18 Getting Pushy

Purpose

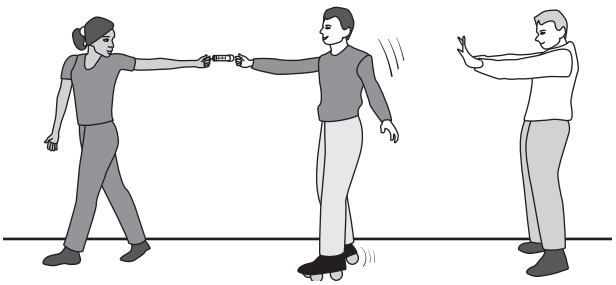
To investigate the relationship among mass, force, and acceleration

Required Equipment/Supplies

roller skates, skateboard, or student dynamics cart
spring balance
stopwatch
meterstick
tape

Discussion

Most of us have felt the acceleration of a car as it leaves a stop sign or the negative acceleration when it comes to a stop. We hear sportscasters describe a running back as accelerating through the defensive line. In this activity, you will investigate some variables that influence acceleration.



Procedure

Step 1: With pieces of tape, mark positions on the floor at intervals of 0 m, 5 m, 10 m, and 15 m. The path along the floor should be smooth, straight, and level. Gym areas or hallways work well.

Mark off distances.

Step 2: A student must put on the skates (or sit on the cart) and stand on the 0-m mark. Another student must stand behind the 0-m mark and hold the skater. The skater holds a spring balance by its hook.

Step 3: A third student must grasp the other end of the spring balance and exert a constant pulling force on the skater when the skater is released.

Pull on skater . . . catch skater.

Activity

The puller must maintain a constant force throughout the distance the skater is pulled. Do not pull harder to "get going." Time how long it takes to get to the 5-m, 10-m, and 15-m marks, and record this data in Data Table A along with the readings on the spring balance.

Data Table A

Trial	Distance (m)	Force (N)	Time (s)
1	5		
	10		
	15		
2	5		
	10		
	15		
3	5		
	10		
	15		

Step 4: Repeat the experiment twice, using different skaters to vary the mass, but keeping the force the same. If the results are inconsistent, the skater may not be holding the skates parallel or may be trying to change directions slightly during the trial.

Step 5: Repeat with the puller maintaining a *different* constant force throughout the distance the skater is pulled, but using the same three skaters as before. Record your results in Data Table B.

Data Table B

Trial	Distance (m)	Force (N)	Time (s)
1	5		
	10		
	15		
2	5		
	10		
	15		
3	5		
	10		
	15		

Name Period Date

Analysis

1. Until the time of Galileo, people believed that a constant force is required to produce a constant speed. Do your observations confirm or reject this notion?

2. What happens to the speed as you proceed farther and farther along the measured distances?

3. What happens to the rate of increase in speed—the acceleration—as you proceed farther and farther along the measured distances?

4. When the force is the same, how does the acceleration depend upon the mass?

5. When the mass of the skater is the same, how does the acceleration depend upon the force?

6. Suppose a 3-N force is applied to the skater and no movement results. How can this be explained?