

SECTION 1

Accidents

Section Overview

The section begins by having students assess their knowledge of risks involved with vehicles. Students answer questions designed to deal with common misconceptions about automobile safety. A list of common safety features found in automobiles today is provided. Students use this list to consider how safety features have changed over time. They apply their knowledge of safety features by identifying safety features in various modes of transportation, describing what type of collision they protect passengers from, and how they protect passengers. Students then record new ideas in their logs for designing their prototype of safety features to protect passengers during a collision.

Background Information

Accidents occur whenever a vehicle collides with another object. The major factors that influence accidents are slowed reaction times and road hazards, such as snow, potholes, or animals. The physics involved in accidents is the same. The fundamental concepts of conservation of energy and conservation of momentum determine how severe the accident is or how much damage is done to the objects and passengers involved in the collision. The more energy and momentum transferred, the greater the damage. Safety features are designed to avoid collisions and to assist in absorbing and dispersing energy and momentum during a collision.

There are two main categories of safety features: active and passive. Active safety features use information from the vehicle's external environment to change and improve the response of the vehicle before and during a collision. The ultimate goal of an active safety feature is to avoid a collision. Examples of active safety features include the following:

- Intelligent speed adaptation—uses global positioning satellites and an electronic throttle to control the speed of a vehicle, not allowing the vehicle to go over the speed limit.
- Turn signals and brake lights—allow other drivers to determine how the vehicle is changing its motion.
- Dynamic steering response and variable-assist power steering—change how much force is needed to turn the steering wheel, requiring less force when driving at slow speeds and more force when driving at higher speeds. They reduce overcompensation when drivers try to avoid collisions at high speeds.
- Traction control—prevents wheels from spinning and operates the brakes or the throttle to restore traction.
- Four-wheel drive—allows each wheel to have the power to rotate. This feature reduces sliding and over and under-compensation of turning.
- Reverse backup sensors—alert drivers to items behind their vehicle when driving in reverse.
- Electronic stability control—monitors an automobile's stability; can decrease power, apply brakes, and adjust steering compensation if the automobile seems to be going out of control.
- Lateral support—alerts drivers when they leave their lane.
- Mirrors—provide visibility.
- Low center-of-gravity—provides better handling.
- Anti-lock braking assist, brake-assist systems, dynamic brake control, etc. —braking systems that reduce skidding and sliding.
- Driver-state sensor—monitors a driver's eyelid movement.

Passive safety features are designed to help minimize injury during a collision. Some examples of passive safety features include the following:

- Seat belts—absorb some of the energy and limit the forward motion of an occupant, keeping the occupant from being ejected from the vehicle. Shoulder harnesses restrain the upper body, absorb energy, and prevent a secondary collision with items in the vehicle.
- Air bags—restrain motion and absorb some of the energy during a collision.
- Crumple zone—absorbs the energy of a collision, diverting it from the occupant compartment.
- Side-impact bars—reduce deformation of the side of a vehicle during impact.
- Collapsible steering column—reduces impact between driver and steering wheel.
- Fuel pump shut-off—turns off the fuel pump during a collision.
- Car seats—reduce energy of impact for children.
- There are also features that protect pedestrians involved in accidents:
 - bumpers are soft;
 - no sharp edges on the exterior of the vehicle;
 - and the shape of vehicles prevent the hit pedestrian from hitting other parts of the vehicle.

Crucial Physics

- Identify and describe factors that affect safety while driving.
- Compare and contrast safety features designed to protect passengers during collisions.

Learning Outcomes	Location in the Section	Evidence of Understanding
Evaluate your understanding of safety.	<i>Investigate</i> Steps 1-3	Students take a test about safety.
Identify and evaluate safety features in selected automobiles.	<i>Investigate</i> Step 3 <i>Physics Talk</i> <i>Physics Essential Questions</i> <i>Physics to Go</i> Questions 1, 6 <i>Inquiring Further</i> Question 1	Students consider a list of common safety features and describe the conditions under which they protect passengers and how they protect passengers. Students identify and/or evaluate safety features of new vehicles.
Compare and contrast the safety features in selected automobiles.	<i>Investigate</i> Step 3 <i>Physics Talk</i> <i>Inquiring Further</i> Question 2	Students compare and contrast common safety features in automobiles.
Identify safety features required for other modes of transportation (in-line skates, skateboards, bicycles).	<i>Physics to Go</i> Questions 2-4 <i>Inquiring Further</i> Question 1	Students identify safety features that would reduce the risk of injury during a collision for other modes of transportation, such as in-line skates, skateboards, and bicycles.