

3.1 The Law of Inertia

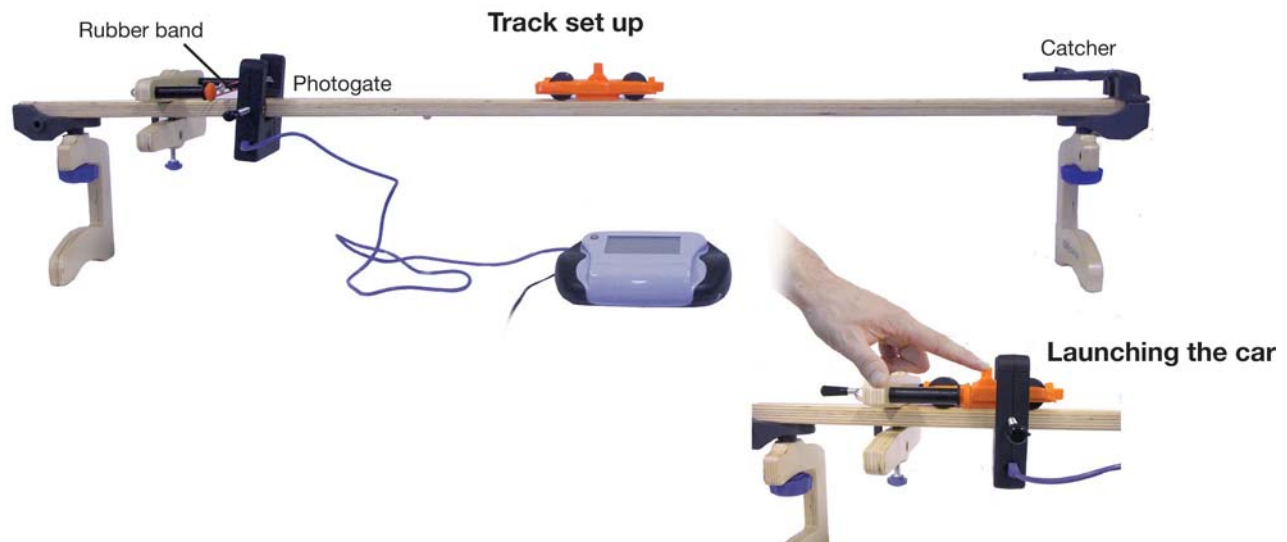
Why are heavier objects harder to start moving or stop from moving?

This investigation is about mass and inertia. Inertia is the property of an object that resists changes in motion. Inertia comes from mass. Objects with more mass have proportionally more inertia. In this Investigation, you will explore Newton's first law, the law of inertia.

Materials List

- Energy car
- SmartTrack
- Three steel marbles
- DataCollector
- Photogate
- Electronic balance or triple-beam balance

1 Launching cars of different mass



1. Set up the SmartTrack with a launcher at the 20 cm mark facing the catcher end of the track.
2. Put a rubber band onto the arms of the launcher in an x pattern by giving the rubber band a half-twist, then secure it in place between the retaining washers with the securing screws.
3. Put one photogate about 10 cm away from the rubber band. Plug it into the A photogate slot on the DataCollector. Use the timer mode and the interval function to measure the time the car's flag breaks the photogate's beam.
4. Use the plunger screw to set one constant deflection of the rubber band. This means each time a car is launched the same force is applied to each car.
5. Perform four trials by launching cars with 0, 1, 2, and 3 steel marbles. Record the mass and the time through the photogate for each launch in Table 1. Calculate and record the speed in Table 1.

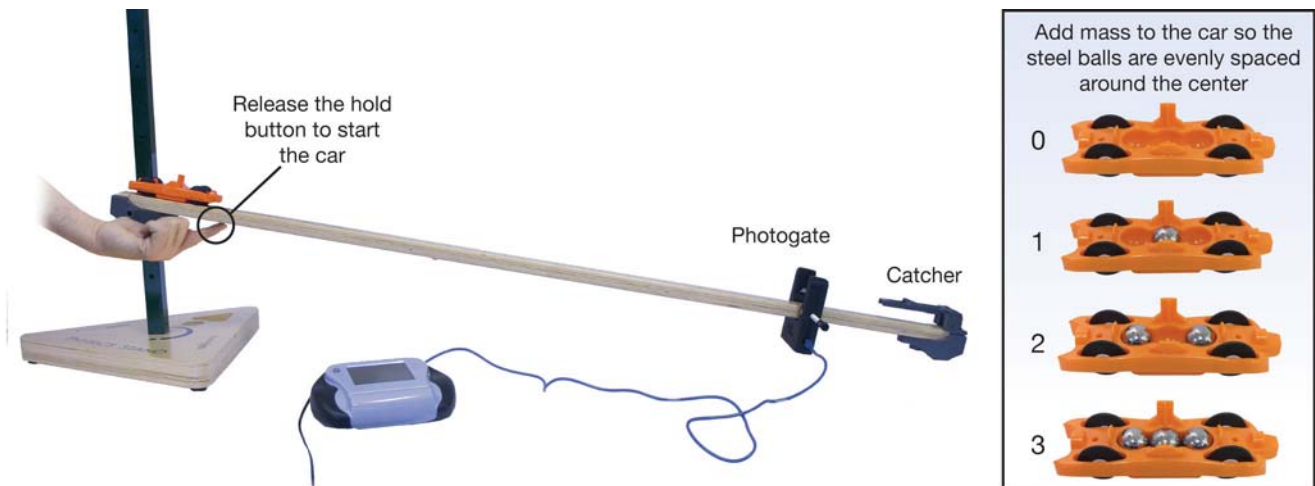
Table 1: Constant force data

Mass of car (kg)	Time through photogate (s)	Speed (m/s)

2 Thinking about what you observed

- Use Table 1 to graph the speed of the car (y) against the mass (x).
- Why did the speed change when the same launching force from the rubber band was applied to cars of different mass? How do your observations support your answer?

3 Inertia and weight



- Attach the SmartTrack to the fourth hole up from the bottom of the stand with a blue-threaded knob. Attach the photogate to the 100 cm mark.
- Use the hold button at the top of the track to drop the car from the same place each time.
- Drop cars of four different masses—0, 1, 2, and 3 steel marbles—from the same height on the hill. Use the DataCollector to measure the time through the photogate, and record it in Table 2.
- Record the mass and calculate the speed of each trial in Table 2.

Table 2: Constant height data

Mass of car (kg)	Time through photogate (s)	Speed (m/s)

4 Thinking about what you observed

- What force makes the car go down the hill? What property of matter does this force act upon?
- Does increasing the mass of the car increase its speed by a proportional amount? Does the speed decrease with increasing mass? Does the speed stay about the same, no matter what the mass?
- Discuss and propose an explanation for why changing the mass has a very different effect on the speed when gravity provides the force compared to when the force is provided by a rubber band.
- Research and define the terms *inertia*, *weight*, and *mass*. Write two to three sentences that describe how these three concepts are similar and how they are different.