# Modern Marvels: Car Crashes Video

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

1. Fill in the blanks for these car crash facts:
   1. \_\_\_\_\_\_\_\_ Americans die on the road every 24 hours and \_\_\_\_\_\_\_\_ die each year!
   2. A frontal car crash take place in \_\_\_\_\_\_\_\_\_ seconds.
   3. An unbelted passenger weight 160 lbs driving at 30 mph experiences a force \_\_\_\_\_\_\_\_ time greater than that of gravity and hits the steering wheel with a force of nearly \_\_\_\_\_\_ tons!
   4. A change in velocity (Δv) of \_\_\_\_\_\_\_\_\_\_ is life threatening.
2. How can the environment and/or weather conditions affect the severity of a car crash?
3. Using your understanding of impulse, explain why crashes occurring more quickly (as cars became faster) made the crashes more dangerous for the occupants.
4. Why is it not always beneficial to use the strongest parts/materials available to build vehicles (use impulse and kinetic energy in your explanation)?
5. Using your knowledge of types of collisions, why do we say that crumple zones “absorb” energy? What does this phrase actually mean from a physics stand point?
6. Fill in the blanks for these car safety facts:
   1. The first reported car crash occurred in \_\_\_\_\_\_\_\_\_\_\_. The first reported traffic accident in the U.S. occurred in \_\_\_\_\_\_\_\_\_\_\_ when a car hit a bicyclist and the first traffic fatality occurred in \_\_\_\_\_\_\_\_\_\_\_, when a car struck a pedestrian.
   2. Seat belts were first added to cars in \_\_\_\_\_\_\_\_\_ and the 3 point seat belt was later introduced in \_\_\_\_\_\_\_\_\_.
   3. Air bags were introduced by \_\_\_\_\_\_\_\_\_\_\_ in the \_\_\_\_\_\_\_\_\_\_\_.
7. What are the 3 collisions that occur during a car accident?

1.

2.

3.

1. Why were early models of the air bag too dangerous for smaller occupants?
2. What is the function of anti-lock brakes? How do they increase vehicle safety?
3. Use energy to explain why the energy absorbent end caps increase the safety of guard rails on highways.
4. How do law enforcement agencies use physics and engineering to help in the after math of a traffic accident?
5. What is the single greatest safety device? How many lives could be saved if everyone used this device?

# Modern Marvels: Car Crashes Video ANSWER KEY

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

1. Fill in the blanks for these car crash facts:
   1. 120 Americans die on the road every 24 hours and 42,000 die each year!
   2. A frontal car crash take place in 0.10 seconds.
   3. An unbelted passenger weight 160 lbs driving at 30 mph experiences a force 45 time greater than that of gravity and hits the steering wheel with a force of nearly 4 tons!
   4. A change in velocity (Δv) of 30 mph is life threatening.
2. How can the environment and/or weather conditions affect the severity of a car crash?

Environmental factors can affect road conditions which in turn affect the stopping distance of the car and other functional limitations.

1. Using your understanding of impulse, explain why crashes occurring more quickly (as cars became faster) made the crashes more dangerous for the occupants.

Car crashes that occur more quickly have a smaller time interval for the collision to occur in. According to the definition of impulse, this means that the force felt during the impact is increased. Another factor is change in velocity. As the change in velocity increases, so does the impulse (according to impulse-momentum theorem) and thus the force is also increased.

1. Why is it not always beneficial to use the strongest parts/materials available to build vehicles (use impulse and kinetic energy in your explanation)?

Using the strongest materials means that they may be able to withstand the impact force without being damaged. This can mean that the space inside the cabin can be reduced, thus injuring the occupant. Additionally, we know that if there isn’t any damage, the collision occurs over a smaller interval of time, which increases the force felt during the collision according to the definition of impulse. It would also mean that the collision is more elastic (no damage), so the kinetic energy is transferred through the vehicle and to the occupant, increasing the risk of injury.

1. Using your knowledge of types of collisions, why do we say that crumple zones “absorb” energy? What does this phrase actually mean from a physics stand point?

Crumple zones are designed to be damaged in a collision. As we know, damage creates an inelastic collision in which kinetic energy is not conserved! This is because the kinetic energy of the car before the impact is then shared between kinetic energy and the energy required to damage the crumple zone, such as sound energy and thermal energy.

1. Fill in the blanks for these car safety facts:
   1. The first reported car crash occurred in 1771 . The first reported traffic accident in the U.S. occurred in 1896 when a car hit a bicyclist and the first traffic fatality occurred in 1899, when a car struck a pedestrian.
   2. Seat belts were first added to cars in 1950 and the 3 point seat belt was later introduced in 1959.
   3. Air bags were introduced by General Motors (GM) in the 1970s.
2. What are the 3 collisions that occur during a car accident?

1. The collision involving the vehicle

2. The collision involving the occupant

3. The collision(s) involving the occupant’s internal organs

1. Why were early models of the air bag too dangerous for smaller occupants?

The air bags deployed too quickly; a smaller time of impact with the air bag meant the force experienced by the occupant could be fatal for small women and children.

1. What is the function of anti-lock brakes? How do they increase vehicle safety?

Anti-lock brakes ensure that maximum braking pressure is applied without sending the vehicle out of control.

1. Use energy to explain why the energy absorbent end caps increase the safety of guard rails on highways.

By using materials designed to dissipate energy during a collision, the time of impact is increased thus decreasing the force of impact. It also transforms kinetic energy into another form of energy, therefore bringing the car to rest safely.

1. How do law enforcement agencies use physics and engineering to help in the after math of a traffic accident?

Physicists and engineers are able to collect evidence about the accident and use that information to determine a cause of the car crash(es). They are also able to recreate the collisions, even with multi-car pile-ups so that we can learn more about collisions and vehicle safety.

1. What is the single greatest safety device? How many lives could be saved if everyone used this device?

The seat belt is the single greatest safety device invented in motor vehicle history. Over 10,000 lives would be saved each year if American wore their seat belt.