



# Drone Logistics Service Learning **Math Editions**

# Lesson 7: Finding The Plot

Problem Solving | Coordinate plane | Coding with Functions



"Get Ready Player One!"

There has been a report that some cargo from one of the ships has been lost at sea. Alerts have been sent out asking people to keep their eyes open.

Luckily a tourist reported seeing some of the cargo near the Lovelace Islands. It's time to pack your gear and head out on another adventure. We know with your amazing coding skills that cargo is as good as re-turned!"

## Instructions:

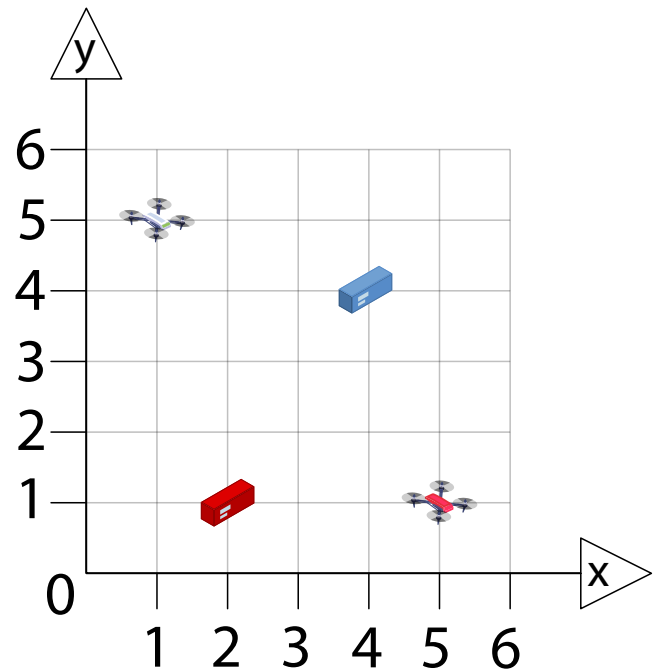
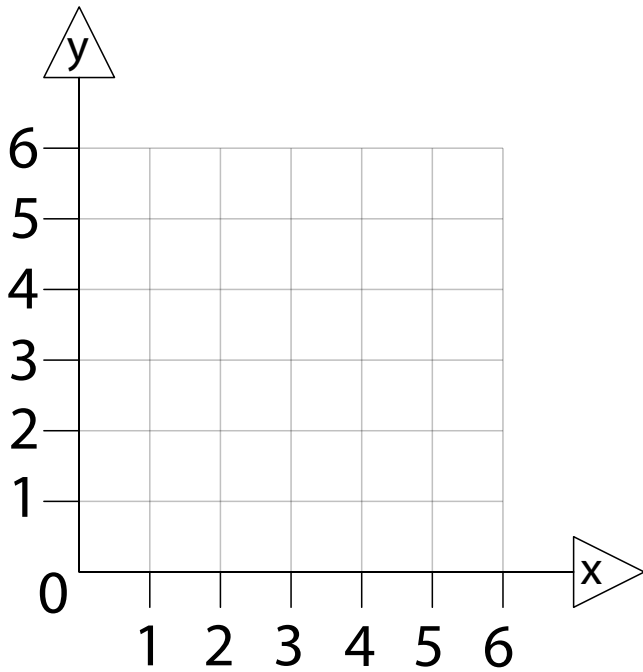
Learn about a coordinate plane.

Learn to read and understand plot points.

Play the lost cargo minigame.

Save the day, yet again.

## Plane and Simple:

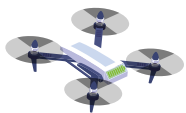


This is a coordinate plane. From **left to right** we have some **numbers**. This direction is called the x-axis. We also have some **numbers** going **up and down**. This is called the y-axis.

Looking at the plane on the right we can see 2 drones and 2 cargo containers. The plane makes it very easy for us to identify the position of each object. The white drone is currently at x1 and y5. We can write that like this (1, 5).

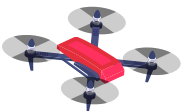
Let's Play a Game:

Fill in the x and y values for the following objects:



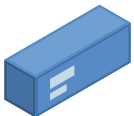
(1, 5)

The white drone has already been filled in. Remember we always write the x value first. Let's see where our red drone is.



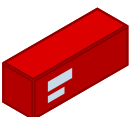
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Counting along the x-axis we see our red drone is at 5. Counting along the y-axis we see it is a 1. Very cool. How do we write that? (5, 1). Amazing!



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Where is the blue container? It looks like it is hanging out in the 4s. Cool. So that would be x...4 and y...4. (4, 4). Nice

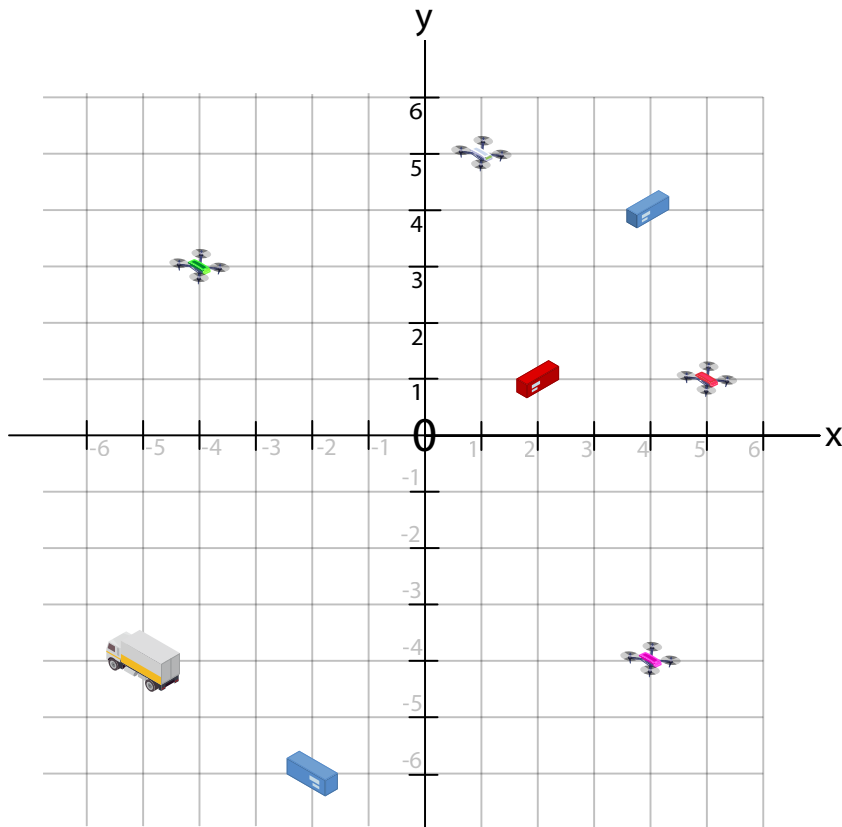


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The red container is the closest object to 0 (0,0). It is only 2 along the x-axis and only 1 up the y. (2, 1) is it's current location.

Well done! The x and y values are called the coordinates. You have just filled in the coordinates for the 4 objects above.

## Up, Down, Left, Right:



The plane doesn't just go right and up. It can go up, down, left and right.

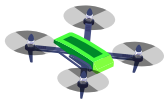
When we go left passed 0 we use negative numbers. That means  $x = -1, -2, -3$  etc...

When we go down passed 0 we use negative numbers. That means  $y = -1, -2, -3$  etc...

With that in mind, we get to play another game!

Let's look at the new objects on the plane and list their coordinates.

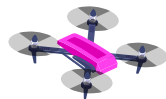
Exciting times!



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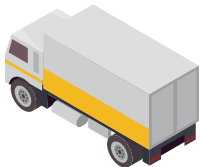
How did you go?

Counting along the x-axis, we start at 0 and move left to -4. From -4 we need to count up 3 to get to the green drone. (-4, 3).



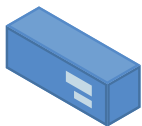
\_\_\_\_\_

Counting along the x-axis, we move right to 4. Counting along the y-axis, we go down below 0 to -4. That leaves us with (4, -4).



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What's in the truck? Well, we will never find out BUT what we will find is the x and y value. X-axis, we move left from 0 to -5. For the y-axis we go down to -4. This leaves us with (-5, -4).



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Our lucky last item. X-axis we go left from 0 to -2. Dropping down passed 0 for the y-axis, we get to -6. (-2, -6).

## The Plane Pattern:

Our plane is divided into 4 quadrants:

Quadrant 1 is  $x+$  and  $y+$

Quadrant 2 is  $x-$  and  $y+$

Quadrant 3 is  $x-$  and  $y-$

Quadrant 4 is  $x+$  and  $y-$

On the next page we are going to see what that looks like by helping our cargo ship retrieve it's lost cargo.

## Mapped and Ready:

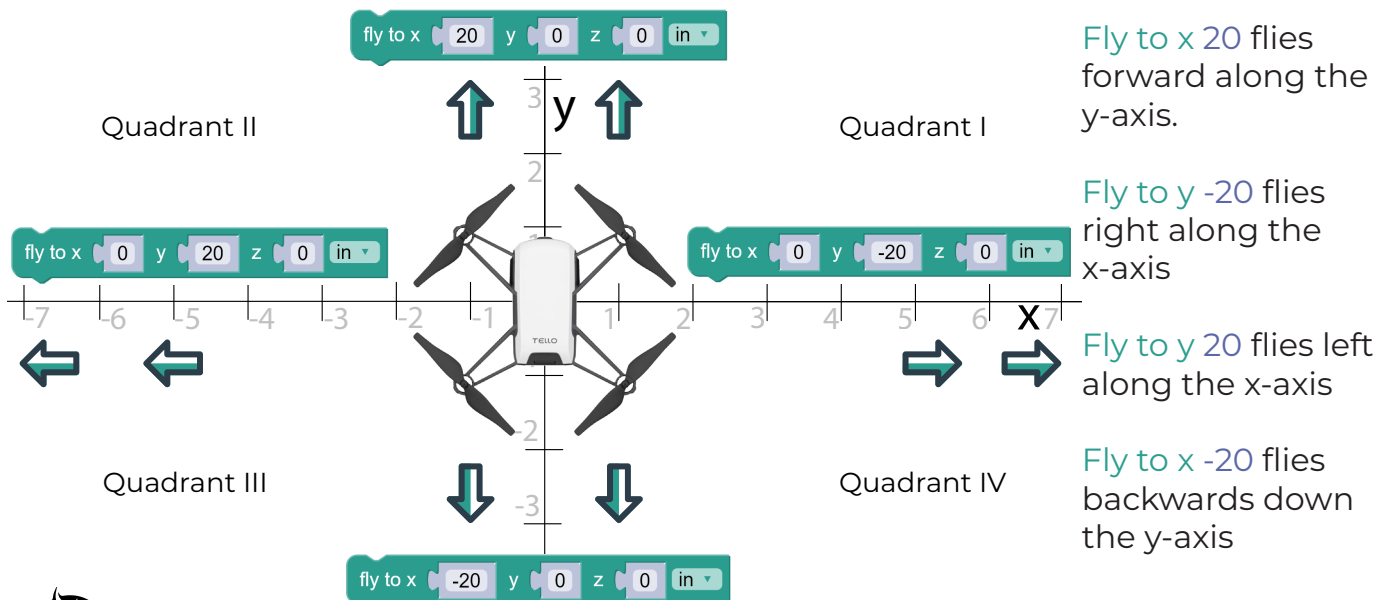


Our ship is currently sitting at 0. That's nice and convenient. Our drone is all ready for its first scouting mission. What we need is a scout program that will fly around each quadrant looking for cargo. We will take in two parameters (x and y). Using those values we will fly along the x-axis to x and slowly move up in a snake pattern until we reach the y value on the y-axis.

Try write some code and see what you come up with.

## Learning The Controls:

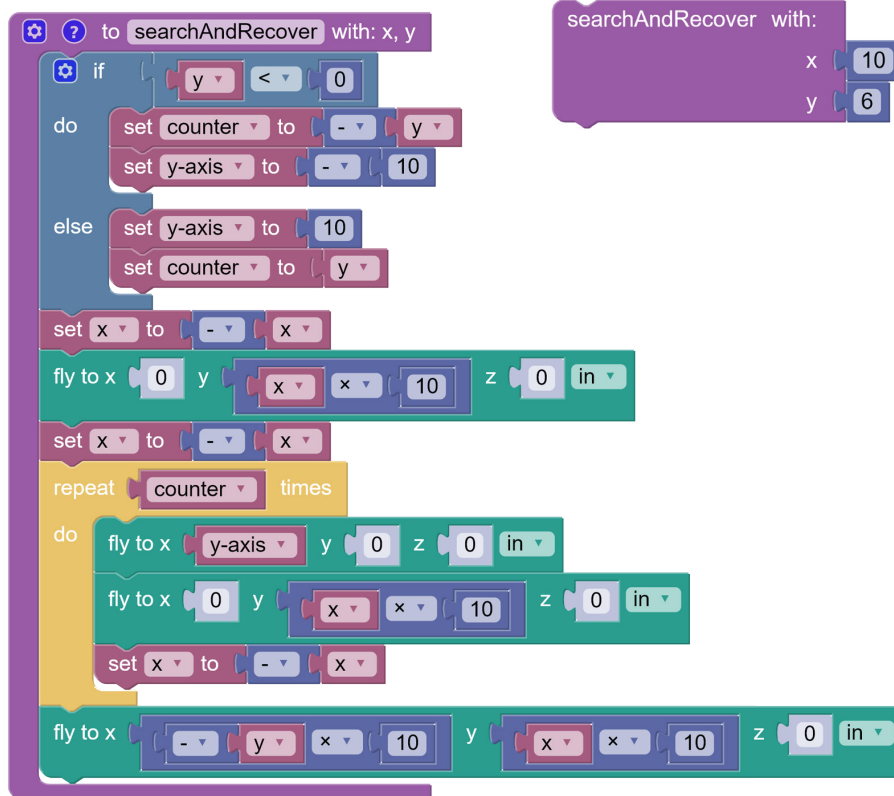
Our code is going to be using a new block. Introducing the **fly to** block. This block allows us to fly in specific directions. To make this block work with our Tello Drones we had to map x and y a specific way. The x value is **fly forward and backward**. Positive numbers go **forward**, negative numbers go **backward**. The y value is **fly left and right**. Positive numbers **fly left** and negative numbers **fly right**.





## Snake:

Now that we've learned that "fly to x 20" travels along the y-axis and "fly to y 20" travels along the x-axis we can look at our code.

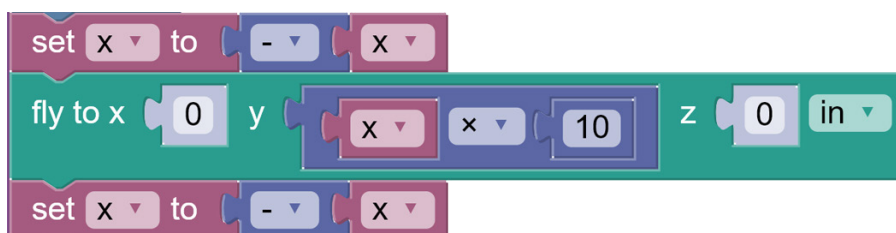


$x = 10$  and  $y = 6$ .

Our first block of code is an "If else" block. Looking at  $y$  (6), if  $y < 0$  (a negative number) then we do the following:  
Set counter to  $-y$  (the  $-$  block will convert  $y$  to a positive number)  
Set  $y$ -axis to  $-10$  (we will use this to fly down the  $y$ -axis by 10 inches)

else:

if  $y > 0$  (a positive number) then we do the following:  
Set counter to  $y$   
Set  $y$ -axis to  $10$  (to fly up the  $y$ -axis by 10 inches)



The next 3 blocks focus on how we deal with the  $x$ -axis. Our function needs to move right to left if  $x$  is positive and left to right if  $x$  is negative.

Set  $x$  to  $-x$  (this makes  $x = -10$ )

Fly to  $y [x * 10]$  will fly right along the  $x$ -axis by 100 inches. We use  $x * 10$  so we can move in 10 inch blocks along the grid.

Set  $x$  to  $-x$  (this makes  $x = 10$ ). This means the next time we use our fly to  $y$  block we will fly to the left.

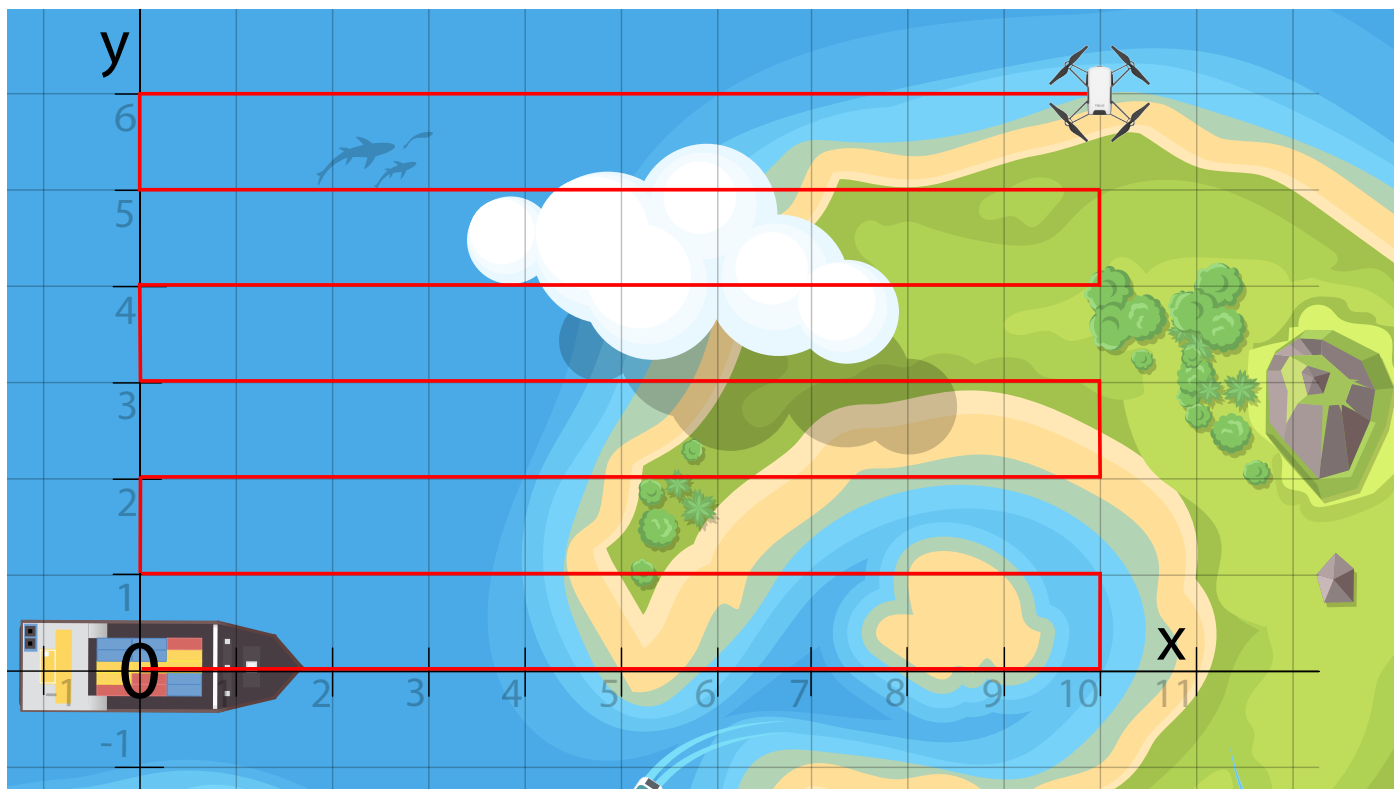
Now for the loop. The loop repeats itself by the variable counter. This is converted to the positive number in our first block. In our example we will loop 6 times.

We fly to  $x$  using the  $y$ -axis variable (either 10 or -10) moving our drone either up or down the  $y$ -axis. Then we fly left or right by  $x * 10$ . After that we change direction by setting  $x$  to  $-x$ . This makes our drone fly left to right or right to left, depending on whether the coordinate of  $x$  is positive or negative.

At the end of the loop, we fly our drone back to the starting point by using the following block:



## Snake Continue:



Look at that amazing flight path! With our functions parameters of  $x = 10$  and  $y = 6$  we end up with the above path. Our drone flies right along the x-axis to 10 and then flies up the y-axis to 1. Then it flies left to 0. This repeats all the way up to coordinates of (10, 6). Amazing!

Let's try expanding our search to all 4 quadrants of the plane.

As you can see it makes a really cool snake shape up and down the quadrants. Amazing! This is one of the amazing things about functions. We can fly our drone as a snake search mission to various points of the map just by inputting an x and y value in the function. That's so awesome.

takeoff

searchAndRecover with:  
x 10  
y 6

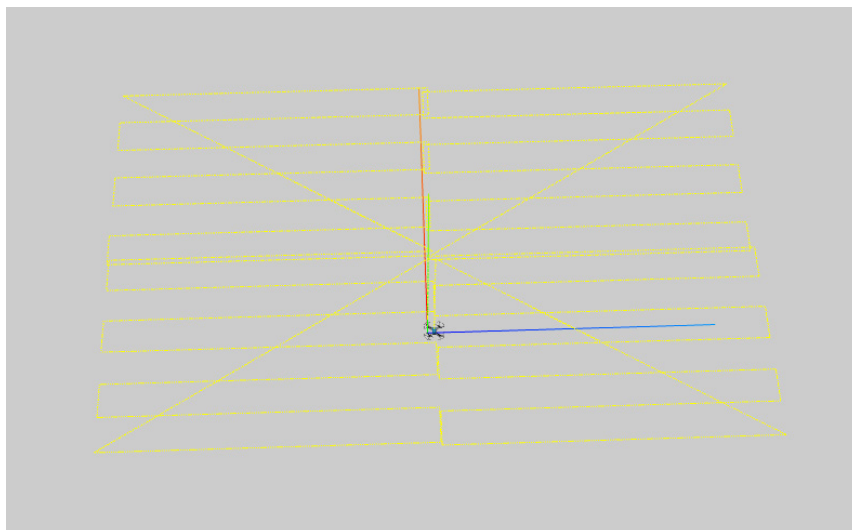
searchAndRecover with:  
x -10  
y 6

searchAndRecover with:  
x -10  
y -6

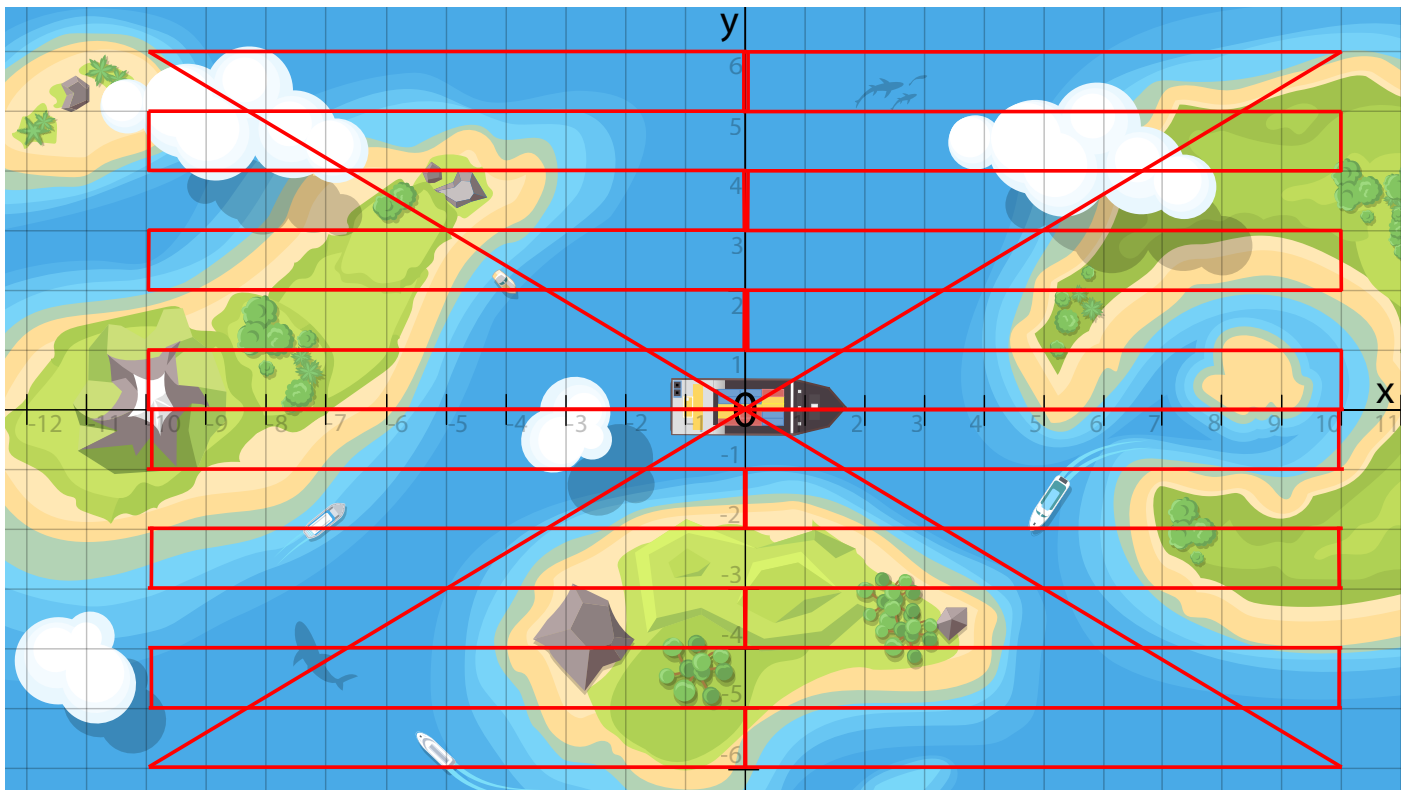
searchAndRecover with:  
x 10  
y -6

land

Look at that simulator go! How awesome is that! Let's see what it looks like in our cargo mission.



## Calling All Quadrants, Calling All Quadrants:



Well done! You've done it! That's amazing work. Let's finish off this lesson with a minigame. We are going to fill in the coordinates of all the missing cargo.

## Missing Cargo Minigame:



How many missing crates of cargo are there? \_\_\_\_\_

How many of those are in quadrant 1? \_\_\_\_\_

How many of those are in quadrant 2? \_\_\_\_\_

How many of those are in quadrant 3? \_\_\_\_\_

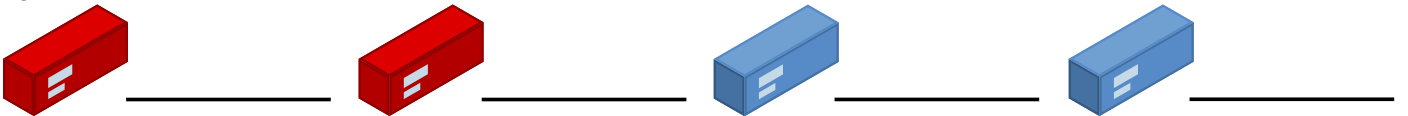
How many of those are in quadrant 4? \_\_\_\_\_





What are the coordinates for the missing cargo?

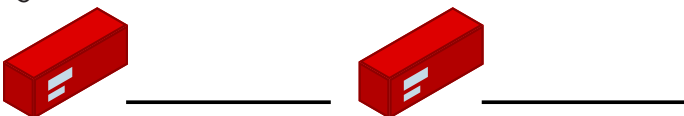
Quadrant 1:



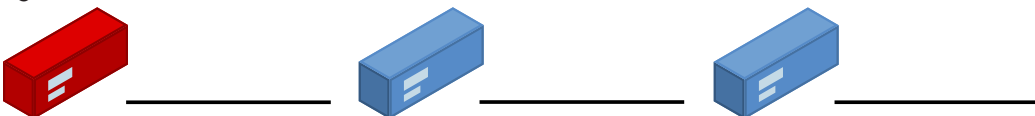
Quadrant 2:



Quadrant 3:



Quadrant 4:



Well done on completing the minigame!

In the next and final lesson, we are going to run a quick overview of all the subjects we have covered so far. We will also look at clever ways of making challenges for your friends or students by using DroneBlocks.