Determining Travel Distance with a Rotational Sensor

There are two ways you can determine how far your robot will move in one rotation of the wheel axle. One is to measure the **radius** of your wheel and use this information to calculate the wheel circumference. Another way is to program your robot to go for a given number of rotations and measure how far it goes. Whichever method you choose, it is a good idea to check your answer using the other method. Either way, in the end, you will test to see if you can program your robot to go the distance you want it to!

You may notice that your robot goes a bit further in the trials than you calculated based on wheel circumference. That's because of the **momentum** of the robot. Momentum is the tendency of an object in motion to stay in motion, until something stops it. So when you stop the motors on your robot, it will still coast forward. You'll need to take this into account whenever you're programming your robot to go an exact distance.

Method 1: *Determining the circumference*.

- Measure the radius of your wheel—this is the distance from the center of the wheel to the outside of the tire. It is important that you do this carefully to get an accurate measurement. You may want to ask your Helper to assist you.
- Measure the distance in inches and express the distance as a decimal. For example, if you measure 1 and 1/8 inches you must write it as 1 inch plus 1 divided by 8 (1/8 inch = 0.125 inches), which is 1.125 inches.
- Multiply the radius distance, which you measured, by 2 to determine the diameter.
- Multiply the diameter by 3.14 (an approximation of pi) to determine the circumference.

In this example, a wheel that has a radius of 1 1/8 inches has a diameter of 2.25 inches and a circumference of 4.815 inches.

Remember, the rotational sensor makes sixteen clicks for one rotation, so the distance traveled for each tick is the circumference divided by 16.

In this example, the robot will travel 4.81/16 = 0.30 inches per tick.

Method 2: *Determining distance traveled by collecting data*.

Mark a starting spot on your test field where you will start the robot. Program the robot to move forward ten axle rotations then stop. Measure how far the robot moved during the ten rotations. Start from the same starting spot and run the robot again for 10 rotations. Run the experiment 5 times to see if your robot's performance stays fairly consistent. Each time, record the distance traveled in the table below. Remember, for each axle rotation, the sensor makes 16 clicks; so 10 rotations will be 160 clicks!

After you collect your data, determine how far the robot traveled for each sensor tick for each trial. To do this, divide the distance traveled by 160. Is the distance per tick about the same for each trial? How does this number compare with the distance per tick you calculated based on the wheel circumference?

Rotations	**Sensor Clicks**	**Distance (inches)**	**Distance per Tick (inches)**
10	160		
10	160		
10	160		
10	160		
10	160		

Once you know how far, your robot will move for each click, then it's easy to determine the number of clicks your robot will need to go for any given distance. In the previous example, we calculated that the robot went 0.30 inches per click. To find out how many clicks your robot will need to go, just divide the distance (in inches) by the distance per click. So if you wanted your robot to go 8 inches, you'd divide 8 by 0.3 or 8/.3 = 26.67 clicks. Since there are no partial clicks, you would round your answer to the nearest whole number or 27 clicks.