

STEM Sims™

Push-A-Cart



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**Do you need an idea for a scientific study?
Try out one of our ideas or make one of your own.**

Start learning right now about force, mass, and acceleration. Take the following brief quiz to see how much you already know about how force and mass affects the acceleration of an object. See the bottom of page 4 to check your answers.

1. Which country is most famous for holding its annual pushcart derby every August at the Kaiser's Sports Club?
 - a. Germany
 - b. Jamaica
 - c. France
 - d. Spain

2. What is the top speed of the fastest pushcarts at the Kaiser's Sports Club annual push cart derby?
 - a. 30 mph
 - b. 40 mph
 - c. 50 mph
 - d. 60 mph



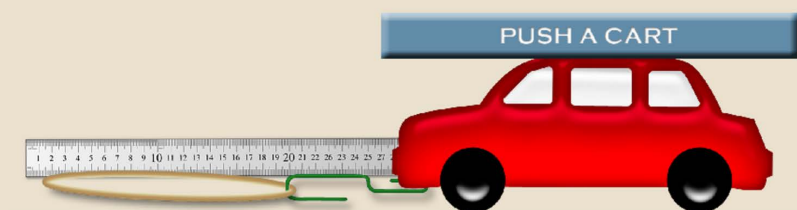
3. The Kaiser's Sports Club annual pushcart derby was responsible for launching a national team for which Olympic sport?
 - a. men's 100-meter dash
 - b. women's pole vault
 - c. 4-man bobsled
 - d. women's floor gymnastics
4. Pushcarts entered into the Kaiser's Sports Club annual pushcart derby can have small (less than 5 hp) electric motors to help the cart move from the starting gate.
 - a. true
 - b. false
5. Which movie's plot revolves around the Kaiser's Sports Club annual pushcart derby?
 - a. *Blade Runner*
 - b. *Cool Runnings*
 - c. *Logan's Run*
 - d. *Running Man*

Stretching Your Mind

Acceleration, which is a change in an object's motion, requires a net force. For instance, if an object is at rest, it takes a net force to start the object moving. If an object is already moving, it still takes a net force to change the object's motion. Think about a ball rolling in a straight line across a level table. A net force is needed to make the ball roll faster, roll slower, or to change the direction of the ball. In this activity, you'll investigate how acceleration, force, and mass are related. Pull yourself together and start this study of force.

Materials

toy car or something that rolls smoothly
small paperback books of similar size (3)
rubber band
paperclip
ruler



Procedure

1. Place the toy car on a level smooth surface, such as a table.
2. Open the paperclip up so you can attach one end to the toy car.
3. Attach the rubber band to the closed end of the paper clip.
4. Hold the ruler in one hand and use your other hand to pull on the car with the end of the rubber band *not* attached to the paperclip.
5. When the car first begins to move, use the ruler to measure the length of the rubber band. Record this in Table 1. Stop pulling on the rubber band.
6. Return the toy car to its original position and place one small book on top of the car.
7. Repeat steps 4-5. Make sure to enter your data in Table 1.
8. Add a second book to the top of the toy car and repeat the experiment.
9. Add the third book to the top of the toy car and repeat the experiment, testing all 3 books on the car.

Table 1.

Condition	Rubber band length (centimeters)
Toy car, only	
Toy car + 1 book	
Toy car + 2 books	
Toy car + 3 books	

Questions

1. What did the rubber band's amount of stretch measure?
2. How did the rubber band's amount of stretch change depending on the number of books?

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With a Little Too Much Help from a Friend

The United States' version of the Kaiser's Sports Club pushcart derby is the All-American Soap Box Derby™ held annually in Akron, Ohio. This event, started by a local newspaper man, has been held every year since 1935. Around 500 males and females between the ages of 10 – 17 from around the world participate in the race each year. The downhill 989-foot long race track has been covered in times around 26 seconds, resulting in speeds up to 35 mph.

One major difference between the pushcart and soap box derbies is the source of the force that moves the racer. The pushcarts are initially powered by people pushing the cart forward until the cart moves downhill, while the unpowered soap box racers rely on only gravity to pull them from the starting gate down the sloping track. Therefore, all soap box derby racers experience the same force and differences in speed depend only on the quality of the race car's construction.



Photo courtesy of Troup 330



In the early 1970's a scandal rocked the annual event when a competitor was disqualified for modifications to his car that gave him an unfair advantage. The racer had an electromagnet built into the front of his car that he could activate by moving his helmet. The magnet in the front of his car was attracted to the metal starting gate as the gate fell forward releasing the car. This gave his car an extra forward pulling force that accelerated his car out of the starting gate more quickly than his competitors. While most

races were won by a difference between competitors at the finish line of 1 to 3 feet, he won his races by between 20 to 30 feet! Officials used x-rays to analyze his car construction, which revealed his elaborate cheating system. He was disqualified and the race's second place finisher was declared the winner for that year.

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Answers: Page 2 Answers: 1) b, 2) d, 3) c, 4) b, 5) b. Page 3 Answers: Stretching Your Mind: 1) The amount of rubber band stretch was used to measure the applied force on the toy car. 2) The greater the number of books on the car (more mass), the more force (stretch of rubber band) required to change the motion (accelerate) the toy car.

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