

Activity Sheet: Acceleration (Newton's 2nd Law of Motion)

Name:

Instructions

Your goal is to investigate how mass affects an object's motion and acceleration. By changing the weight of the car with coins or washers, you will calculate the average velocity of each car and observe the difference in acceleration. The difference in velocity indicates a difference in acceleration since the greater the acceleration, the greater the change in velocity over a given time.

Step 1: Background knowledge

Define Newton's 2nd Law of Motion and come up with your own example.

Step 2: Form a hypothesis

Predict how mass will affect the velocity of each car.

Step 3: Set Up Experiment

1. Make your track and attach it to the car launcher.
2. Tape down your measuring tape so it starts at the front of the car and runs down the length of the track.
3. Obtain a video camera and stopwatch (preferably, download and use a StopwatchCamera app to record videos with a more accurate timestamp (for accurate calculations).

Step 4: Test

1. While using these tools, pull on the car launcher and record the car moving. Try to grab the most accurate time stamp so that you can note the time that the car started and stopped moving.
2. Record the distance that the car traveled. If you are using inches, convert inches to centimeters by multiplying by 2.54, since velocity uses metric units (cm/s).
3. Now you can use this data to calculate the average velocity. Remember to write down your data.
4. Perform the next trials the same way, but remember to add coins to change the weight of the car. Tape the coins together, then use a longer piece of tape to attach the coins to the top of the car.

Step 5: Observations and Calculations

Use the table below to record your observations.

For example, you can use '5 pennies' or '5 quarters' for your change.

	Trial 1	Trial 2	Trial 3	Average
No weight	Distance:			
	Time:			
	Avg Velocity:			
Change #1				
Change #2				

Use the velocity formula. Typically, the velocity is the distance traveled (in meters) divided by the time it took to travel (in seconds) or $v = m/s$. To calculate the average, add the velocities from all three trials and divide by 3.

Calculations

$$v = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$$

Δx = change in displacement
 x_2 = final displacement
 x_1 = initial displacement
 t_2 = time at the end
 t_1 = time at the beginning

Step 6: Conclusion

Review your hypothesis. How did the change in mass affect the car's average velocity? How does this relate to its acceleration? Use your data to write a conclusion and discuss your findings about how mass affects the motion of an object.

Extension

Plot the mass x average velocity on a bar graph. Label the x-axis "Mass" and the y-axis "Average Velocity."

