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Car Safety



Millions of people die or are injured in vehicle accidents every year.

Car Crashes

Worldwide, almost 1.3 million people die in car accidents every year. That's an average of 3,287 deaths per day. In the United States alone, more than

37,000 people die in car accidents. Car crashes injure or disable 20-50 million people worldwide and 2.35 million in the United States every year. While that's a lot of people, there would be more without airbags and seatbelts, which protect people from death and injury. Moving vehicles are dangerous because of the amount of **momentum**¹ they have.

Did You Know?

Airbags and seatbelts make people 51% less likely to die in a car crash.

What is Momentum?

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The cue ball's momentum is transferred to the other balls when breaking at the beginning of a pool game.

When a moving

object runs into something, the force of the hit changes the velocity, and thus the momentum, of the moving object. However, the momentum of the moving object - we'll call it object A - combines with the momentum of the other object - object B. This is called **conservation of momentum**². This means that the total momentum of the two things doesn't change. The individual momentums of each object, however, do change. So, if object A is a 1000-kg car traveling east at 20 m/s and object B is a 1000-kg car traveling west at 20 m/s, their momentums will combine to fully stop both cars.

Conservation of momentum is used in pool as well as Newton's cradle desktop toys.

The force of a hit acts over some amount of time. The product of force and time is called **impulse**³. This impulse is equal to the change in momentum felt by an object.

¹ **Momentum:** the movement of mass in a direction.

² **Conservation of momentum:** when two objects hit each other, the total momentum of the two before they hit is the same as after they hit.

³ **Impulse:** force acting over a period of time (force x time); equal to the change in momentum felt by an object.

The more momentum, the more impulse needed to stop it. Breaking this down, the bigger an object or the faster an object is moving, the more force and/or time is needed to stop it. More force needs less time, while a longer amount of time means less force is felt by the object.



When a car crashes into a larger vehicle, it loses a lot of momentum to the other vehicle.

What Happens in a Car Crash?

When a car crashes into another car, wall, guardrail, or other object, it loses forward momentum really fast. This means that it feels a lot of force. This force acts on the car itself as well as everything inside the car, including people. Airbags and seatbelts work together to make the force people feel smaller. The force a person would feel without any safety features would be

hitting the dashboard or windshield (windscreen) headfirst. That type of hit is what causes most deaths in car accidents.

How Do Airbags and Seatbelts Protect People?

To make the force smaller, both airbags and seatbelts increase the amount of time the force acts over.

Airbags⁴ are nylon bags in the steering wheel and the

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Seatbelts do two things.

Seatbelts⁵ are a little different. They do two things. The first is to keep people's bodies connected to the vehicle so they don't fly through the windshield in a crash. The second is to make the force of a crash smaller for people in the car. When the car stops suddenly, the seatbelt lets people move forward a little. This increases the time of impact with the belt itself while keeping passengers strapped in.

⁴ **Airbags:** nylon bags in the steering wheel and dashboard that inflate.

⁵ **Seatbelts:** belts that keep people strapped into a car.

Reading Comprehension Questions:

1. How many
2. How many people are injured or disabled in traffic accidents worldwide each year?
3. What is
4. What
5. What is impulse?
6. What do
7. Simply,
8. How do airbags make the time of impact longer?
9. What are the two things seatbelts do?

Extension Questions

10. Imagine you have a friend who doesn't like to wear their seatbelt. What would you tell them? How would you explain that seatbelts are important? Use physics!
11. Think of
12. Create a diagram showing how airbags work. Check out [canva.com](https://www.canva.com) for templates.

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