Newton’s second law states that the acceleration of an object equals the net force acting on the object over the object’s mass.

Acceleration is what causes an object’s velocity to change over time. Which means the object will speed up, slow down, or change direction.

(show force equation and acceleration)

Here are the equations for both the net force (F-net), and acceleration (A). Where mass is kilograms (kg), distance is meters (m), and time is seconds (s).

As you can see, the more mass an object has, the less it will accelerate from the net force.

(hide equation) (hide title)

(show axis: force, acceleration, velocity)

Note that: force, acceleration, and velocity are all vectors. This means that they have a direction, and a magnitude.

A vector is composed of a value for each axis. In our case, the x and y values. These values can also tell us the direction, and the magnitude.

(hide axis)

(knight enters)

A brave sir knight has brought us a wheel to demonstrate. The wheel is enchanted with magical trails to allow us to observe its motion.

(Show as pop-up pointing to LAUNCH button:)  
Press LAUNCH to begin.

(wait to finish)

(display highlight on the trail during push)

The first few trails are where the knight was pushing the wheel. You can see that the distance between them are increasing.

(hide highlight)

(display highlight on the trail after push, and before the cliff)

At this point, the distance between each trail is equal. This means that the net force acting on the wheel equals zero.

(hide highlight)

(display highlight around the fall area)

The trails here are going down. We can observe that the only force acting on the wheel is the gravity.

(hide highlight)

(enable graph button, show pop-up on it:)  
Press this button to show the graph of the position, velocity, and acceleration of the wheel.

The graph maps out the trails across time along the x and y axis. Be sure to check the velocity and acceleration by scrolling down.

Observe how the position line curves as velocity increases, indicating that there is acceleration.

If the position line is straight, then velocity is constant, and therefore no acceleration.

(wait for graph to close)

(enable interfaces)

(show knight again)

(show goblins)

The nefarious goblins have appeared out of thin air! They are surely up to no good. Push them off the cliff using the wheel.

Press this button once you are finish.

Act 2-2

Hark! More goblins have appeared! This time, they have positioned themselves at different heights.

But fear not, we have the very tool to get the job done.

Let us bring forth the mighty cannon to vanquish these vermin!

(bring forth the mighty cannon)

In this scenario, we are applying force to a cannonball with explosion.

This short burst of force will allow the cannonball to accelerate within a fraction of a second to reach high velocity.

(show drag instruction: Drag angle)

Remember to check the graph to analyze the trajectory of the cannonball.