# Understanding Car Crashes Video

***Instructions****: Please answer the following questions completely in your journal using complete sentences.*

1. How is inertia involved in car crashes?
2. Why are seatbelts important safety measures to help reduce injuries in car crashes (use inertia in your answer)?
3. Use impulse and momentum to explain the egg demonstration.
4. Use momentum and impulse to explain why the driver that stopped more quickly experienced a greater force.
5. Use acceleration and impulse to explain why crumple zones are also important safety measures. Include the information from the crumple zone example in the video and the number of “g’s” experienced.
6. Use conservation of momentum to explain why hitting a wall would yield the same impact force as colliding with another car.
7. What are the pros and cons of weight and size in vehicle collisions?
8. How is kinetic energy involved in car crashes?
9. Why is it important for the car to deform in the correct places during a crash?
10. Why was the white van an example of poor crash safety?
11. Why was the red van safer than the white van in the crash test?
12. Looking back at the video, what is important for you to remember when designing and building your car for the car crash lab? What should happen with the restraint system? The crumple zone?

# Understanding Car Crashes Video ANSWER KEY

***Instructions****: Please answer the following questions completely in your journal using complete sentences.*

1. How is inertia involved in car crashes?

The person in the car is travelling at the same speed as the car. When the vehicle stops, the person tends to keep moving if they’re not strapped to the seat via a seatbelt.

1. Why are seatbelts important safety measures to help reduce injuries in car crashes (use inertia in your answer)?

If a person is not wearing a seatbelt the steering wheel stops them in a crash. This results in a high acceleration and a huge risk of serious injury. If a person is wearing a seatbelt, they are slowed with the vehicle and benefit from the crumple zone decelerating the car in a longer amount of time, thus decreasing the risk of serious injury.

1. Use impulse and momentum to explain the egg demonstration.

Both eggs undergo the same change in momentum, and thus the same impulse upon impact. However, the egg that impacts the wall has a very small impact time, thus a large impact force. This causes it to break! The egg that hits the sheet has a larger impact time, thus a smaller impact force and it survives intact!

1. Use momentum and impulse to explain why the driver that stopped more quickly experienced a greater force.

Both drivers experienced the same change in momentum and thus the same impulse while stopping. The difference is that the driver who panic stopped had a smaller stopping time. This means that he experienced a larger force than the driver who stopped in a normal amount of time.

1. Use acceleration and impulse to explain why crumple zones are also important safety measures. Include the information from the crumple zone example in the video and the number of “g’s” experienced.

The crumple zones are designed to increase the time of impact, thus decreasing the impact force since the impulse will still be the same. By increasing the crumple distance from 1 meter to 2 meters, the g force experienced decreased from 30 g’s to only 15 g’s!

1. Use conservation of momentum to explain why hitting a wall would yield the same impact force as colliding with another car.

Conservation of momentum and impulse were our new version of Newton’s 3rd Law! The changes in momentum in a collision are equal and opposite! So crashing into a wall yields the same impact force as crashing into a car at the same speed!

1. What are the pros and cons of weight and size in vehicle collisions?

A more massive car is safer because there is a smaller change in velocity in head on collisions. The size of a car helps in all types of crashes (crumple zone, passenger compartment, etc.), but weight is only a factor in collisions with other cars.

1. How is kinetic energy involved in car crashes?

The kinetic energy that a car has determines the amount of stopping force and distance (also known as work) needed for a car to stop. The kinetic energy in a car crash is what causes injuries to occur.

1. Why is it important for the car to deform in the correct places during a crash?

The crumple zone is designed to safely stop the car in a longer period of time compared to without the car deforming. However, the passenger compartment should not deform because it make the likelihood of injury much greater! There’s simply less room for the person to stay safe.

1. Why was the white van an example of poor crash safety?

The occupant compartment actually deformed. This meant that the seatbelt and airbag do not keep the person safe from the car collapsing in on them. The occupant is very likely to suffer serious injury.

1. Why was the red van safer than the white van in the crash test?

The safety cage stayed intact for this crash! This meant that the seatbelt and airbag are able to do their jobs! The person is able to slow down at a much safer rate compared to the white van; less likely to be injured.

1. Looking back at the video, what is important for you to remember when designing and building your car for the car crash lab? What should happen with the restraint system? The crumple zone?

Answers will vary – they should say that the restraint system should hold the eggs in place so they don’t hit the body of the car. They should also say that the crumple zone should be as large as possible and actually deform during the collision.