

Voyager & Ozobot: NGSS Science and Engineering Practices Challenge

Notes for the Teacher

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This lesson will likely require students to make graphs of the angular velocity vs. time data and determine areas in order identify the angle made by Ozobot on a typical turn. Since the graph is degrees/second vs. seconds, the area is their product, which has the dimension of degrees. *The number of degrees for each Ozobot turn in a regular geometric shape is the key to what the shape is.* As an example, students would get close to 72° (360/5) for each turn on a pentagon.

Areas can be calculated by summing the areas of narrow trapezoids over the graph region of interest by use of the formula

$$=0.5*(B2+B3)*(A3-A2)$$

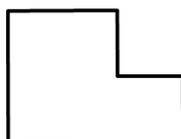
This formula is entered into cell D3, and then copied to the rows below it.

Alternatively, if your students have access to software such as Vernier Software & Technology's *Logger Pro™*, they can copy data from the Excel file to Logger Pro and use its **integral** analysis capability to quickly find areas over desired regions of the data. Any other software that provides integral analysis of point data should also work.

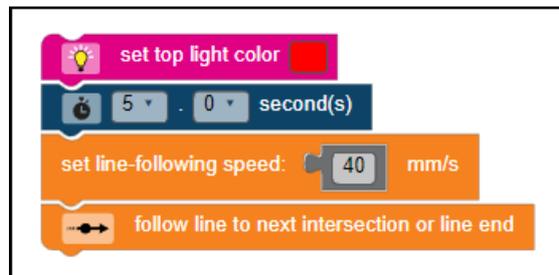
Here are the correct results for matching shapes:

<i>Shape Number</i>	<i>Shape</i>	<i>Period (sec)</i>
1	Pentagon	~16
2	Triangle	~15.5
3	Hexagon	~18
4	Square	~10
5	Regular Trapezoid	~12.8
6	Circle	~10
7	Rectangle	~15

Coming up with the correct shape requires students to understand the difference between positive and negative z-angular velocity. The challenge shape is:



If you have Ozobots available, you may want students to actually collect and analyze some data on their own after they have analyzed the provided data. If this is the case, here is the OzoBlockly program that was loaded into Ozobot:



The program begins by setting the top light to red and then gives the student 5 seconds to place the Voyager/Ozobot team onto the geometric shape figure. The speed was set to 40 mm/s, but any speed between 15 mm/s and 85 mm/s will do.

Printable copies of the seven figures can be found in the accompanying file *GeometricShapes.pdf*.