

# Protective Equipment – Keeping You Safe



Helmets and protective gear have been used for centuries. Originally, they were used for battle and were worn by knights. It would be years until helmets similar to the ones we use today would be developed. Protective equipment is often taken for granted but you do not need to be Evel Knievel (**shown in the picture above**) to wear a helmet and protective gear.

## How Helmets and Protective Equipment Work

The goal of protective equipment is to decrease the force imparted on the person wearing it. Whether you are getting tackled in football, or are in a car accident, a great deal of force is applied to you. Injuries occur when this force is imparted on your body, as we are not designed to accept such impacts. Protective equipment acts to either divert the force away from you, deform to absorb some of the energy from the collision and increase the time of impact and/or to spread the force of impact around an area, delocalizing it. From specialized work, to sports, to everyday life, innovations in protective equipment have improved safety and saved many lives. The following pieces of protective equipment will be discussed, including their components and why you should use them: bicycle, motorcycle, and football helmets, seat belts, airbags, and sports' shoulder pads.

**Helmets:** Helmets are made with a protective **lining** (padding) that absorbs the impact during a collision. Typically, the better the lining, the better the helmet. The shell of the helmet is a hard plastic. Advances in football helmets over the last 50 years have greatly reduced injury.



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seat belt from releasing. This keeps drivers and passengers in place and prevents injury. This only occurs during a sudden stop. If you're moving at a constant rate or decrease your speed slowly, the seat belt will move freely.

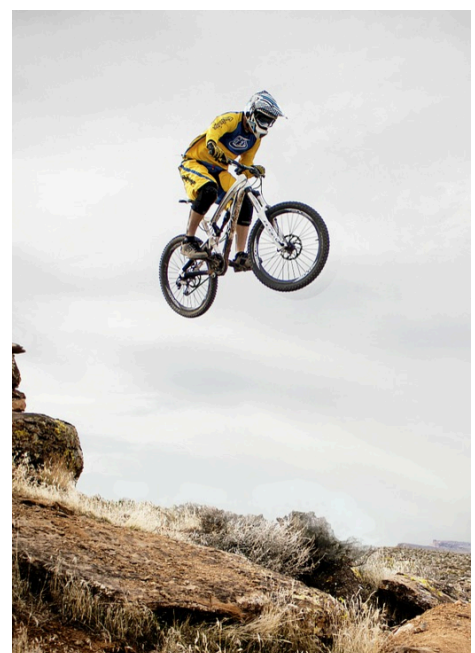
Airbags: The airbag is another innovative piece of protective equipment that has saved countless lives. Today, this product is found in most motor vehicles. The airbag acts as a pillow that is



ejected from different locations in the vehicle when a collision occurs. The airbag is ejected when one of the vehicle's **sensors** detect the force of a collision equal to hitting a brick wall at a speed of at least 10-15 mph. The airbag then pops out in  $1/30^{\text{th}}$  of a second, and prevents drivers and passengers from colliding with the hard interior of the car. However, front seat airbags pose a great danger to children. Parents are urged to never place their children in the front seat of vehicles, as the

force of impact of the airbags is enough to seriously harm or kill a child.

As discussed previously, the goal of protective equipment is to decrease the force experienced by the person wearing it. If our equipment deflects the impact great, that will reduce it. If it spreads the force around our body we will feel less of it in one spot, good again. But whenever there's an impact, the energy from the force needs to go somewhere and that's where we see their real benefit. The average tackle in the NFL can impart 7117 Newtons of force (1600 pounds). To explain the importance of reducing the force of impact we need to consider the impulse equation  $\rightarrow Ft = v_f m - v_i m$  where  $F$  = force,  $t$  = time,  $v_f$  = final velocity,  $v_i$  = initial velocity and  $m$  = mass. The left side of the equation ( $Ft$ ) is the force of impact times the time the impact lasts. The right side of the equation ( $v_f m - v_i m$ ) is telling you how much your velocity changes during the impact. The right side of the equation is fixed (think of traveling 5 m/s then stopping, it doesn't matter how fast you stop, it'll still have the same value). However, we can adjust the



left side. Since the right side is a fixed number, if we increase “t” on the left, we would have to decrease “F”. This is good because it represents a decrease in impact force. That’s the key but how do we increase “t”? That’s where our equipment comes in. By deforming (squishing a material), the impact time increases a small amount (think 0.01 s vs. 0.02 s). This may not seem like much but a doubling of time (t) means a halving of force (F)! The more we can increase “t”, the less “F” will be. Airbags do this and so does the wall padding you might see in your school’s gym.

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### The Future Protective Equipment

With protective equipment constantly being improved, its potential is without limits. Helmets are being made to absorb more impact and distribute the force away from the head region. Seat belts have improved from only the lap belt to include a shoulder belt. Its pendulum technology has been advanced to react more quickly while also ensuring safety to the drivers and passengers. Airbags are now being included in bicycle gear. In the event of a collision, they inflate to protect the cyclist’s head. Innovations to shoulder pads have also greatly reduced risk of dislocations and other sports related injuries. What will come next nobody knows. Prior to the 1950’s, nobody had considered the use of airbags. What else have we not considered?

### Reading Comprehension Questions

1. What is
2. What
3. What are the two main components of helmets?
4. How
5. Explain how a seat belt works.
6. How
7. Why
8. Why does increasing the impact time reduce the force of impact?
9. In 2015, 35,000 people died in motor vehicle accidents. If all those people had been wearing seat belts, how many lives (statistically speaking) could have been saved?

### Extension Questions-Answers

10. Do you usually
11. Research the
12. In many places around the World, it is legal to NOT wear a seat belt. What do you think of this? Should seat belts be mandatory for all vehicle occupants? Why or why not?
13. Concussions have

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**TWF**

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