

**Tart Ma Cart**

Thanks Gregor Steele  
SSERC

Who's idea this was and without  
whom none of this would have  
happened!

# Collisions



- What makes a car 'safe'?
- Why are some cars better in crashes than others?
- What happens during a crash?
- Is this car safe?

# Making a car safe

Depends on

- driver education and attitude
- road design
- car maintenance
- car construction

# Driver education

- 30% of accidents involve a driver under the age of 21.
- 8% of driving licences are held by drivers under 21.
- One in three drivers will have an accident by the time they reach 21.
- Boys under 21 are twice as likely to be involved in an accident.



# Road Design



- New roads are subject to strict design standards covering gradients, radius of curvature of bends etc.



Although sometimes it can be a bit confusing!



# Road Design



- Existing roads are subject to review and accident black spots improved.



# Road Design



- Roadside furniture is being replaced with crushable structures to minimise vehicle intrusion in a crash.



# Car Maintenance

- Accident prevention is the best way of protecting people in cars.
- Proper maintenance of safety systems - brakes, lights, steering, suspension and tyres - is essential to preventing accidents.
- Very few accidents are attributed to mechanical failure.

## WARNING!

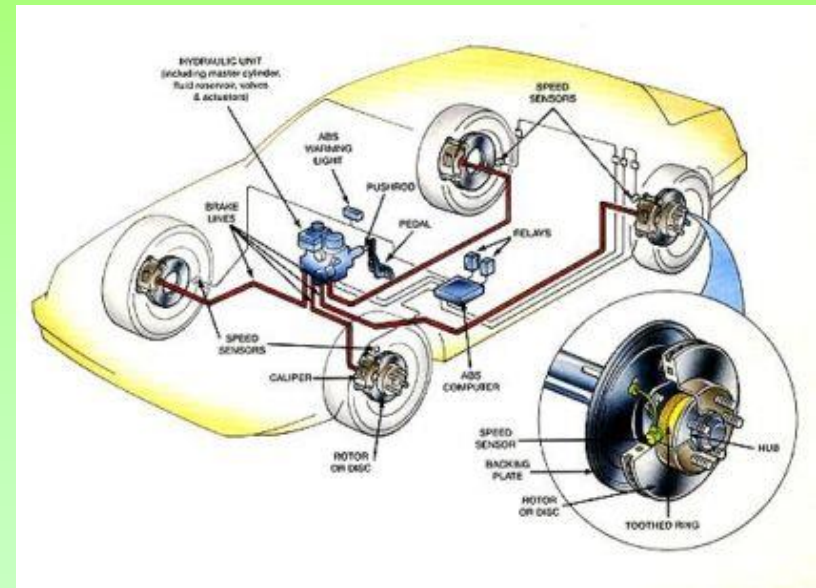
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# Car Construction

- Active safety systems include ABS, traction control, brake assist, dual circuit brakes.



# Car Construction

Passive safety systems include

- seat belts,
- air bags,
- safety cages and padding hard surfaces.



# Car Construction

- Cars are built with a passenger cage.
- A well designed cage should stay intact during a crash.
- Is this car safe?



# Smart v Mercedes E Class

- Who do you think will come off best?



Safe?





For a 50 kg driver at 10m/s (25 mph)  
No seatbelt, 5 mm flesh crumple zone!  
(hitting the windscreen)

- $E_k = \frac{1}{2}mv^2$

- $= \frac{1}{2} \times 50 \times 10^2$

- $= 2,500 \text{ J}$

- $E_w = Fd$

- $2500 = F \times 5 \times 10^{-3}$

- $F = \underline{5 \times 10^5} \text{ N}$

$F = ma$

$5 \times 10^5 = 50 \times a$

$a = 10^4 \text{ m/s}^2$  as  $g = 10 \text{ m/s}^2$  this is 1000 "g"

- Acc<sup>n</sup> about 1000 'g'

For a 50 kg driver at 10m/s (25 mph)  
500 mm crumple zone!  
(Smart car)

- $E_k = \frac{1}{2}mv^2$

- $= \frac{1}{2} \times 50 \times 10^2$

- $= 2,500 \text{ J}$

- $E_w = Fd$

- $2500 = F \times 5 \times 10^{-1}$

- $F = \underline{5 \times 10^3} \text{ N}$

- $Acc^n$  about 10 'g'

For a 50 kg driver at 10m/s (25 mph)

Large car 2.5 m crumple zone!

(Mercedes E Class)

- $E_k = \frac{1}{2}mv^2$

- $= \frac{1}{2} \times 50 \times 10^2$

- $= 2,500 \text{ J}$

- $E_w = Fd$

- $2500 = F \times 2.5$

- $F = \underline{1 \times 10^3} \text{ N}$

- Acc<sup>n</sup> about 2 'g'

## Safety and Style

- Your group's task is to take an ordinary physics trolley and fit it with a bumper or crumple zone to make it safer in a collision. You can make it stylish, but safety is more important! (You have probably seen TV shows where an ordinary car is fitted with an amazing body kit and a fancy stereo before being given a stunning paint job.)
- You will be given a choice of materials plus card and sticky tape.
- Your design must be able to be fixed to the front of the test trolley with velcro.
- It should not add more than 2 cm to the length of your trolley.
- It must not have a large effect on the performance of the trolley.
- Your design will be tested. The test will measure the deceleration of the vehicle in a head-on collision.

Do you think a large or small deceleration will be best in a collision? (Should the change of speed in the collision happen quickly or slowly?)