Modified from PASCO Essential Physics

Objective:
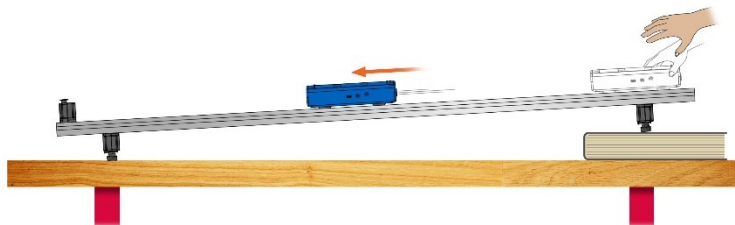- Relate acceleration to speed and velocity.

Materials:
- Smart Cart with Track
- Tablet or computer with SparkVue App
- Book

Procedure:

Part 1: Acceleration down a ramp.

1. In the SparkVue App, open the experiment file **04A_Acceleration** in the Essential Physics folder, then turn on the Smart Cart and connect it to the app.
2. Use a book to set the track at a low angle. Make sure an end stop is at the bottom of the track to catch the Smart Cart.
3. Hold the Smart Cart at the top of the track with the big, black bumper facing down and the spring rod pointing up.
4. Start collecting data and release the Smart Cart. Stop collecting data right after it reaches the bottom.
5. Use the slope tool to determine the acceleration from the slope of the velocity graph. Use only the part of the graph after the cart is released and before it hits the bottom. Does this match the value in the acceleration graph?
   a = _____ m/s^2; _____
   _____
6. What is the total time from the moment the cart was released to the bottom of the ramp? t = _____ s
7. Calculate the expected final velocity using the acceleration from step 5 and the time from step 6. What is the final velocity recorded on the velocity versus time graph right before it hits the bottom?
   Calculated v_f = _____ m/s; Measured from graph v_f = _____ m/s
8. Change the angle of the track and do the experiment again. What is the effect of increasing the angle on the acceleration of the Smart Cart? _____
   _____
9. How can the velocity versus time graph inform you of changes in acceleration? _____
   _____

Part 2: Acceleration up and down a ramp.
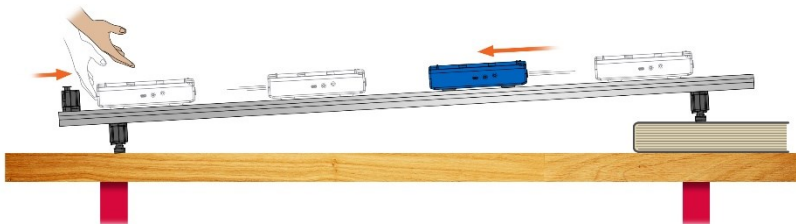
10. Lower the track down to the original low angle from step 2. Set the Smart Cart at the bottom of the track pointing in the same direction as before.
11. Start collecting data. Give the Smart Cart a push up the ramp so that it rolls up the track and then back down again *without hitting the top of the track*. Stop collecting data just before the cart reaches the bottom of the track.
12. Describe the velocity during the motion. Does the velocity change sign? _____
    _____
13. Where is the velocity zero? Explain how the graph shows this. _____
    _____

14. Describe the acceleration during the motion. Does the acceleration change sign? _____

15. Use the slope tool to determine the acceleration from the slope of the velocity graph. Use only the part of the graph after the cart is released and before it hits the bottom. Does this match the value in the acceleration graph?

    $a =$ _____ m/s^2

16. Compare the acceleration from step15 with the acceleration from step 5. _____