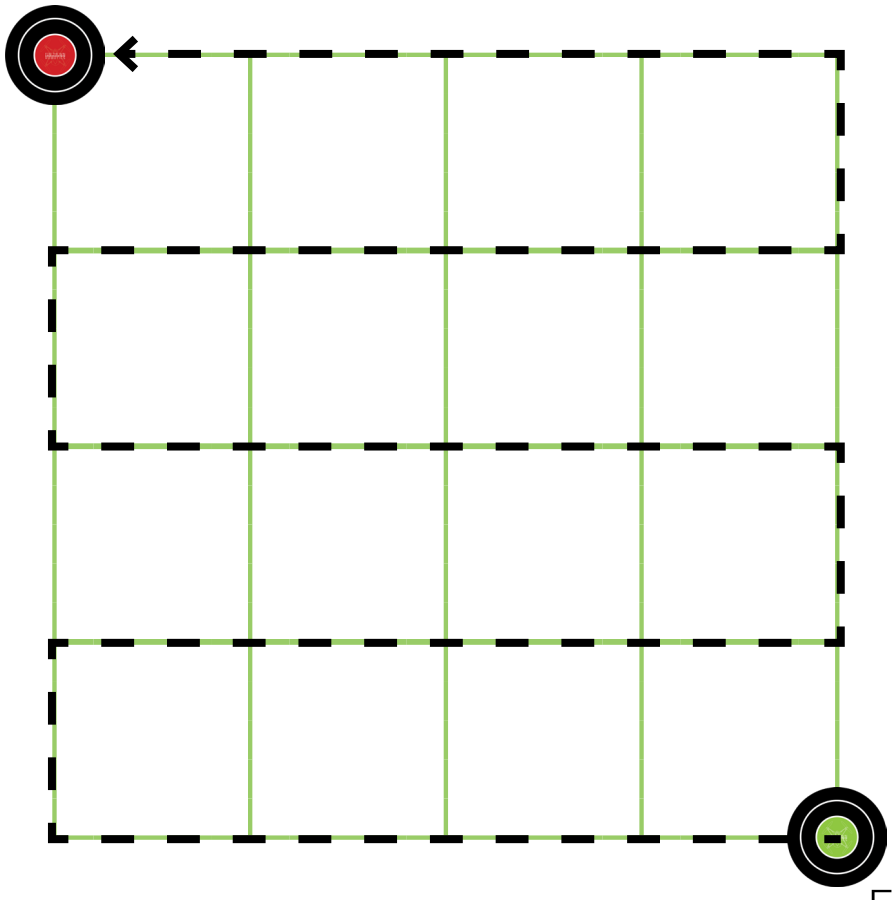
1. Place Hopper on Hopper's starting landing pad. Each team can decide the direction that Hopper's eyes face depending on how they write their code.

2. Have each team code Hopper to fly in a parallel track pattern where the parallel lines are 5 feet apart. They should use the taped 5' × 5' grid as a guide when writing and testing their code.

   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.

   Encourage the use of a loop in their code.

3. If a team was not successful in the accuracy of coding Hopper, have them adjust their code and try again. If Hopper ever flies too far outside of the 20' × 20' square, the student should click on the red Emergency Land button.



# ACTIVITY IMPLEMENTATION

### Extension

If time permits, challenge the students to simulate finding a lost individual using their code and Hopper's camera. Place another landing pad in the search area while the team has their back turned to the search area and have them identify the location of the landing pad while viewing Hopper's camera feed while they run their code.

### Post-Activity Discussion Questions

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

1. Was your initial calculation of Hopper's speed accurate? Or did you have to adjust it while coding the scenario?
2. Did you keep your calculated values as simplified, improper fractions? Why or why not?
3. 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?
4. Compare the code from your group to the codes that other groups wrote. Are they different? If so, how?
5. After comparing codes, would you make any changes to yours? If so, how would you make improvements to your code to make it more efficient?

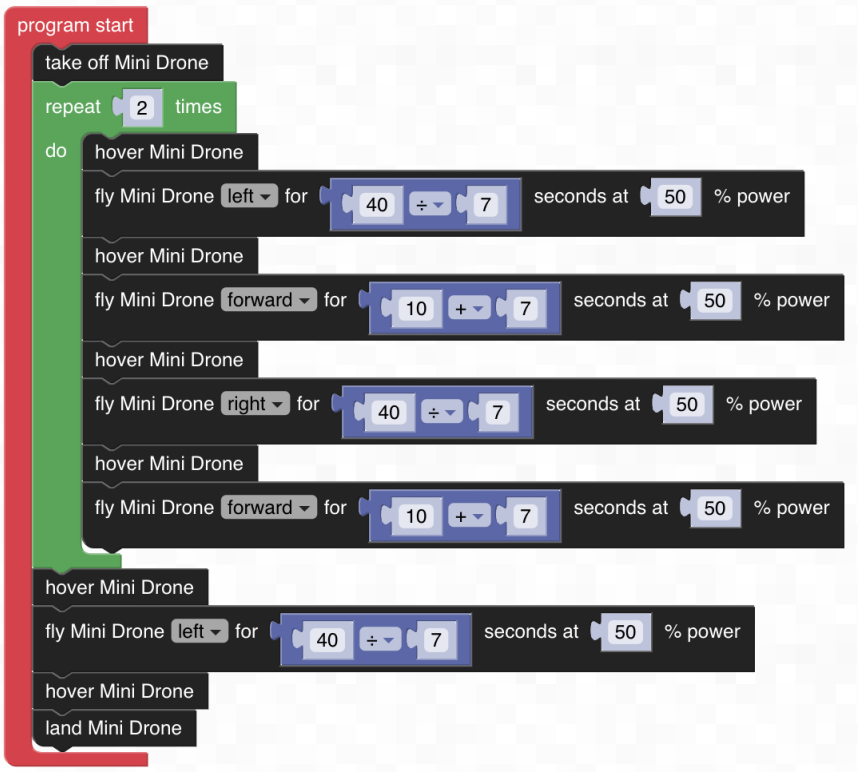
### Flight Log

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

| Date | Drone Model | Location | Flight Time | Notes |
|---|---|---|---|---|
| 04/01/2025 | Hopper | Oxnard High School Gymnasium | 20 minutes | My partners Nikami, Joseph, and I coded Hopper to fly in a parallel track search pattern to simulate locating a lost dog in a forest. |

# CODING EXAMPLES

## Sample Code 1




## Sample Code 2