Motion Evidence Lab

Read how a fair investigation connects force, mass, and motion.

MS-PS2-2 "Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each force or mass value and its unit. Circle the sentence in each paragraph that describes the change in motion, then number the details that make a comparison fair.

Cart Tests on a Straight Track

1. At a school hallway, a battery-powered cart rolls along a straight tape line. For this short test, a student treats the bench as an inertial reference frame because it does not speed up, slow down, or turn during the trial. The cart's motion is described relative to the bench. A force sensor shows 3 newtons pushing right and 3 newtons pushing left. These forces are balanced, so their sum is 0 newtons. The cart keeps the same velocity, whether it is moving or resting.

2. To test how net force affects motion, a team can use a low-friction cart on a straight track. They keep the cart's mass at 0.50 kilograms and use a fan set to produce either a 1-newton or 2-newton net force to the right. For each force, they start the cart from rest and record its velocity in meters per second every second for five seconds. They repeat each trial. If the 2-newton trials show a bigger velocity change each second, the evidence supports that a larger net force causes a larger change in motion.

3. Mass can be tested in a second investigation. The team uses the same fan setting, giving a 2-newton net force to the right, but compares a 0.50-kilogram cart with a 1.00-kilogram cart. They start each cart from rest on the same track and measure velocity each second. The heavier cart should have a smaller velocity change each second because the same net force acts on more mass. Keeping the track, fan force, starting condition, and measurement times the same makes this a fair comparison. Both investigations change only one variable at a time.

2 ANSWER WITH EVIDENCE

Use the passage

1. In the hallway trial, what is the sum of the forces, and what happens to the cart's velocity?

2. In the net-force investigation, what variable changes, what variable stays the same, and what measurement is recorded?

3. What result in the 2-newton trials would support the claim that a larger net force causes a larger change in motion?

4. In the mass investigation, which cart should have the smaller velocity change, and what conditions are kept the same?

3 YOUR TURN

Your own words

Plan an investigation in exactly four sentences that tests both net force and mass on a moving object in one direction. Include an inertial reference frame, force and mass values with units, what you will measure, what you will keep the same, and your predictions.

ANSWER KEY

Motion Evidence Lab

GRADES 6-8 · MS-PS2-2

PART 1 · READ AND MARK

Underline each force or mass value and its unit. Circle the sentence in each paragraph that describes the change in motion, then number the details that make a comparison fair. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In the hallway trial, what is the sum of the forces, and what happens to the cart's velocity?	**The sum of the forces is 0 newtons. The cart keeps the same velocity.**
2	In the net-force investigation, what variable changes, what variable stays the same, and what measurement is recorded?	**Net force changes from 1 N to 2 N. Mass stays at 0.50 kg, and velocity in meters per second is recorded every second.**
3	What result in the 2-newton trials would support the claim that a larger net force causes a larger change in motion?	**The 2-newton trials would show a bigger velocity change each second than the 1-newton trials.**
4	In the mass investigation, which cart should have the smaller velocity change, and what conditions are kept the same?	**The 1.00-kilogram cart should have the smaller velocity change. The track, fan force, starting condition, and measurement times stay the same.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I will use a glider on a straight, low-friction track and measure its velocity relative to a stationary meter stick. First, I will keep the mass at 0.40 kg and use net forces of 1 N and 3 N, recording velocity every second for four seconds. Next, I will keep the net force at 2 N and compare masses of 0.40 kg and 0.80 kg, using the same timing and starting from rest. I will repeat each trial, and I predict that the larger force will cause a larger velocity change while the larger mass will cause a smaller velocity change.

Accept equivalent descriptions of constant velocity, including staying at rest or moving at the same speed and direction. In the open response, accept different safe one-dimensional systems if students change only one variable at a time and include measurable evidence for both force and mass.