This simulation demonstrates four types of motion a red particle could have in two dimensions. It was inspired by the PhET simulation “Motion in 2D” at http://phet.colorado.edu/en/simulation/motion-2d. If you want to control the particle by dragging it inside of the box, pick the “Manual” option. The particle will lag a bit behind your mouse so that you can see the size and direction of the particle’s velocity and acceleration vectors. What happens to the vectors when you move the particle faster? Watch how when you let go of the particle, the acceleration vector switches direction such that it is in the opposite direction of the velocity vector. Why does this happen?

If instead you prefer to watch the particle move automatically, choose the “Automatic” option. There are three types of motion you can pick to observe: a type of linear motion, simple harmonic motion, or circular motion. In the linear motion scenario, you enter the magnitude of the acceleration you want to see the particle have. The particle first speeds up at this acceleration then it decelerates at the negative of the acceleration. A graph of one period of the particle’s linear motion is displayed below the box. Try to draw another period of the motion on your own paper. What happens to the particle’s velocity when you change the magnitude of the acceleration?

In the simple harmonic motion case, you enter the value of the constant k. The equations of the particle’s velocity and acceleration will change depending on what value you input. A graph of one period of the particle’s harmonic motion is displayed below the box. Try to draw another period of the motion on your own paper. What happens to the particle’s velocity and acceleration when you change k?

In the circular motion option, you enter the radius of the circle you want the particle to travel in. How does changing this radius affect the magnitude of the particle’s velocity and acceleration?

After you play around with all of the situations, think about how they are similar and how they are different. What can we now say about the relationship between a particle’s position, velocity, and acceleration?