Challenge: Accelerating and Decelerating on a Square Spiral

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Have you ever watched diving competition at a swim meet? A diver leaves the diving board with his arms and legs outstretched. While he begins falling to the water and pulls his arms and legs in, his rate of rotation increases. Physicists say that his *angular velocity* increases. As he gets closer to the water, he again extends his limbs and his angular velocity decreases back to its initial value.

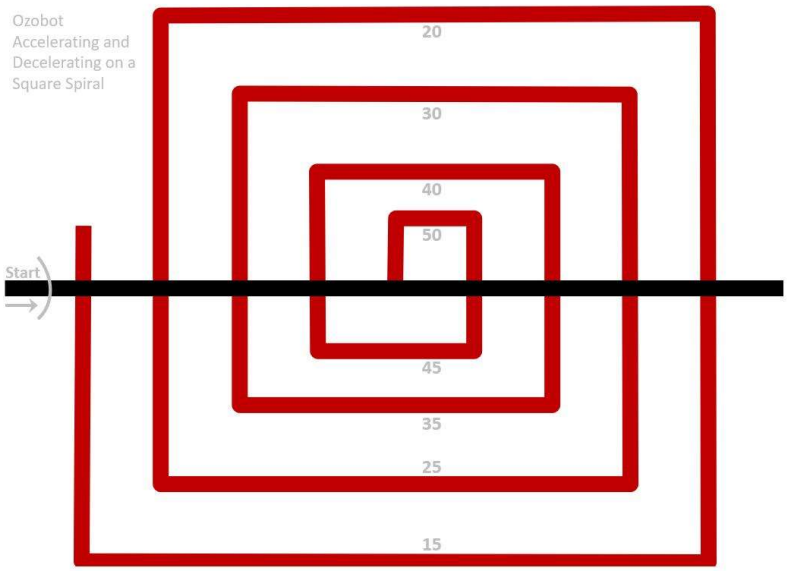
The same principle applies to an ice skater when she is spinning near the end of her routine. Her angular velocity increases as she gradually pulls in her extended arms. Just like the ice skater, if you have ever sat on a stool that is free to rotate about a vertical axis with your arms outstretched, you have probably noticed that your rate of rotation increases as you pull your arms in.

All of these examples illustrate the physics principle of *conservation of angular momentum*. It states that the total angular momentum of a system remains constant as long as the total external torque acting on the system is zero.

In this challenge, you will be making Ozobot *very roughly* simulate this idea by placing him on the edge of a square spiral and let his speed gradually increase as he approaches the center of the spiral. When he reaches the center, he will turn around and gradually decrease his speed back to what it was until he returns to the outer edge of the spiral. When he reaches the outer edge of the square spiral, he will turn around, and repeat this process, *ad infinitum*, or until he runs out of power or you stop him manually.

To accomplish this you will need to print a copy of the file *Accelerating and Decelerating on a Square Spiral.pdf*. This will be the "maze" on which Ozobot will travel. A small version of this maze appears on the next page for ready reference as you study the challenge program requirements. You will notice that the heavy, horizontal black line separates the square spiral into a number of segments, each of which has a number next to it. The number is the speed at which Ozobot should be traveling while on that segment. If you have studied the references on OzoBlockly.com, you should be aware that while line-following, Ozobot can travel at speeds from a minimum of 15 mm/s to a maximum of 85 mm/s. So Ozobot starts at the outer edge at

15 mm/sec, gradually increasing his speed by 5 mm/s as he moves on to the next segment. At the very center segment, he should be traveling at 50 mm/s.



Program Requirements

1. Use Mode 4 (Advanced) or higher for programming this challenge. (You may use the "repeat forever" from Mode 3 too.).
2. Ozobot should initially be placed on the heavy black line at the far left of the maze at the position labeled "Start" and facing the direction shown by the arrow. Make sure that his leading edge does not extend beyond the curved gray line.
3. He should turn right onto the red spiral and must travel at the speeds indicated on each segment of the spiral as he moves toward the center.
4. Upon reaching the end of the red line at the center, he should turn around and proceed back to the outer edge of the spiral, again traveling at the indicated speeds on each segment.
5. Upon reaching the intersection of the red spiral and black line at the left edge, he should turn around and repeat the spiral over-and-over again.