Activity Sheet	
Gr 5 - Lesson #7	Switch Block – Staying On Track
Date:	Name(s):

Check That I'm Done ☑		
☐ Commented on my code	☐ Modify it task	☐ Coding Challenge

Learn

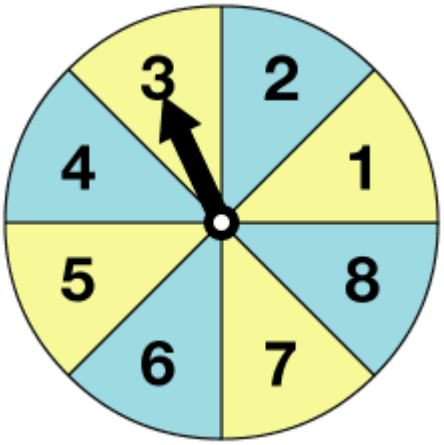
When you would like to figure out the chances of something happening, one way is to first count the number of possibilities (assuming they're all equal).

For example, in this spinning wheel, the probability of landing on a 3, mathematically is 1/8th. This is because there are 8 equal possibilities.

Another way of wording this is, if you span the spinner 8 times, you would expect to land on the number 3 about once.

This may or may not happen, but if you span it 8000 times, it's very likely that you would land on 3 about 1000 times.

In this way, probability is a powerful tool for predicting the future.



Example: 4 2 8 5 7 7 **3** 2

8000 Spins Example

Number	# of Times Landed
1	957
2	1001
3	1023
4	904
5	984
6	1005
7	1020
8	1084

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Many things in real life don't work quite like a spinning wheel, so we need to do experiments to figure out what the likelihood of events are.

For example, the chance of losing your pencil on any given school day is hard to predict, however, if you record the results over 100 school days and notice you lost 7 pencils, that's a 7/100 chance of losing a pencil or 7% on any random school day.

Robots and sensors often need experiments to figure out the probability of their success also.

A sensor on a factory line, that is used to make sure a product is the correct weight, may make mistakes 1/10,000 times, which most factories would say is ok (depending on the product). However, if they found out it was 1/20 times then they have a serious problem.

You are going to put on your scientist hat and figure out what the chances are of your robot failing or succeeding in its task of line following, under different circumstances. Perhaps then, you will know how to best set up your robot for success.

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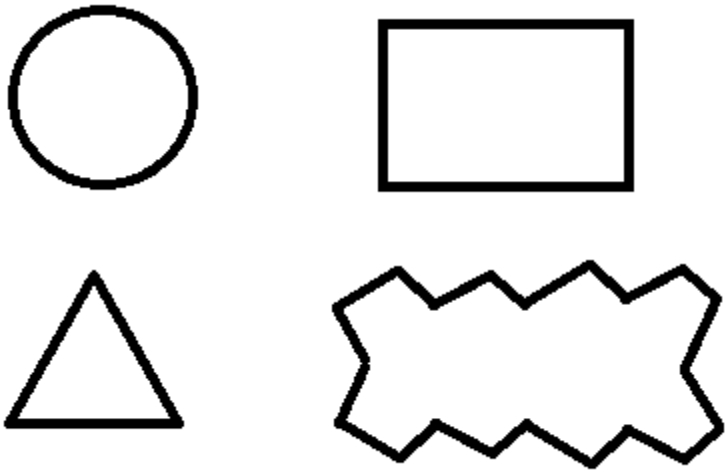
Predict and Plan

1. What shapes do you think the robot will have the most trouble following? Rank them from hardest to easiest by writing a number beside each one.



Explain why you made your decisions _____

_____

2. Robots need very clear instructions to make decisions. A threshold value is the number that triggers the robots decision. For example if you're told to come home when the street lights turn on, this is your clear signal to come home. Not only do all of their rules need to be like this, but they also always involve a number of some kind.

   Say you know that a certain black line gave you back 20% of the sensors light (some does bounce back) and a white floor gives you back 80% (some gets absorbed). That 20% value will move around a bit, sometimes it'll be 18, sometimes maybe 25, depending on the

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outside lighting. The 80% might get as high as 87% or as low as 65% if there are some shadows.

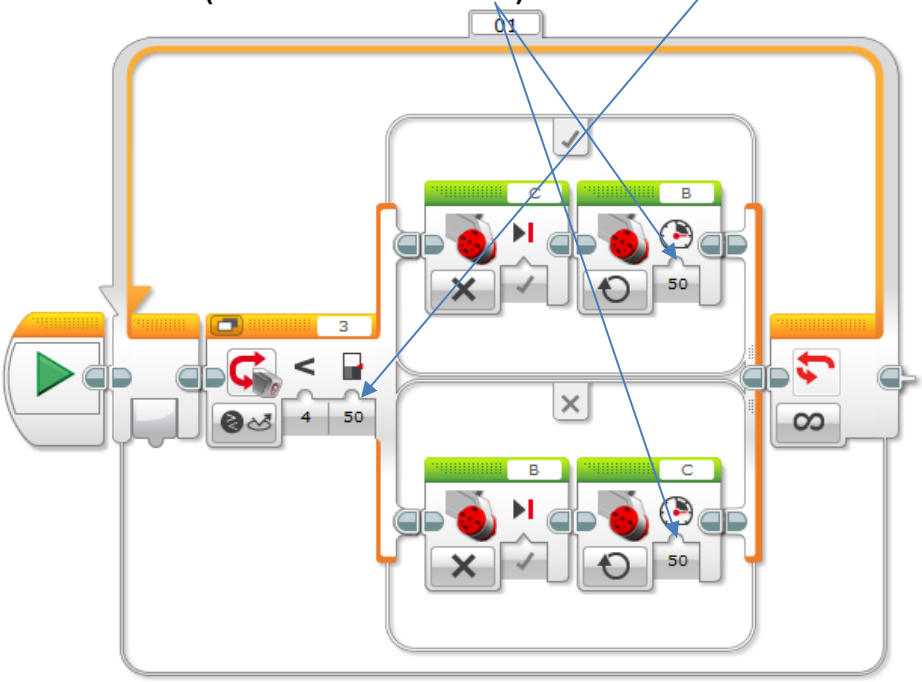
Knowing this, you don't want the threshold value to be too close to either number (20 or 80) or the robot could get confused and loose the line.

Following this example, take a guess at what would be the best threshold value to use, so that the robot never gets confused between light and dark. You'll be asked this again at the end of the activity. _____ %

3. Using the port view on your robot's brick, measure the reflected light intensity of the floor and the tape that you're given.
   Floor: ____% Line: ____%

Demonstrate/Design/Discover

- ✓ Make sure your light value is set to 5% **more** than your "line %" from above (and motors to 50). This will be our starting point for testing.



- ✓ Create a track on the floor with black tape with the following shape (it doesn't have to be exact). Make sure the angles aren't too extreme.

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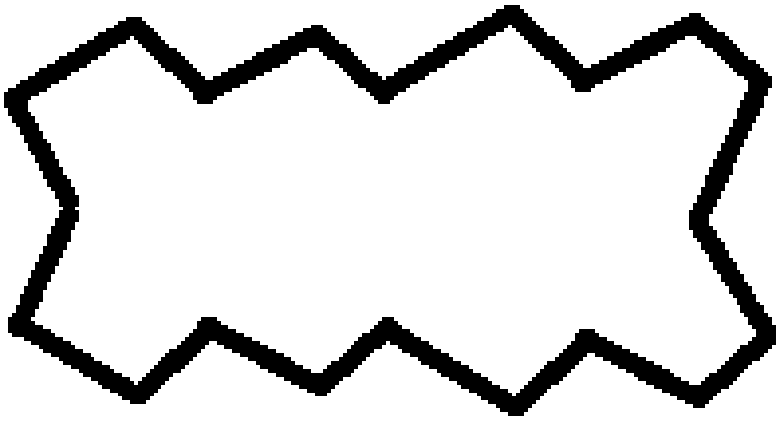

- ✓ Let it lose! Count the number of times the robot loses the line, and the total number of zig-zags it completes successfully. Everytime the robot loses the line, start it back where it left off. Record your results the table below.

- ✓ As you go, keep increasing the light threshold value by 10 until you reach the floor % you measured earlier. (An example could be, 25%, 35%, 45%, 55%, 65%, 75%).

Tips: Having some paper and pencil nearby will help you remember how many zigs and zigs the robot has made before it fails and you need to put it back on the track. The total number of zigs and zags should be almost the same for each test.

If you're robot is having way too much trouble, or conversely, never losing the line change the speed of your wheels.

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Record		
Light Value	**Number of Successful Zigs and Zags**	**Number of Times it Lost the Line**

Questions	
Question 1 Math	A fraction can tell us the exact probability that the robot will fail. For example, 5 failures out of 43 zig-zags is 5/43 chance of failing. Calculate the chances of losing a line for each light value using this method.
Question 2 Math	What threshold value had the highest probability of success? Why do you think that was?
Likely the number in between the two light values. (The mathematical	

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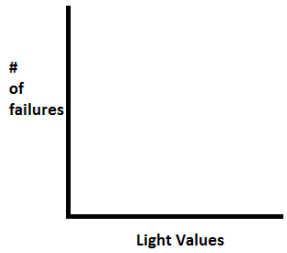
mean).	
Question 3 Math	Which light value would you NOT trust to follow a line? Explain you reasoning.
The one closest to either one of the light values, because a slight change in the ambient light can trick the robot and make it fail.	
Question 4 Math	On a separate piece of paper, create a bar graph with the light values on the horizontal axis and times it lost the line on the vertical axis (see below). 
Question 5 Robotics	Robots never behave perfectly, but the best we can do is try and raise the probability of success as high as we can. What else could have made the robot more successful? Hint* think about the line, and the environment.
A thicker smoother line could help, with a very bright floor and perfect lighting. Also, travelling slower could help too.	

Extension Coding and Math	Tune the motor speed so that the robot has an even higher probability of success at each light value. Explain what worked and what didn't!

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