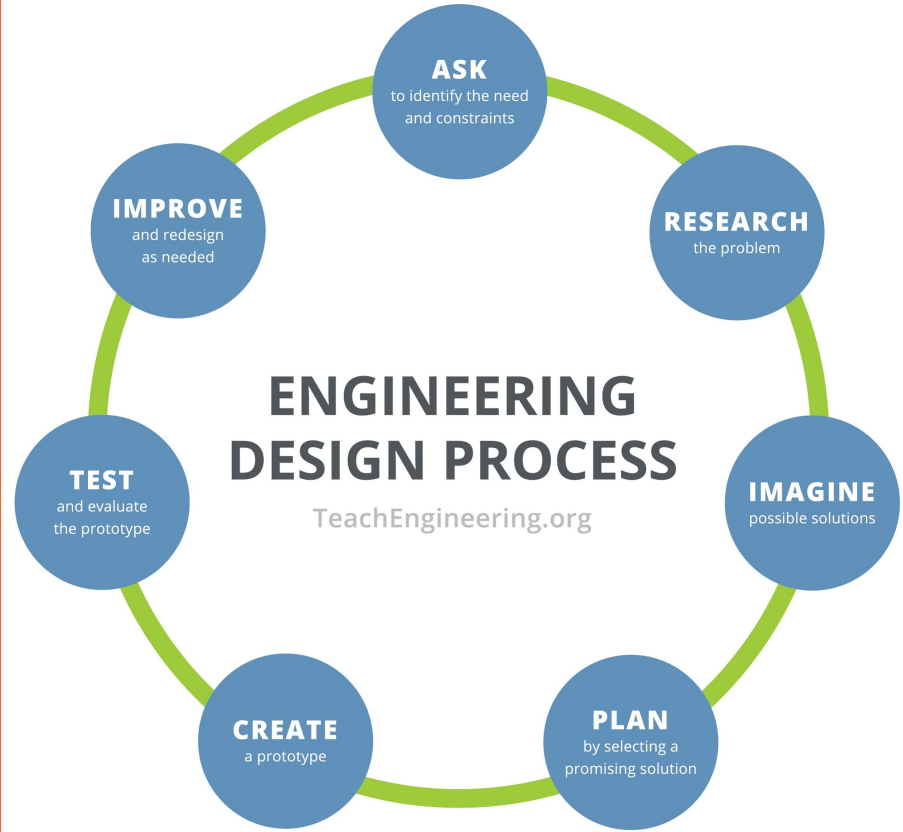
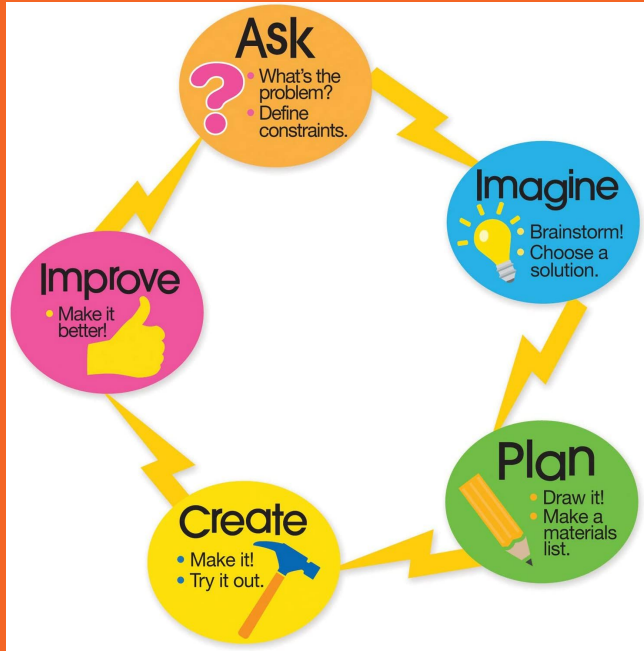

Crash Cushion



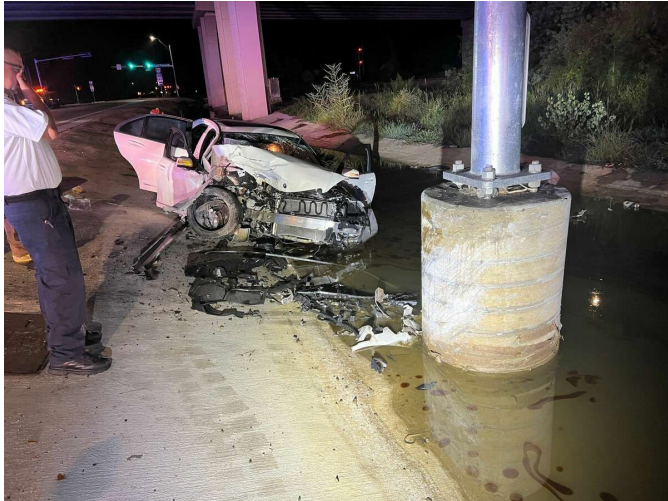
Students will explain Newton's 3rd Law in their design that appropriately solves a problem involving the motion of two colliding objects in a system.



The Problem

ASK

to identify the need
and constraints



Car crashes on highways occur at high speeds. This makes those crashes especially dangerous. Civil engineers are always designing and testing new ideas to make highways safer. Building crash cushions along highways that reduce the impact force experienced by the passengers of a car in a crash can save lives.

The Research

When cars crash into a wall, the car will exert a force on the wall and the wall will exert a force back on the car. If the car crashes into the wall with a large force, an equally large force will be exerted back on the car. This is an example of Newton's Third Law of Motion.

Newton's Third Law of Motion:

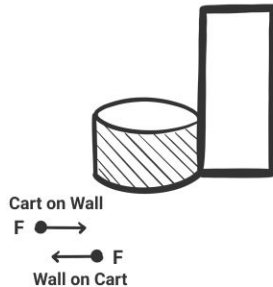
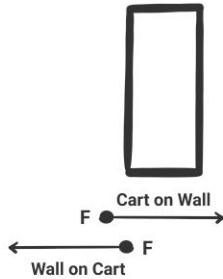
For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in opposite direction

The Research

If two identical cars traveling on the highway have equal mass and equal velocity they have the same momentum. Momentum can be thought of as the strength or force an object has when it is moving.

If the first car crashes into a wall without a crash cushion it will change momentum very suddenly, causing it to exert a large force on the wall. The wall will then exert a large force back on the first car, causing a dangerous situation for the passengers.

If the second car crashes into a well-designed crash cushion instead of the wall, the crash won't be as sudden. The momentum of the car will change more gradually. This means the second car will exert a smaller force on the cushion and the cushion will exert a smaller force back on the cart.



What did they do about it?

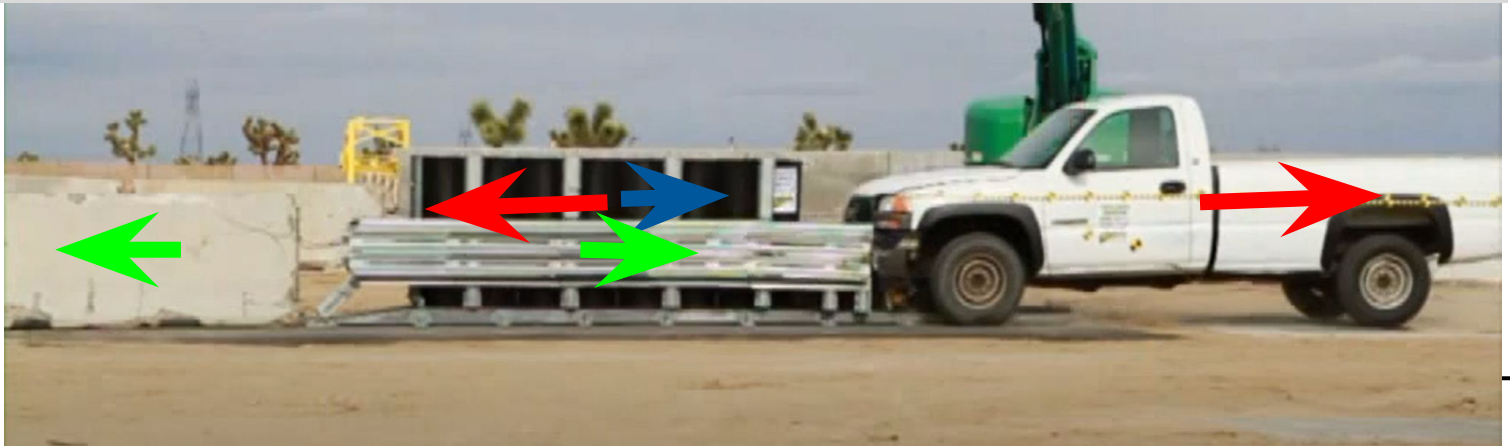


Explained

The system is the car, cushion, and barrier.

The car hits the cushion with a force, then the same force is applied to the car by the cushion. The cushion however acts like a spring. A spring applies a force in the opposite direction of what is applied to it. Making the net force passed on to the barrier less.

Green = cushion and barrier Blue = spring force Red = car and cushion



Investigation Design Challenge

How should crash cushions on highways be designed? In the event of a car crash, how can these crash cushions change the *momentum* of the car more gradually?

Your group is a team of civil engineers that work for the Department of Highway Safety to make highways safer. Using the available supplies, your group must design two model crash cushions and test which model would be better to build for the highway. You will test each model crash cushion design using G-force cars. Using the data collected from your crash cushion models, you will then draw a conclusion about how to design the best real-world crash cushion to make car crashes safer.



Materials

one sheet of 8.5" x 11" paper

one meter of masking tape

ruler and scissors (cannot be used as a part of your design)

Rules

Work in groups of 2

Nothing can be applied directly to the chip.



IMAGINE
possible solutions

Draw designs for your cushion
(you may not get your materials until after you have drawn at least 2 different designs)



CREATE
a prototype

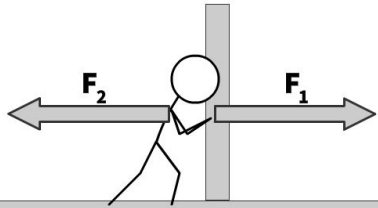


PLAN
by selecting a promising solution

Show designs to your teacher to get your materials



Newton's Third Law



Forces always Come in Pairs:
You Push on a Wall
the Wall Pushes Back



Test and evaluate your prototypes

After you have tested your designs, evaluate your prototypes.

Which design was better at reducing the impact ?

Why do you think one was better than the other?

Redesign

If you could build another one what would you add or change to make it better?

Credit:

Lesson taken from the pocket lab notebook and adjusted for time constraints.

<https://app.thepocketlab.com/lab-report/E8dSUNKi0001og58?ro=1&ref=%2Fresources%3Ffilters%3D%255B%2522subject.physical%2520science%2522,%2522sensor.gforce%2522,%2522grade.6-8%2522%255D>
