

## In the Classroom:

**Grade Level:** 6-8

**Time:** 60 min

**Building Skills:** Building with sensors    **Programming Skills:** Display, Sensors

**Other Skills:** Measurement, circumference of a circle

# Digital Measuring Wheel



*Measuring long distances can be difficult with a traditional measuring tape. Tapes may not be long enough, or two people may be needed to make a measurement. To solve this problem, measuring wheels were created so one person can walk a distance with the wheel to measure it.*

## **Challenge**

Use your NXT and a rotation sensor to build a digital measuring wheel. The device can be pushed by hand on the ground or at a distance using a handle. Check your device's accuracy with a measuring tape.

## **Materials**

NXT, NXT motor with built in rotation sensor, extra LEGO pieces.  
Optional: legacy rotation sensor, extra wire and conversion cable

## **Skills Learned**

Measurement, building, programming with sensor values and math, programming display



## Procedure

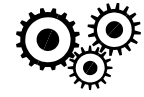
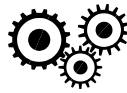
1. Build a measuring wheel device. If using a legacy sensor, the sensor should be connected to a wheel and to the NXT. If using the NXT motor, a wheel should be connected to the motor to get rotation values.
2. Measure your wheel's circumference to use when calculating distance.
3. Program your NXT to display the distance traveled.
  - a. Divide the rotation degrees value by 360 to get the number of rotations traveled. (Legacy sensor: divide by 16 instead of 360)
  - b. Multiply this value by the circumference to get a distance value.
  - c. Convert this value to text.
  - d. Display the value on the NXT screen
4. Check the accuracy of your device against a tape measure.

## LEGO Tips

Be sure you are walking or pushing straight to get accurate measurements – use a wall or a line on the floor to follow. It can take time for the NXT to calculate and display the distance. Pause when you reach the desired distance to ensure the reading has updated. The motor should not be powered (no move or motor blocks). Be careful with the circumference of wheels that have tires- the tires may squish, changing the circumference! To avoid this- just use the hubs. Gears can be used as “wheels” also to get a better grip on carpeted surfaces. The NXT motor with built in rotation sensor has a lot of resistance. Consider this when building your device.

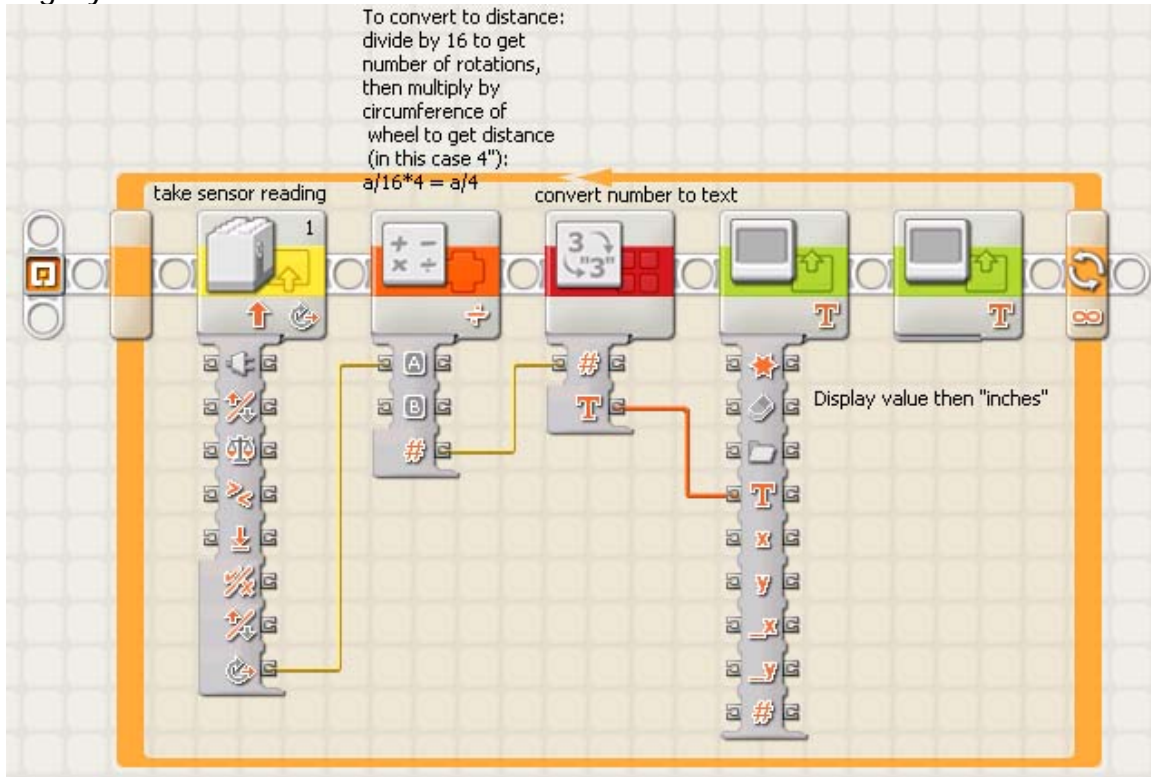
## Extensions

1. Add a touch sensor to clear data to take a new measurement
2. Use a touch sensor to trigger when measurement is displayed
3. Add sound feedback when certain distances are reached
4. Convert your device to a wench that measures the length of string wrapped around it



### Sample Program

#### Legacy Sensor:



#### NXT motor:

