# Who Pushed That Car?

Purpose

The purpose of this activity is to calculate the unbalanced force needed to accelerate a car or pickup truck to a given final velocity and determine the forces of friction that act on a car at the given velocities.

Materials

Pickup Truck with operating horn and speedometer, two stopwatches, and a roadway approximately one city block

Procedure

The class will be divided into two groups (A and B) of equal pushing ability. Select a driver that will drive in all of the times trials outlined below. The driver's weight will be considered as part of the car's weight. Record the weight of the car and the driver in the data table provided.

Times will be recorded for the acceleration from rest to a final velocity of 10 mph and then the car will be timed as it coasts from the above listed final velocity until frictional forces finally stop the car. Position the group that is pushing at the back of the car, instruct the driver to keep the car at rest with the foot brake, and set both stopwatches. The driver will release the brake and sound the horn as a signal to start the first watch when the final velocity is reached. At the second horn, the second watch will be started to time the negative acceleration from the final velocity to rest. When the car stops, the driver will sound the horn for a third and final time for the second timer. Record the two times in the data table.

DO NOT PUSH AFTER THE SECOND HORN!!!!!

The groups will conduct the trials as shown below:

Group A will push with only the driver in the car.
Group B will push with only the driver in the car
Group A will push with Group B riding in the car
Group B will push with group A riding in the car.

| | Empty A-push | Empty B-push | B-ride A-push | A-ride B-push |
|---|---|---|---|---|
| Weight of car and driver – lbs | | | | |
| Weight of passengers – lbs | | | | |
| Total weight – lbs | | | | |
| Initial velocity - mi/hr | | | | |
| Final velocity - mi/hr | | | | |
| Time for acceleration – s | | | | |
| Time for negative acceleration – s | | | | |
| Number of students pushing | | | | |
| Calculate total mass - kg (1kg = 2.2 pounds) | | | | |
| Calculate final velocity - m/s (1 mph = .45 m/s) | | | | |
| Acceleration - $m/s^2$ | | | | |
| Accelerating force – Newtons | | | | |
| Accelerating force - lbs (9.81N = 2.2 pounds) | | | | |
| Negative acceleration - $m/s^2$ (from friction) | | | | |
| Friction force – newtons | | | | |
| Friction force – pounds | | | | |
| Acceleration and frictional forces - lbs (total force) | | | | |
| Force per person – pounds | | | | |

Summing Up

1.Compare the times for the accelerations with your group pushing the loaded and unloaded car. Using the terms force, mass, and acceleration explain which trial took the longer time and why.

2. Compare the accelerating force in the loaded and unloaded car and predict if one force should be larger than the other. Does this predication hold true for the other group?

3. Compare and interpret the magnitude of accelerating and frictional forces.

4. What are the measurements in this lab that would tend to produce results with significant errors? How could these measurements be improved?