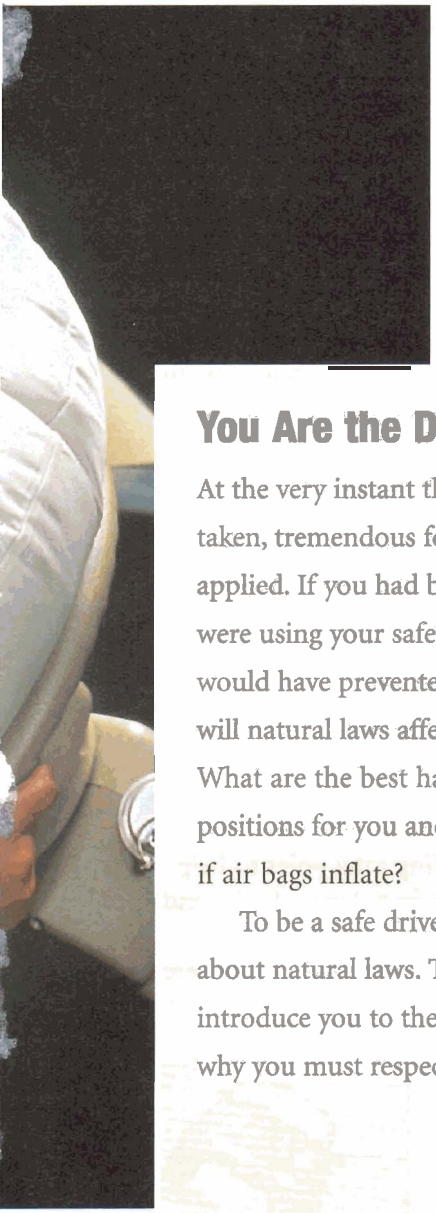
Unit 2

Controlling Your Vehicle

Chapter 5
Natural Laws and Car Control



You Are the Driver!

At the very instant that this picture was taken, tremendous forces were being applied. If you had been the driver and were using your safety belt, the air bag would have prevented serious injury. How will natural laws affect your car control? What are the best hand and seating positions for you and your passengers if air bags inflate?

To be a safe driver, you need to know about natural laws. This chapter will introduce you to these laws and explain why you must respect them.

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5.1
Gravity and Energy of Motion

Objectives
1. Explain how gravity affects your car.
2. Describe the factors that affect energy of motion.

Gravity and energy of motion are natural laws that will affect the way your vehicle performs. When you operate a light vehicle like a bicycle at low speeds, you can easily maintain control. Control can be tricky, however, when you drive a car or a light truck that weighs almost two tons. In emergency situations, natural laws can create forces that can work for or against you.

Gravity

Gravity is the force that pulls all things to Earth. The lack of gravity in outer space lets astronauts float. However, if you hit a ball, drop a rock, or drive your vehicle over a pothole, gravity pulls each to Earth.

Driving Up and Down Hills

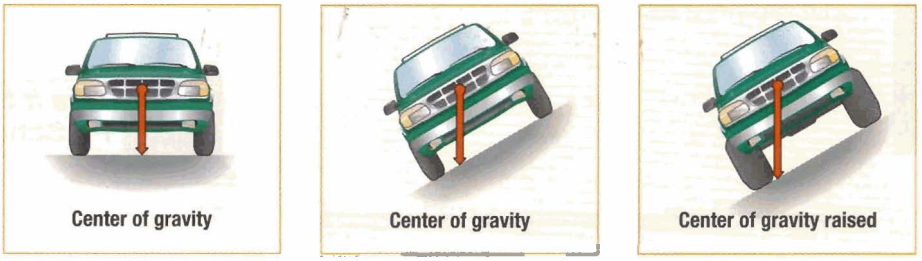
You can feel the pull of gravity as you drive up and down hills. When you drive uphill, you will lose speed unless you use extra power. To hold the same speed, you must increase the vehicle's power to overcome the pulling force of gravity. On a steep hill in a standard stickshift vehicle, you will have to use a lower gear to increase power and maintain speed.

Gravity will increase your speed on a downhill road unless you control it. It will take you longer to stop, so you will need to think further ahead. Start braking early and shift to a lower gear on a long downhill stretch of road. This will let the engine—instead of the brakes—slow your vehicle.

How will an uphill or downhill situation affect your intended path of travel? In an uphill situation, your actual braking distance will be shortened a little. On a downhill road, your actual braking distance will be longer. The steeper the incline, the longer your stopping distance will be.

Center of Gravity

The point around which an object's weight is evenly distributed is called its **center of gravity.** For example, high-wire circus performers use this law by holding long poles to help them maintain balance. As the ends of the pole curve down, the performer's center of gravity is lowered.



A vehicle's stability decreases as its center of gravity rises.

This lower center of gravity helps the performers to maintain balance and walk the thin wire without falling.

An automotive engineer tries to make a vehicle's center of gravity low so that it can perform better. Look at the vehicle in the pictures on the left. See how raising the vehicle's center of gravity could make it unstable on a steep hill or sharp turn. How would this vehicle perform in a sudden stop or swerve situation?

Energy of Motion

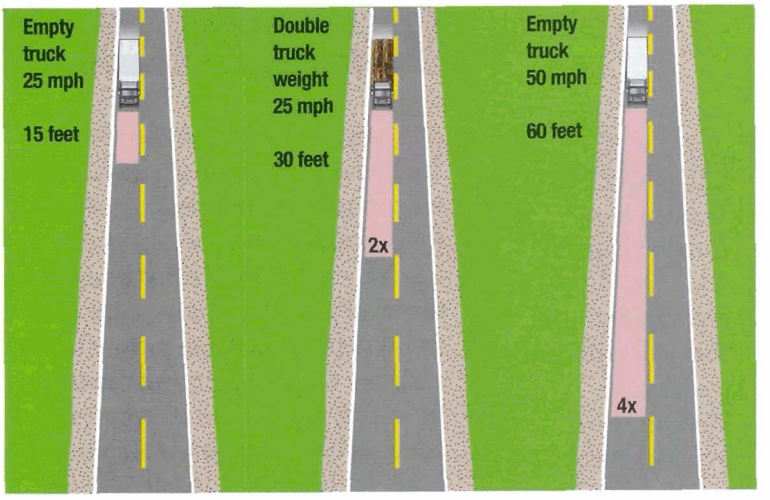
When an object moves, it acquires energy. This force is called **energy of motion,** or kinetic energy. The faster your vehicle moves, the more energy of motion it has. Energy of motion is also affected by the weight of the moving object.

The pictures on this page show how a truck's energy of motion increases dramatically as weight and speed increase:

- The truck's energy of motion doubles when its weight is doubled by a load. When the truck weighs twice as much, it needs about twice the distance to stop.
- The truck's energy of motion will change in proportion to the *square* of its change in speed. When the truck's speed doubles, it needs about *four times* the distance to stop. If you triple your speed, you will need *nine times* the distance to stop.

Once you really understand this natural law, you can adjust to traffic situations ahead of time. You will see how important it is to slow before an emergency situation develops. Every time you cut your speed in half, you cut your energy of motion by four times.

As a driver, you will feel the laws of gravity and energy of motion affecting your vehicle. Remember these laws when you need to judge how long it will take you to stop your vehicle.



A vehicle's energy of motion increases dramatically with increases in weight and speed.

Review It

1. How does the force of gravity affect your car going downhill?
2. What factors affect energy of motion?

5.2
Friction and Traction

Objectives
1. Explain how traction controls your car.
2. List three things that can reduce traction.
3. Describe how you can check traction while driving.
4. List factors that affect your car in a curve.

Many people believe their steering wheel, brake pedal, and accelerator control their vehicle. Actually, your four tires, and their footprints that touch the road, are the first and one of the most important parts to the control system. Look at the picture below and spot the four footprints created by the car's tires. Each footprint is about as big as a page of this book.

Friction is the force that keeps each tire from sliding on the road. You can feel this same force by rubbing your hands together.

The friction created by the tire on the road is called **traction.** Traction makes it possible for your vehicle to grip the road so you can change speed and direction. Press the accelerator, and the drive wheels rotate. The traction of the tires mounted on these wheels makes your vehicle go forward.

Push the brake pedal, and braking friction will slow the four wheels on your vehicle. As the tires on these wheels slow, traction between the tires and the road will slow your vehicle. This same system will enable your vehicle to turn left or right when the front wheels turn.

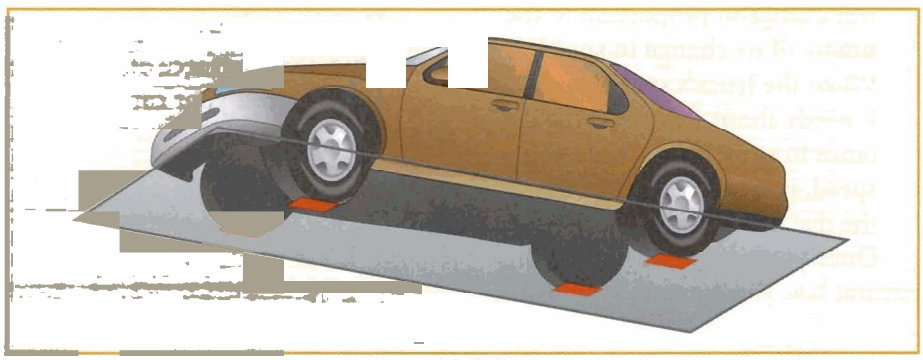
Tires

Tires make a difference in the way your vehicle performs. The simple mistake of driving with low pressure in your tires can mean the difference between avoiding a collision or hitting something.

Tread and Traction

The grooved surface of a tire that grips the road is called the **tread.** When the road is wet, the tread allows water to flow through the grooves and away from the tire. This action allows the tire tread to cut through the water and grip the road. Thus, the tire will not float on the water and lose traction. This gripping action on wet roads is critically important in preventing skids and hydroplaning (see page 252).

A tire's gripping ability will increase as the amount of tread



The four footprints of your tires on the road are the only contact between your car and the road.

touching the road increases. Tire size will also affect the amount of tread and traction on the road. Use care when putting larger tires on a vehicle. Check the owner's manual for your vehicle for the maximum recommended size of tire to use.

A worn, bald tire is dangerous. A bald tire will not grip a wet or icy road. Because it has no tread, the tire may puncture. If this happens, the tire could suffer a **blowout** when all the air escapes at once. Check page 96 to see how to check your vehicle's tire tread depth.

Inflation and Traction

Each tire is designed to work best between a range of high- and low-inflation air pressures. Check your owner's manual for the best pressure to use. The pictures on this page show how too much or too little pressure can change the amount of tread, or footprint, on the road. The dark gray areas show the best traction areas. The more dark gray area, the better. When your tire pressure is right, you will get your best control. You also will get your best gas mileage and tire wear because tires roll easier at the right pressure.

Underinflation When you drive on an underinflated tire (see the middle picture on this page), only the outside edges of the tire provide traction. That means the outside edges will wear out first. When this happens, the life of the tire is shortened. More importantly, in an emergency, the underinflated tire will not perform properly. Finally, an underinflated tire is likely to heat up and fail more quickly than a properly inflated tire.

Overinflation Overinflating a tire should also be avoided. If the tire has too much pressure, only the center of the tire will grip the road properly (see bottom picture on this page). Over time, the overinflated tire will wear out its center tread more quickly than a normal tire.

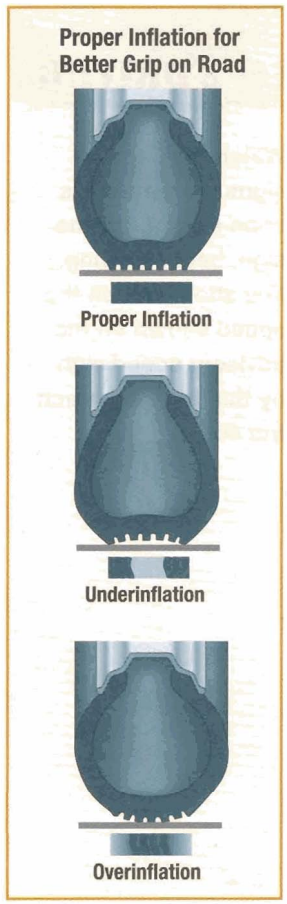
Outside air temperatures can change the pressure in your tires, too. If the air gets colder, tire pressures will drop. Hot temperatures will increase pressures. Check tire pressures on a regular basis to make sure they have the right amount of air. To assure an accurate reading, check tire pressures when your tires are cold, before you start driving.

Split Traction

Even under ideal conditions, the amount of traction your tires can produce is limited. The way you use the amount of traction you have is up to you.

In a straight-line braking situation, all traction is used to slow down your vehicle. However, when you are braking and turning, you divide your traction limit. You may use some of your traction to turn and some to slow. Or, you may use some traction to turn and some to speed up. In turning-braking situations, you will have to ease up on your brake pedal to avoid skidding. And remember, always try to drive at a speed where you can hold some traction in reserve.

Many vehicles today are four-wheel, or all-wheel drive. That means they can apply power to all four of



The boxes show the areas of best traction—properly inflated tires grip evenly; underinflated tires grip only by the outer edges; overinflated tires grip only in the center.

TIP

SAFE DRIVING

Watch for warning signs for curves. As soon as you see the sign, begin slowing. You should reach the speed shown on the advisory speed sign by the time you reach the curve.

their wheels for added pulling power. But again, the basic laws of nature apply. Both two-wheel-drive and four-wheel-drive vehicles can use almost all of their four wheels of traction for stopping or turning. In a split-traction situation, however, you must divide the amount of available traction between stopping or starting and steering.

Reduced Traction

You need two things to maintain ideal levels of traction. First, your vehicle must be in good condition. Second, the road must be smooth, paved, level, and clean.

Vehicle Condition

When your vehicle is new, it is easy to control. But as it ages, you need to work hard to make sure it is maintained in top condition so it will perform correctly. If you allow tires, shock absorbers, or steering system parts to wear, traction and control will be reduced.

Good shock absorbers are very important for maintaining traction. Worn shock absorbers will cause your tires to bounce off a rough road and limit your control. Worn shock absorbers must be replaced to regain control.

Worn or improperly inflated tires also will limit your control. In an emergency situation, you will need all the control your tires can provide. Check tire pressure and tread frequently. You can check tire tread with a gauge or a penny. Make sure there is at least one-sixteenth of an inch, as the driver in the picture is doing.

Road Surface

When you drive on a straight, dry, flat road, traction and control are great. But, if you drive the same vehicle on the same road on a rainy or snowy day, control will be reduced dramatically. When you see the road is about to change, reduce your speed before you reach the reduced-traction area.

Icy weather can be especially dangerous for driving. When ice is covered with water, traction control will be reduced to almost nothing. Be alert that water will freeze in shaded areas and on bridges *before* it does on regular roads.

Checking Traction When road conditions are bad, slow down your vehicle. You can use these steps to check how much traction you have:

1. Check your rear zone to make sure no traffic is near.
2. Brake *gently* to see how your vehicle responds.
3. If your vehicle does not slow or if your antilock brakes start to work, reduce speed even further.

If you can see all of Lincoln's head on the penny, switch the tire.

Curves

Energy of motion and traction will work on your vehicle as you drive around a curve. The energy of motion in your vehicle will try to make it go straight in a curve. The higher your vehicle's speed, the more it will tend to go straight.

Tire traction is the second force working for you in a curve. But if your speed is too high, you might not have enough traction to make the curve.

Vehicle Control in Curves

Your vehicle's speed, the sharpness of the curve, the bank of the curve, and your vehicle's load will affect the control you have in a curve.

Speed You have no control over how sharp a curve is, but you can adjust your speed. To reduce your chance of skidding, lower your speed before entering a curve. Remember, your energy of motion will change in proportion to the square of your increase or decrease in speed. If you cut your speed in half, the force pushing you off the road will be cut four times.

Sharpness of Curves The sharper a curve, the more traction your vehicle needs to grip the road. Use lower speeds for sharp curves.

Banked Curves A curve that is higher on the outside than it is on the inside is called a **banked curve.** This type of curve helps to overcome your vehicle's tendency to move to the outside of the curve. This can be very helpful on a road that has a crowned, or higher, center.

This driver slowed ahead of time for this curve.

What should the driver do to adjust for the extra load?

Load Your vehicle's load affects your control in a curve. How will adding the load to the vehicle in the right picture affect control? To maintain control, the driver must slow when heavily loaded.

Vehicle Capabilities

Vehicles of different sizes and power handle differently. Small vehicles like a motorcycle are light and can accelerate quickly. Large trucks and recreational vehicles, on the other hand, take lots of power just to accelerate to highway speeds. Large vehicles can take a long distance to stop. You need to remember these differences when you use the IPDE Process.

Review It

1. How can traction control your vehicle?
2. What are three things that can reduce your traction?
3. What three steps can you take to check traction while driving?
4. Name three factors that can affect your vehicle in a curve.

5.3
Stopping Distance

Objectives
1. Define total stopping distance.
2. Explain how to use the four-second rule.
3. Name four factors that affect braking distance.

When you are driving and have to stop, three things must happen. You must perceive the hazard in your path of travel, react, and brake your car to a stop.

Total Stopping Distance

The distance your car travels while you make a stop is called your **total stopping distance.** The picture on this page shows how this distance is measured from the point you first see a hazard to the point where your vehicle stops.

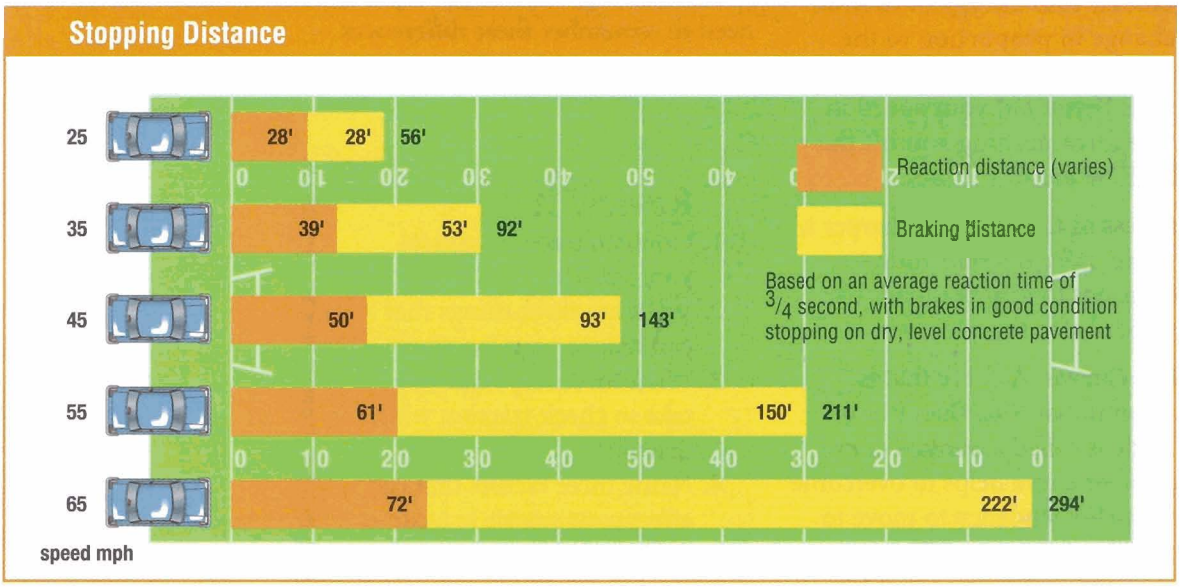
Perception Time and Distance

The length of time you take to identify, predict, and decide to slow for a hazard is called your **perception time.** Perception time will vary greatly depending on visibility, the hazard, and your abilities at the time. The distance your vehicle travels during this time is your **perception distance.**

You cannot consistently estimate your perception distance because your ability to perceive will change. Sometimes it will take longer to perceive a complex driving situation than it will take to brake to a stop. To help compensate for your long perception time, aim high and look 12 seconds or more down the road.

Reaction Time and Distance

Once you recognize a hazard, the length of time you take to execute your action is your **reaction time.** An average driver's reaction time is



Distances traveled at various speeds once driver perceives hazard and begins to stop

three-fourths of a second. The distance your vehicle travels while you react is called your **reaction distance.**

Braking Distance

The distance your vehicle travels from the time you apply the brake until you stop is called **braking distance.** A vehicle's energy of motion—and your braking distance—are proportional to the square of the increase in speed. If you accelerate from 20 mph to 40 mph, your braking distance will be about four times longer. If you know you are going to be driving into a high-risk situation, why is it so important to drive at a lower speed?

Estimating Stopping Distance

The chart on this page shows your reaction distance and braking distance from different speeds.

Use the four-second rule, which enables you to project your approximate stopping distance under ideal conditions at any speed.

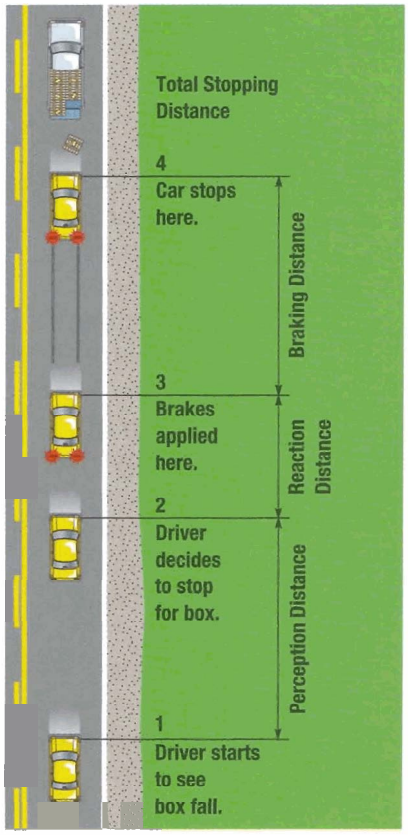
1. Pick a fixed checkpoint (a mark or shadow on the road) ahead where you think you could stop.
2. Count off four seconds: "one-thousand-one, one-thousand-two, one-thousand-three, one-thousand-four."
3. Check your vehicle's position. If you have just reached your fixed checkpoint, you can assume the distance you estimated in Step 1 was the approximate distance it would have taken you to stop.

Practice estimating your stopping distance from various speeds. Keep in mind it will take you almost 300 feet, or the length of a football field as shown in the chart, to stop if you are traveling at 65 mph.

Factors That Affect Braking Distance

These seven factors can affect your total braking distance:

- **Speed** The higher your speed, the longer your braking distance.
- **Vehicle Condition** A vehicle with worn tires, shock absorbers, or brakes needs a longer distance to stop.
- **Roadway Surface** Rain, snow, ice, dirt, wet leaves, and gravel reduce road traction and increase stopping distance.
- **Driver Ability** If you are distracted or impaired, you will take longer to stop your vehicle.
- **Antilock Braking System (ABS)** If your car has an antilock braking system, you can better control your stopping distance while turning.
- **Hills** Your braking distance increases when driving downhill.
- **Loads** Heavy loads increase your braking distance.



Total stopping distance

Review It

1. What three parts add up to your total stopping distance?
2. How can you estimate your stopping distance?
3. What factors can affect your braking distance?

5.4
Controlling Force of Impact

Objectives
1. List three factors that will change your vehicle's force of impact in a collision.
2. Explain the correct way to adjust safety belts.
3. Describe how a driver and passengers should position themselves to benefit from air bags.
4. Explain how to best position and use child safety seats.

If you have ever seen a severe traffic collision, then you know that collisions happen with blinding speed—usually in less time than it takes to blink your eye—and that these collisions can be violent. The following pages will show you how to protect yourself and your passengers if you are involved in a severe collision.

Force of Impact

In a violent collision, vehicle occupants need all the protection they can get. If they are not protected, they will be thrown against the vehicle's interior in a second collision or ejected from the vehicle.

The force with which a moving object hits another object is called **force of impact.** Three factors determine how hard something will hit another object—speed, weight, and distance between impact and stopping.

Speed Speed is the most important factor in determining how hard a vehicle will hit another object. The force of impact is in proportion to the square of the increase or decrease in the vehicle's speed. Any reduction in speed will greatly reduce the damage inflicted. Always try to reduce speed in an emergency.

Weight The heavier a vehicle, the more damage it will cause in a collision. A vehicle weighing twice as much as another vehicle will hit a solid object twice as hard.

Distance Between Impact and Stopping The distance a vehicle covers between the instant it hits an object and the moment it comes to a stop can vary greatly. Imagine hitting barrels filled with sand sitting in front of a light post rather than hitting the post itself. The barrels will slow you as you hit them rather than stopping you like the post would. This is why traffic engineers put cushioning materials in front of solid roadside objects.

Safety Belts

Three collisions occur when a vehicle hits a solid object. First, the vehicle hits the object and stops. Second, the occupants either hit the inside of the vehicle or their **restraint devices.** Third, occupants may suffer internal collisions as their organs impact inside their bodies.

A restraint device is any part of a vehicle that holds an occupant in a crash. A **passive restraint device,** such as an air bag, is a part that works automatically. A device you have to engage, like a safety belt, is called an **active restraint device.**

How to Wear Safety Belts

What can you do ahead of time to reduce the possibility of serious injury? Using safety belts is your number one defense. Safety belts will hold you in place during an emergency and prevent you from being thrown from your vehicle. Any time you are in a vehicle, you need to follow these steps for wearing your safety belt:

1. Adjust your seat to a comfortable upright position. Make sure your safety belt is not twisted.
2. Snap the metal fitting on the end of the safety belt into the buckle. Then adjust the lap part of your safety belt so that it is low and snug across your hips. The bottom edge of the safety belt should just touch your thighs. By making this adjustment, any crash forces will be applied to your pelvic bones.
3. Finally, adjust the shoulder part of your safety belt across your chest. Your shoulder belt should be snug.

These adjustments will work for all normal-height individuals, including expectant mothers. For children, see the section on child safety seats later in this chapter. Like the driver shown in the picture, you are responsible for everyone in your vehicle.

Everyone needs to take responsibility for a safe trip.

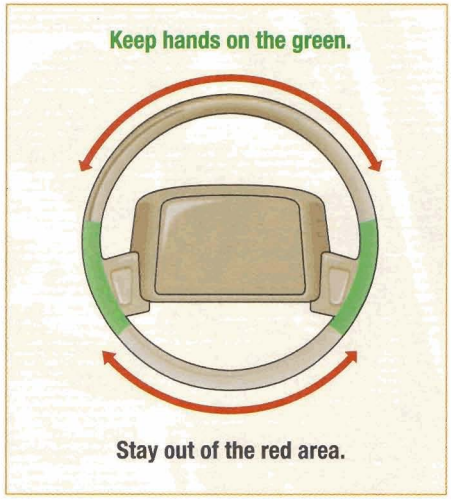
Air Bags

An air bag is a balloon-type device that automatically inflates to protect you. Look at the first page of this chapter to see an inflated air bag. If collisions happen in the blink of an eye, air bags work even more quickly. They deploy at speeds over 200 mph. The following description of a collision between two air-bag-equipped cars will give you some idea of their effectiveness.

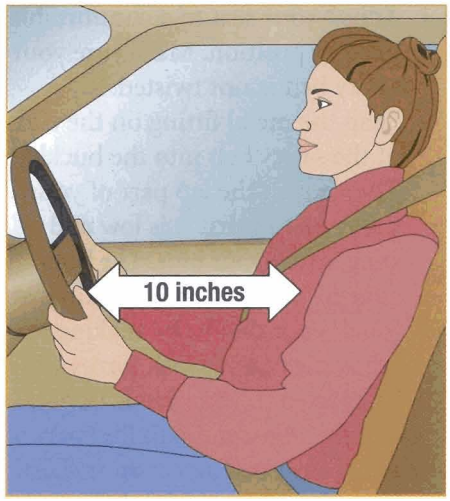
> The investigation revealed exactly what happened. Driver A had seen

INVENTOR OF SAFETY BELTS Nils Bohlin is the engineer who invented the modern three-point lap and shoulder safety belt while working for the Volvo Automobile Company in Sweden. These belts appear in most vehicles around the world.

According to Mr. Bohlin's design, the belts should fit snugly across the chest. Belts that are too loose will not restrain the chest properly in a crash.



A balanced steering position between the 9 and 3 o'clock or the 8 and 4 o'clock position is best to avoid injury from an air bag.



You must have 10 inches or more between your chest and the air bag in the steering wheel.

a car heading toward him on his side of the road and had virtually stood on his brakes. Then he was aware that his face was being buried in a balloon-like pillow. Driver B remembers her bag suddenly billowing in front of her nose. "It was a jolt, but not a hard jolt. Like when you were a kid and jumped on a mattress...."

The Insurance Institute for Highway Safety team established that the crash was the equivalent of each of them hitting a stationary object at 68 mph. As the cars slammed together, each driver's head was thrown forward with 1700 pounds of force....

By the time the hood of each car began to crumple, both bags were fully inflated and positioned directly in line with the head and torso of each driver. As their heads slammed forward, the folds of the air bag softened the impact, like a big balloon. At maximum inflation, the bags began to vent nitrogen gas to ensure the gentlest impact possible.

Thanks to air bags, both drivers recovered from this collision.

To receive full benefit from air bags, you need to know the following:

- Air bags are designed to work with safety belts. That is why air bags are called a supplemental restraint system. Most air bags protect in frontal collisions only. Safety belts provide front, side, and rollover protection. Some vehicles also have overhead and side-door air bags for extra protection.
- To avoid an air-bag injury, keep your hands on the steering wheel between the 9 and 3 o'clock and the 8 and 4 o'clock position. This balanced steering position will give you your best ready position for steering. Look at the picture above left to see this range. If your hands are too high or too low in an air bag collision, you could suffer a serious hand, arm, head, or eye injury.

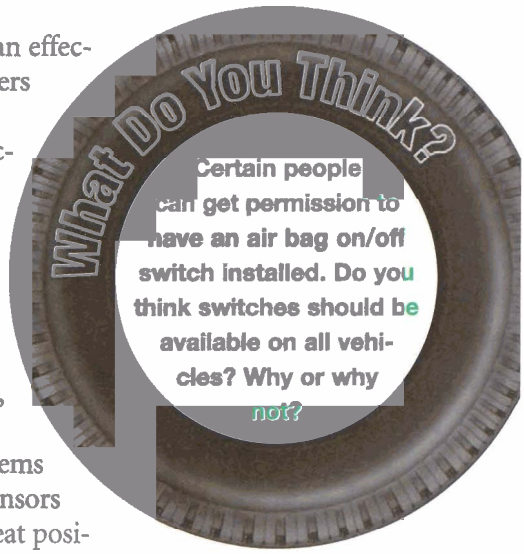
- Sit away from an air bag after you are belted. As the driver, your chest should be at least 10 inches away from the steering wheel hub, as shown in the right-hand picture on the opposite page. Use approved pedal extensions if needed to attain this distance. As a front-seat passenger, move your seat as far back as possible.
- If you have a tilt steering wheel, tilt it so your air bag will deploy toward your chest.
- Children in child seats and young people up to the age of twelve must sit in the back seat as shown in the picture. When children, and even short adults, ride in the front seat of an air-bag-equipped vehicle, they can be injured if the air bags deploy.

Always use child seats in the back seat.

Air Bag Improvements

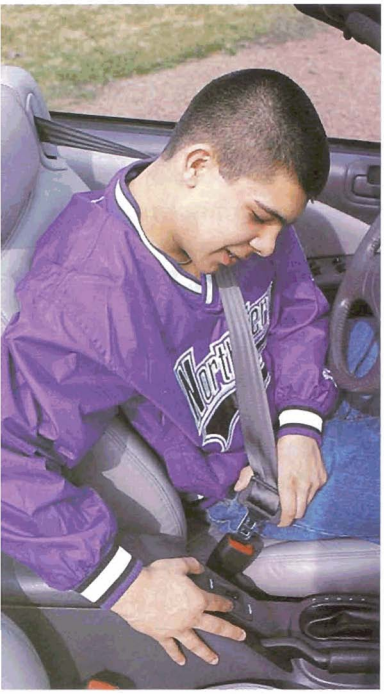
The air bag has proved to be an effective life-saving device. Engineers are now designing features to make air bags even more effective. The following list highlights some of the features that are being developed:

- **Advanced air bags** Because some people have suffered serious injuries as the bag deploys, some vehicles are now equipped with air bag systems with advanced features. Sensors can measure weight and seat position of passengers and severity of the crash. Then, the air bag deploys in two stages with appropriate speed and intensity.
- **Air bag switches** To give vehicle owners a choice about using an air bag, some owners may ask permission to have a switch installed to turn off the front passenger air bag. This is an enormous compromise. If you are considering this option, check your insurance policy to make sure it will be in full force if you switch off an air bag. Also check your safety belts to see if they are designed to stretch. If you install the switch, you will need to replace those safety belts with belts that do not stretch.



Other Protection Devices

To reduce risk in collisions, automobile engineers have designed



Make sure your lap belt is used with your shoulder belt.

Adjust your head restraint to reach the middle of the back of the head.

additional devices in new vehicles to protect you. These are a few of them:

- **Automatic safety belts** Some vehicles have automatic safety belts for occupant protection. To use these belts, you must make sure your lap belt is buckled low and across your hips. Then when your door is shut, your shoulder belt is drawn into place as shown in the picture.
- **Front and rear crush areas** Vehicles are now designed to have their front or rear end crush on impact. When this happens, the dramatic force of impact is lessened for occupants in the vehicle.
- **Energy-absorbing bumpers** Most vehicles are now equipped with bumpers that are designed to absorb low levels of impact under 5 mph without damage. This will provide protection in many minor collisions.
- **Side door beams** Many vehicles now have steel beams built into the side doors. These beams provide valuable protection in collisions where you are hit on an angle.
- **Reinforced windshield** To avoid flying glass in a collision, vehicles now have laminated windshields. This means the windshield is really two pieces of glass with a thin layer of plastic in the middle.
- **Energy-absorbing steering wheel and column** This type of steering wheel and column is designed to compress when hit.
- **Padded dash** This design feature can reduce injury in all crashes.
- **Child seats** The use of special seats for infants and small children is required in every state. These seats must be used in the back seat of your vehicle, as shown in the picture on page 103. If used in the front seat of a vehicle with air bags, an air bag could seriously injure a child in the event of a crash. Always follow your child seat manufacturer's instructions.
- **Head restraints** Padded head rests on the top of seats are designed to protect you against whiplash injuries. To make sure you get the full benefit of this protection, adjust your head rest as shown in the picture.

Review It

1. What three factors can affect force of impact?
2. What three steps should you take when putting on safety belts properly?
3. What are the two key steps you should take to protect yourself as the driver of a car with air bags?
4. Where should all child seats be secured in a car?

Reviewing Chapter Objectives

1. Gravity and Energy of Motion

1. How does gravity affect your vehicle? (92)
2. What are the factors affecting energy of motion? (93)

2. Friction and Traction

3. How does traction control your vehicle? (94)
4. What three things can reduce traction? (95–96)
5. How can you check traction while driving? (96)
6. What are the factors that affect your vehicle in a curve? (97)

3. Stopping Distance

7. What is total stopping distance? (98)
8. How do you use the four-second rule? (98–99)
9. What are four factors that affect braking distance? (99)

4. Controlling Force of Impact

10. What are three factors that will change your vehicle's force of impact in a collision? (100)
11. What is the correct way to adjust safety belts? (101)
12. How should a driver and passengers position themselves to benefit from air bags? (102)
13. How do you best position and use child safety seats? (103–104)

Projects

Individuals

Investigate With the owners' permission, examine the tires of at least 10 vehicles. Check for signs of worn tread or bald spots. Write a short report about your findings. In the report, describe the condition of each vehicle's tires. Also give the percentage of vehicles that you checked that have worn tread or bald tires.

Use Technology Using a tire-pressure gauge, determine the tire pressure of the vehicles you checked in the Investigate project above. Make a computer spreadsheet for your findings. Your spreadsheet should also include your observations about the conditions of the tire treads.

Groups

Research Observe at least 50 vehicles at a busy intersection. One-third of the group should record the number of drivers wearing safety belts; one-third should record the number of passengers wearing safety belts; one-third should record the number of child seats, and whether the child seat was in the front or back seat of the vehicle. Discuss your results with the class.

Investigate Gather advertisements for tires from newspapers or magazines. Make a group list organized by sizes of tires you see in the ads. Also include prices and special features (such as special treads or other safety-related features). Compare your group lists in class.

Chapter 5 Review

Chapter Test

Check Your Knowledge

Multiple Choice Copy the number of each sentence below on a sheet of paper. Choose the letter of the answer that best completes the statement or answers the question.

1. When an object moves, it acquires
   (a) friction. (c) energy of motion.
   (b) traction. (d) speed.
2. The length of time you take to execute an action is called your _____ time.
   (a) total stopping (c) braking
   (b) perception (d) reaction
3. Which of the following is an example of a supplemental restraint system?
   (a) air bag (c) lap and shoulder belt
   (b) safety belt (d) antilock brakes
4. In a _____ situation, you must divide the amount of available traction between stopping or starting and steering.
   (a) reduced traction (c) sharp curve
   (b) split traction (d) banked curve

Completion Copy the number of each sentence below. After each number, write the word or words that complete the sentence correctly.

5. The force that pulls all things to earth is called _____.
6. A vehicle's energy of motion will change in proportion to the _____ of its change in speed.
7. The gripping ability of a tire will _____ as the amount of tread touching the road increases.
8. The _____ your speed, the longer your braking distance.

Review Vocabulary

Copy the number of each definition in List A. Match the definition in *List A* with the term it defines in List B.

List A

9. grooved surface of a tire that grips the road
10. point around which an object's weight is evenly distributed
11. restraint device that you have to engage
12. distance your vehicle travels while you make a stop
13. force that keeps each tire from sliding on the road

List B

a. active device
b. friction
c. tread
d. total stopping distance
e. center of gravity

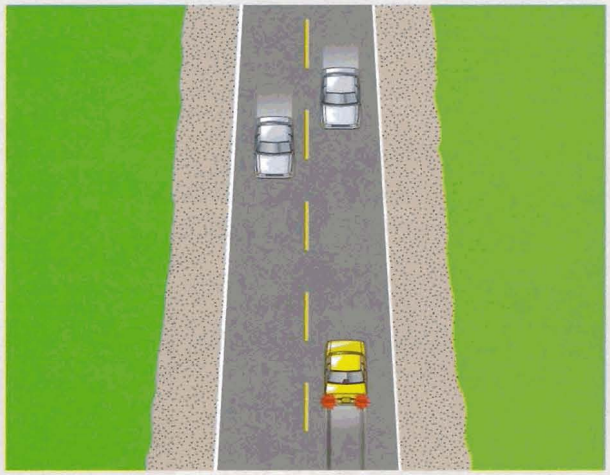
Think Critically

Write a paragraph to answer each question.

1. Explain the relationship between traction and the amount of air in a vehicle's tires. Use the terms "underinflation" and "overinflation" in your answer.
2. Discuss how speed, sharpness of curve, and your car's load affect how you control your vehicle in a curve. Why are banked curves often beneficial?

Decision Making

1. What two things has this driver done to adjust to the air bag?



2. You are driving the yellow car and have locked your standard brakes to avoid a head-on collision. Your wheels are sliding. You want to head for the shoulder to avoid trouble. What should you do?

3. You are approaching this curve at 40 mph. To maintain control, when should you adjust your speed?

4. The driver ahead is braking to maintain control. What two factors might increase the stopping distance in this situation?