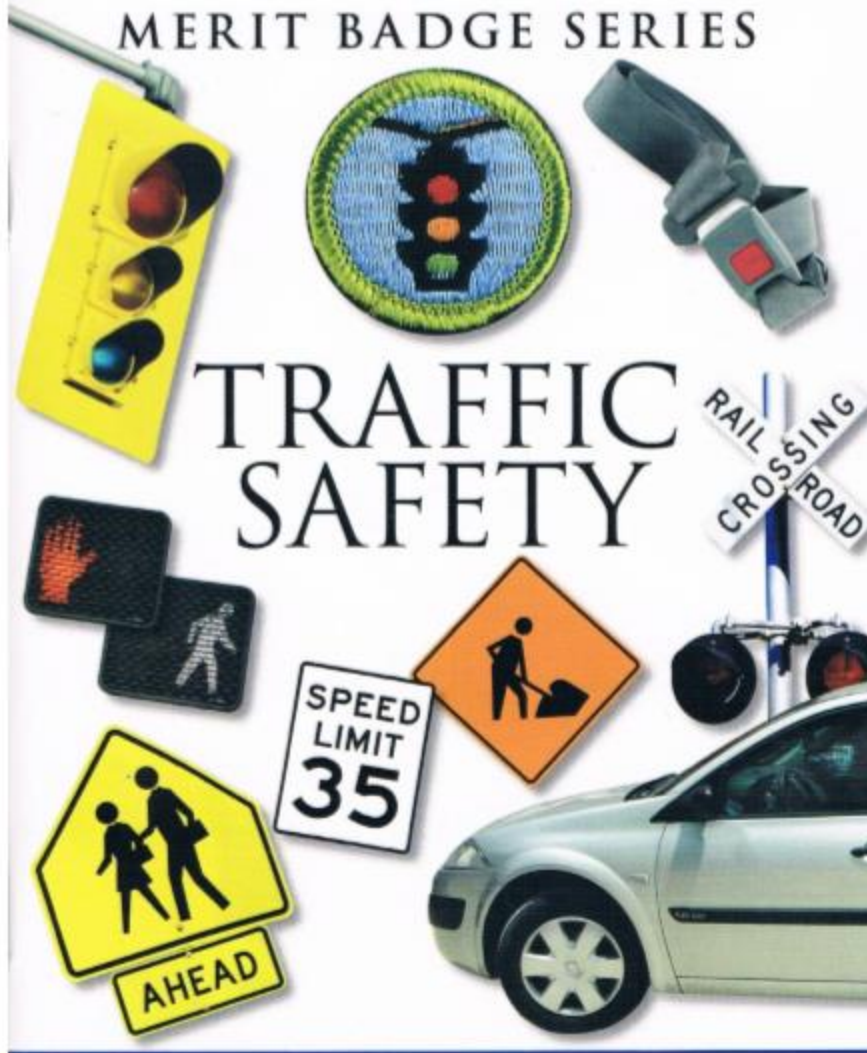


MERIT BADGE SERIES



BOY SCOUTS OF AMERICA

## HOW TO USE THIS PAMPHLET

The secret to successfully earning a merit badge is for you to use both the pamphlet and the suggestions of your counselor.

Your counselor can be as important to you as a coach is to an athlete. Use all of the resources your counselor can make available to you. This may be the best chance you will have to learn about this particular subject. Make it count.

If you or your counselor feels that any information in this pamphlet is incorrect, please let us know. Please state your source of information.

Merit badge pamphlets are reprinted annually and requirements updated regularly. Your suggestions for improvement are welcome.

Send comments along with a brief statement about yourself to Youth Development, S209 • Boy Scouts of America • 1325 West Walnut Hill Lane • P.O. Box 152079 • Irving, TX 75015-2079.

## WHO PAYS FOR THIS PAMPHLET?

This merit badge pamphlet is one in a series of more than 100 covering all kinds of hobby and career subjects. It is made available for you to buy as a service of the national and local councils, Boy Scouts of America. The costs of the development, writing, and editing of the merit badge pamphlets are paid for by the Boy Scouts of America in order to bring you the best book at a reasonable price.



BOY SCOUTS OF AMERICA  
MERIT BADGE SERIES

# TRAFFIC SAFETY



BOY SCOUTS OF AMERICA

## Requirements

1. Do the following:
  - a. Describe the top 10 mistakes new drivers frequently make. Name the two items you are required by law to carry with you whenever you operate a motor vehicle.
  - b. Describe how alcohol and other drugs affect the human body and why a person should never drink and drive, or drive while under the influence of any mind-altering substances including prescription drugs, cold medications, and illicit drugs. For the state where you live, find out what is the legal blood alcohol concentration and the consequences for driving while intoxicated or driving under the influence. Find out what the open-container law is in your state.
  - c. Describe at least four factors to be considered in the design of a road or highway. Explain how roadside hazards and road conditions contribute to the occurrence and seriousness of traffic crashes.
  - d. Explain why a driver who is fatigued or distracted should not operate a motor vehicle. List five common distractions, explain how driver distractions contribute to traffic accidents, and tell how drivers can minimize distractions. Describe how volunteer drivers can plan to be alert when transporting Scouting participants.
2. Do the following:
  - a. Demonstrate how to properly wear a lap or shoulder belt. Explain why it is important for drivers and passengers to wear safety belts at all times.
  - b. List five safety features found in motor vehicles besides occupant restraint systems. Describe each safety feature, how each works, and how each contributes to safety.
3. Do the following:
  - a. Using your family car or another vehicle, demonstrate that all lights and lighting systems in the vehicle are working. Describe the function and explain why each type of light is important to safe driving.
  - b. Using your family car or another vehicle, demonstrate how to check tire pressure and identify the correct tire pressure for the vehicle. Explain why proper tire pressure is important to safe driving.
  - c. Demonstrate a method to check for adequate tire tread. Explain why proper tire tread is important to safe driving.
  - d. Demonstrate with a smear-and-clear test if the windshield wiper blades will clear the windshield completely or need to be replaced. Describe instances in good and bad weather when windshield washers are important to safe driving.
4. Do the following:
  - a. In a location away from traffic hazards, measure with a tape measure—not in a car—and mark off with stakes the distance that a car will travel during the time needed for decision and reaction, and the braking distances necessary to stop a car traveling 30, 50, and 70 miles per hour on dry, level pavement. Discuss how environmental factors such as bad weather and road conditions will affect the distance.
  - b. Demonstrate the difference in nighttime visibility between a properly lit bicycle and rider (or a pedestrian) wearing reflective material and a bicycle and rider with no lights (or a pedestrian) dressed in dark clothing, without reflective material.
  - c. Explain how color and shape are used to help road users recognize and understand the information presented on traffic and roadway signs. Explain the purpose of different types of signs, signals, and pavement markings.

- d. Describe at least three examples of traffic laws that apply to drivers of motor vehicles and that bicyclists must also obey.
5. Do ONE of the following:
- a. Interview a traffic law enforcement officer in your community to identify what three traffic safety problems the officer is most concerned about. Discuss with your merit badge counselor possible ways to solve one of those problems.
  - b. Using the Internet (with your parent's permission), visit five websites that cover safe driving for teenagers. As a group, discuss what you learn with your counselor and at least three other teenagers.
  - c. Initiate and organize an activity or event to demonstrate the importance of traffic safety.
  - d. Accompanied by an adult and a buddy, pick a safe place to observe traffic at a controlled intersection (traffic signal or stop sign) on three separate days and at three different times of the day, for 30 minutes on each visit. At this intersection, survey (1) such violations as running a red light or stop sign; or (2) seat belt usage. Count the number of violations or number of drivers not wearing a seat belt. Record in general terms if the driver was young or old, male or female. Keep track of the total number of vehicles observed so that you can determine the percentage of compliance vs. violations. Discuss your findings with your merit badge counselor.



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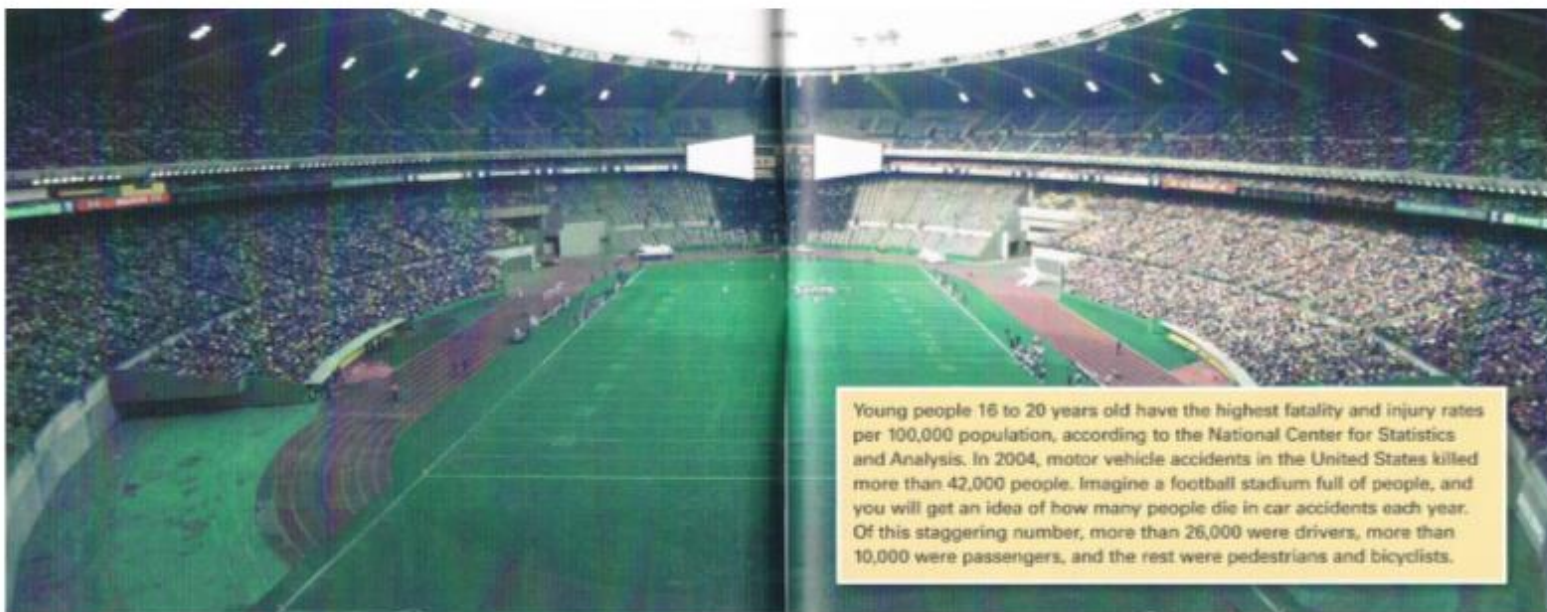


## Traffic Safety: So Important It Could Save Your Life

Staying safe in traffic wherever you live is getting more difficult all the time, as more and more people take to the road. This pamphlet will help you earn your Traffic Safety merit badge and will give you some crucial tools to stay safer, whether you are driving a car on a highway, riding a bike across town, or jogging across a busy street.



Whether you live in a rural area or in the cities and suburbs, traffic is a fact of life. You can be surrounded by pristine wilderness and still be in the middle of a traffic jam. Just ask the thousands of tourists who drive or bring their vehicles to Alaska via the ferry system every summer, clogging the state's few major roads and slowing traffic to a crawl.



Young people 16 to 20 years old have the highest fatality and injury rates per 100,000 population, according to the National Center for Statistics and Analysis. In 2004, motor vehicle accidents in the United States killed more than 42,000 people. Imagine a football stadium full of people, and you will get an idea of how many people die in car accidents each year. Of this staggering number, more than 26,000 were drivers, more than 10,000 were passengers, and the rest were pedestrians and bicyclists.

Accidents can happen in a split second. Even experienced drivers might take their eyes off the road a moment too long or go into a skid on an icy road. As a young driver, you should be aware that teenagers in the United States are far more likely to have a serious traffic accident in their first year operating a motor vehicle than any other age group. Why? It comes down to a combination of factors from inexperience to the sense of invincibility and exhilaration young people sometimes feel when they first get behind the wheel of a 2-ton car. Combine alcohol or drugs with driving and the results are often deadly. As a new driver it is critical that you develop a combination of defensive, proactive skills to help you stay safe on the roads.

### The Cost of Our Car Culture

Americans love their cars. We spend at least half as much time stuck in traffic each year as we do going on an annual vacation. Wherever you live, commutes to school or work are getting longer and more snarled with traffic.

The problem is that we rely on our vehicles for our daily needs. Trucks deliver food and other items to stores for us to buy and use. Emergency vehicles such as fire trucks and police cars respond to emergencies. Yet for all the advantages of motorized transportation, there is a big price to pay. Motor vehicle crashes are the leading cause of death among people ages 1 through 34 and the leading cause of injury for all age groups.

Vehicular accidents lead to tremendous social and economic costs. When someone is killed in a car crash, a whole range of people from family members to friends and acquaintances feel the terrible loss. Economically, in addition to lost wages, crash injuries contribute to expenses for medical care, emergency services, nursing-home care, rehabilitation, home modifications, insurance administration, and property damage that amount to billions of dollars each year.

However, the biggest price society pays for transportation accidents is personal. Lives can change in an instant. Just imagine how parents feel when they get a phone call telling them that their child has been injured or killed in a car accident.



## The Perils of Impaired Driving

Motor vehicle crashes are the leading cause of death in the United States for young people, and an alarming number of these crashes are related to alcohol or drug abuse. Alcohol-impaired driving is highest among persons 21 to 24 years old, and the percentage of fatal crashes that are alcohol-related is highest for this age group.

However, even for the youngest drivers, alcohol-related crashes are a serious problem. Not only are drivers under age 21 more likely than older drivers to be involved in fatal crashes, but their added risk for fatal crash involvement increases more sharply at all levels of alcohol use.

Alcohol and drugs are perhaps the most publicized causes of impaired driving, but they are not the only causes. Each year a considerable number of serious crashes occur as a result of drivers who are impaired by fatigue and drowsiness.

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To impair means  
to weaken  
or damage.

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### Alcohol and Driving

Alcohol is a depressant. It slows down the functioning of the brain and the nervous system. The physical and mental skills needed to operate a vehicle safely, along with clear vision, are impaired when a person drinks and then gets behind the wheel.

Alcohol **impairs** the following skills and abilities:

- **Multitasking**—Research suggests that the most serious effect of alcohol on a driver is that it reduces the driver's ability to handle several tasks at one time.
- **Reaction time**—Alcohol slows the driver's ability to react to sudden events on the road.
- **Tracking**—Drivers under the influence of alcohol have trouble continuously observing the position of the vehicle with respect to the road and keeping the vehicle in the correct location.
- **Comprehension**—Alcohol diminishes the driver's ability to perceive hazards on the road.
- **Attention span**—Alcohol reduces the driver's alertness over an extended period of time.
- **Coordination**—A drunken driver cannot handle tasks that require high levels of precise movement.

Six Scout-age youths lose their lives in alcohol-related crashes every day. More than one-third of all traffic fatalities are alcohol-related.

### Blood Alcohol Concentration

*Blood alcohol concentration (BAC)* is the amount of alcohol in the bloodstream. It is measured by the weight of the alcohol in relation to the blood. BAC can be measured by breath, blood, or urine tests within 30 to 70 minutes after someone has had a drink.

It is more accurate to refer to alcohol-impaired driving rather than intoxicated (drunken) driving because a person does not have to be legally intoxicated to be impaired. In all 50 states, the legal standard for intoxication is a BAC of 0.08. However, studies have shown that impairments first appear at BACs as low as 0.02. Driving skills, especially judgment, are impaired in most people long before they show obvious signs of drunkenness.



Factors that affect BAC include the following:

- **Amount of alcohol consumed.** The more a person drinks, the higher the BAC level will be.
- **Body weight.** Heavier people are not as quickly affected by alcohol as lighter people.
- **Food in the stomach.** When the stomach has food in it, the bloodstream absorbs alcohol more slowly.
- **Gender.** Women reach higher BACs faster than men. Therefore, if a man and woman, with all other factors being equal, are both drinking the same amount of alcohol, the woman will have a higher BAC level.
- **Type of alcohol consumed.** The higher the alcohol content of a drink, the more quickly it is absorbed. Distilled spirits (whisky, vodka, rum, gin) have the highest concentration of alcohol, followed by wine and then beer.
- **Speed at which a person drinks.** The liver can process and eliminate only about one drink per hour (one drink = 1.5 ounces of 80-proof distilled spirits; 5 ounces of wine; or 12 ounces of beer). If a person drinks more quickly than this rate, the excess alcohol will remain in the bloodstream and elevate the person's BAC.



### Consequences of DUI/DWI

Many insurance companies automatically cancel their coverage of a driver convicted on a DUI/DWI violation.

The laws regarding *driving under the influence (DUI)* or *driving while intoxicated (DWI)* in the United States are very rigid. It is illegal in all 50 states to drive with a BAC at or above 0.08 percent. In a majority of states, drivers who are found to have a BAC of 0.08 or higher will have their licenses revoked or suspended under a procedure called administrative license suspension. Drivers who refuse a BAC test will also have their licenses suspended or revoked. These administrative suspension laws, which go into effect right after an arrest, have proved to be more effective than laws that did not suspend or revoke a license until after a person was convicted of alcohol-impaired driving.

Most states have open-container laws that prohibit the driver or other occupants of a vehicle from having open containers of alcohol in the passenger compartment of the vehicle. Penalties for those convicted of violating open-container laws vary from state to state but include fines and community service. Find out what the open-container law is in your state.



The consequences of DUI/DWI vary but can include some or all of the following: fines, license suspension, license revocation, mandatory alcohol-awareness classes, community service, and jail time. Repeat offenders will likely serve time in jail, be required to participate in an alcohol-abuse program, and also may need to enroll in an Alcoholics Anonymous program.

Other circumstances can make the punishment harsher. Drivers under the influence who have a child in the car with them, who are speeding, who refuse to take a BAC test, who have prior DUI/DWI convictions, or who cause an accident or injury will receive stiffer penalties. In most states, if a drunken driver injures someone, it is considered a felony. If the person dies, the driver can be charged with manslaughter or murder.

A conviction for DUI/DWI for driving under the influence of alcohol or drugs can cost a person as much as \$15,000 as a result of attorney's fees, increased insurance rates, towing fines, court costs, and bonding fees. A person's license may be suspended or revoked. A conviction can prevent a person from getting a job or a promotion, and it can even get the person fired.



### A Tremendous Loss

By Joe, age 16

Last September, a friend, teammate, and fellow Scout in my troop was in a horrible car accident. His name was Tim Murphy. He was a senior at my school and a year older than me. He was captain of our school's varsity soccer team, the first-chair French horn player in the band, and a Life Scout working hard on Eagle Scout requirements.

One night after a senior dance, Tim was driving home very late on Interstate 55, headed south. Tim's car was hit head-on by a northbound car. Both cars were totaled, and Tim was stuck inside. We later learned that Tim died instantly, and the other driver, who had been drinking, also died. People living close to the scene of the accident heard the noise and came to see what happened. A man who witnessed the accident had trouble sleeping because he kept thinking about the two people who had died in the crash.

Tim was a great person. His soccer number, 17, is retired now. The band dedicated a concert to him. Photos of him are posted all over school. I sometimes wonder why the other driver had been drinking and driving, and I wonder if anyone had tried to stop him from getting behind the wheel.

We all miss Tim, and we wish he were still with us today.



Here's the  
Real Deal!**ZERO TOLERANCE****ZERO CHANCES****Zero-Tolerance Laws**

Young drivers are particularly susceptible to impairment by alcohol. During a typical weekend, one teenager dies every hour in a car crash. Nearly 50 percent of those crashes involve alcohol. Safety advocates have argued that teens should not drive if they have had any amount of alcohol, which has led to support for zero-tolerance laws. All 50 states have enacted zero-tolerance laws for drivers under age 21. These laws set the BAC limit of 0.00 (no detectable level) to 0.02 percent as the

legal limit. Underage drivers found to be under the influence may be fined and/or have their license suspended. In addition, they may be required to attend alcohol-education classes and perform community service.

**MADD and SADD**

A drunken driver can cause much hardship and suffering, the ripples of which are felt throughout communities nationwide. Many survivors and the families and friends of victims look for ways to prevent others from going through the same pain. Organizations such as Mothers Against Drunk Driving (MADD) and Students Against Destructive Decisions (SADD) believe that hearing from those whose lives were forever changed by an alcohol-related driving accident can help deter potential drunken drivers.

A drunken-driving impact panel is often effective in educating drivers to the dangers of drinking and driving. Transportation officials, a safety officer at your school, or nonprofit organizations such as MADD and SADD can help you put together a panel discussion. These panels consist of three to four people who speak to audiences about the alcohol-related crashes in which they were injured or in which a loved one was killed or injured and how it affected them.

Judges or probation officers often require convicted DUI/DWI offenders to attend an impact panel as part of their sentences. It is a good way to bring home the real-life consequences of mixing drinking with driving. After attending panel presentations, many offenders resolve to never again drive after drinking.

**Drugs and Driving**

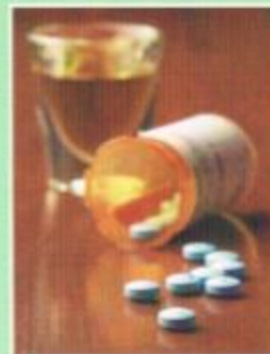
Using marijuana also impairs many of the skills needed for driving a car. Effects may include difficulty in judging distances and delayed reactions to sights and sounds that drivers absolutely need to notice, much like the effects of drinking alcohol. When users combine marijuana and alcohol, the hazards of driving become even more serious. Driving while under the influence of drugs is more common among drivers ages 16 to 20 than any other age group.

**A Deadly Mix**

Research shows that

- Marijuana is harmful to the brain, heart, lungs, and immune system. It limits learning, memory, perception, judgment, and complex motor skills such as those needed to drive a vehicle.
- People under the influence of cocaine become easily confused and lose the ability to think clearly for any length of time.
- Inhalants can cause damage to the heart, kidneys, liver, brain, and other organs.

Many people believe that only alcohol, marijuana, and other "hard" drugs impair their abilities. Prescription drugs and over-the-counter medicines such as antihistamines for colds and allergies can cause drowsiness and other side effects, too. Every year some crashes are caused by drivers who are not alert because of medicine they took. The danger is even greater for a person who is taking more than one medication. The interaction of two or more medicines may impair driving in ways that catch the driver by surprise. Warnings on prescription bottles—such as those advising drivers to stay off the road when on the medication—should be taken seriously.



### Your Responsibilities as a Passenger

Even when you are a passenger, you should pay attention to the condition of the person who is driving the vehicle. You might think that young victims of drunken drivers are usually in a car that is hit by the intoxicated driver or that they were hit while walking or riding their bikes; however, a study of children who died in alcohol-related crashes revealed that nearly two-thirds of those children were riding with the drunken driver. Two-thirds of drunken drivers studied were parents or adult caregivers, while most of the others were young drivers.\*

Even if you experience peer pressure to get in a car with a group of friends who have been drinking or you are at a family event where a parent has been drinking, your life and the lives of others may depend on your having the judgment and the courage to say, "I'm not riding with you because you've been drinking."

### Asleep at the Wheel

Most people know that drinking and driving is dangerous, but they may not realize that driving while drowsy can be just as fatal as driving while drunk. Fatigue or lack of sleep can cause a driver to fall asleep at the wheel or to not pay attention while driving. Fatigue slows reaction time, dulls awareness, impairs judgment, and consequently increases the risk of crashes.

Research into sleepiness focuses on the human biological clock. Everybody has a biological clock that plays a role in controlling hunger, energy levels, and body temperature. Most people's biological clocks make them especially likely to feel sleepy at three specific times during the day. One is the afternoon lull, from 2 p.m. to 5 p.m. The others are early in the morning and late at night, which is by far the most dangerous time for drivers.

When you drive, pay careful attention to the behavior of other drivers near your vehicle. If you see them weaving, drifting into another lane inexplicably, heading for a ditch, or exhibiting any other unusual behavior, actively avoid them—slow down and stay in back of them. If you yourself start feeling drowsy while driving, get off the road immediately. Get out and take a brisk walk to wake yourself up, or have someone who is well-rested take the wheel.

\*Quinlan, Ryan, M.D., et al., "Characteristics of Child Passenger Deaths and Injuries Involving Drunk Drivers," *Journal of the American Medical Association* (May 3, 2000).

Did you know that 58 percent of commercial vehicle accidents are estimated to be related to fatigue?

### The Risk Zone

Driving while fatigued is a transportation concern being addressed by the Boy Scouts of America. The BSA hopes to raise awareness of the dangers of drowsy driving with the help of the Risk Zone campaign. The following driver's pledge is an important piece of the campaign and emphasizes that planning is the best defense against killer fatigue.

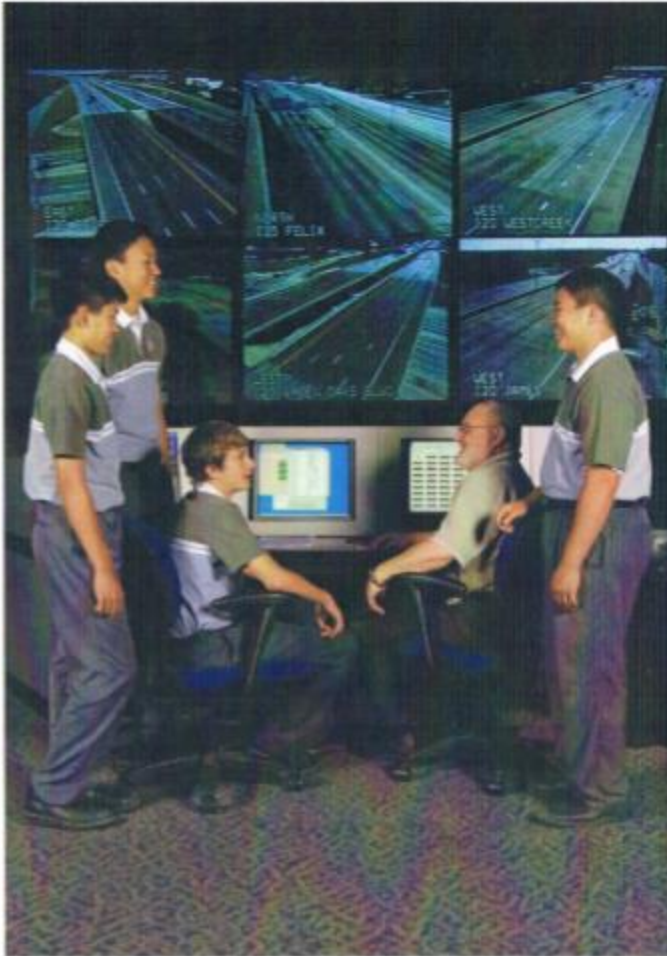
**T H E  
RISK  
ZONE**

## DRIVER'S PLEDGE



- I will not drive when I feel fatigued. I realize that when I am fatigued, I process information more slowly and less accurately, and this impairs my ability to react in time to avoid accidents.
- I will arrange my schedule so that for several days before a Boy Scout driving trip, I will get a good night's sleep every night to avoid the cumulative effects of not getting enough sleep.
- I will make trip preparations far enough in advance so that last-minute preparations don't interfere with my rest.
- I will make travel plans that take into account my personal biological clock and will drive only during the part of the day when I know I will be alert.
- I will be smart about engaging in physical activities during Scouting outings and will make sure that I will be ready to drive alert.

**DO ALL THAT YOU CAN  
TO KEEP SCOUTS SAFE.**



## Keeping Us Alive Through Road Design

The need for better and safer roads is a constant challenge for engineers. In this section you will learn to look at streets and roads through the eyes of a highway engineer. Highway engineers design roads using scientific principles and standards that help keep drivers safer and cyclists and pedestrians safe. A highway engineer has much responsibility and many factors to consider when designing a road.

### The Role of the Federal Highway Administration

The Federal Highway Administration (FHWA) is a federal agency that helps develop and improve the nation's transportation system. Among the chief responsibilities of the FHWA is the improvement of roadway safety. The FHWA seeks to educate the public about roadway safety and to find ways to reduce the number of pedestrian fatalities, intersection fatalities, and *road departure fatalities*—deaths that occur when a vehicle leaves its designated lane.

According to the FHWA, roadway safety is a serious, national public health issue. In 2003, almost 3 million injuries and 42,643 fatalities occurred on our nation's roads—that's an average of 117 deaths a day.

## Rumble Strips

Rumble strips help keep roads safe because they increase driver attention. The textured patterns of rumble strips will not damage a vehicle and can safely be driven over at the speed limit. They may be used in the following roadway locations:

- Across a road when there is a tollbooth ahead or when there is an unexpected stop sign or traffic signal after a long stretch of uninterrupted roadway
- Along the shoulder of rural highways, especially interstates, to alert drowsy drivers that they have begun to drift onto the shoulder
- In the center of a two-lane road to warn of the danger of passing

### Roadway Safety Features

Rumble strips, retroreflective signs and markings, and special roadway hardware are some of the safety features highway engineers incorporate in their roadway designs. *Rumble strips* are small indentations or raised strips on the pavement that, when driven over, make noise. Rumble strips alert drivers when they are veering off the road or heading into a different lane. *Retroreflective* signs and pavement markings help nighttime drivers. Made from a material that bounces light from headlights back to drivers' eyes, such signs and markings are quite easy to see at night. Forgiving roadside hardware (such as guardrails and breakaway poles) skid-resistant pavement, and all-weather pavement markings also help prevent or minimize the severity of accidents.

About 40 percent of all crashes occur at intersections. To make intersections safer for drivers, pedestrians, and bicyclists, traffic engineers have made improvements to the timing mechanisms of traffic signals. They also have improved signage, added exclusive turn lanes, and built roundabouts—circular intersections that eliminate certain intersection conflicts such as left turns.

To improve safety specifically for pedestrians, traffic engineers make improvements to lighting to enhance visibility and construct islands on medians that give pedestrians a safe place to stop when crossing a multilane street or road. For blind and low-vision pedestrians, traffic engineers add special audible signals that help them know when it is safe to cross a street and truncated domes that help them detect the boundary between the sidewalk and the street.



Roundabout sign

### Speed

When a new road is built or an old one rebuilt, one important decision that guides the design is what the speed limit will be. Common sense dictates that if a driver can just barely negotiate a curve safely while driving 30 miles per hour, the curve will be too sharp for an interstate highway where the speed limit is 65 to 75 miles per hour. For example, if engineers know that the project is for a rural two-lane highway with a speed limit of 55 miles per hour, they can research the correct standards to find out how they should design lane and shoulder widths, curves, grades, passing zones, and intersections. When the road is built, it will be safe to drive at 55 miles per hour.

### Uniformity

Imagine you and your family are driving from your home in Pennsylvania to the Grand Canyon in Arizona. When you get to Indiana, the stop signs are blue circles instead of red octagons. In Colorado, all the road signs look like pine trees, and you cannot see them well at night. To keep this traffic-safety nightmare from happening, the FHWA makes sure every state adheres to its *Manual on Uniform Traffic Control Devices*, which tells traffic engineers which signs are needed, what they must look like, and where they must be installed. You will learn more about signs, signals, and pavement markings in the "Navigating the Road" section of this pamphlet.



## Accommodating All Road Users

Traffic engineers must be mindful of the needs of all the people who will use the roads. With an increasing number of older drivers in our society, engineers must pay special attention to making signs more visible and intersections and interchanges less confusing. An engineer also must consider the needs of younger drivers. A teenage driver, for example, may lack the experience to anticipate hidden hazards that can cause crashes. Nor can the engineers fail to address the needs of people with disabilities. Someone who walks with a cane, for example, will take longer to cross the street than other pedestrians and, thus, traffic signal timings will need to be long enough to allow them to safely get across an intersection. Curbs must have ramps so people in wheelchairs can safely cross the street.



### Intersection, Lane, and Visibility Safety Issues

Intersections are the most dangerous locations in urban areas. Based on volume of traffic and other factors, a traffic engineer needs to decide if a traffic signal is necessary and whether there ought to be separate left-turn or right-turn lanes. Parking must be prohibited near intersections so that drivers can clearly see other cars and pedestrians. Room for a bus stop may be needed. If there is a traffic signal, crosswalks and "Walk/Don't Walk" signals must be included in the design.

At rural intersections, sight distance is an important part of the design. Drivers on a side road must be able to see far enough to the right and to the left so that they can safely pull onto a highway where traffic may be traveling at 55 miles per hour or faster.

Lane safety is also important to road engineers. They need to figure out how many lanes are needed to prevent congestion and move traffic along smoothly. They also need to determine how wide the lane should be to permit safe travel at the speed limit. On a quiet residential street, lanes may need to be only 10 feet wide, while a high-speed freeway requires 12-foot lanes.

On high-speed, high-volume highways, it is important to separate lanes of opposing directions of traffic to prevent head-on crashes. Engineers prefer a wide grass median between lanes so oncoming cars have room to stop or recover if they leave the left side of the roadway. Also important are shoulders on suburban or rural roads where drivers can safely stop in case of an emergency. To prevent accidents that could happen as vehicles enter and exit interchanges on expressways and freeways, traffic engineers include acceleration and deceleration lanes.

Visibility is important in all road design. A driver needs to be able to see hazards ahead to have time to make a decision to stop if necessary. It is impossible to see over the crest of a hill or around a curve. Engineers try to design roads so hazards such as intersections and railroad crossings are not hidden from view. Signs and pavement markings must be visible not just in bright daylight but in dark nighttime conditions as well as in poor weather. Proper street lighting is important, especially in urban areas where pedestrians are present.

Cities across the country have added high-occupancy vehicle (HOV) lanes to help alleviate congestion during peak traffic times.



### Don't Hang Out in the No-Zone

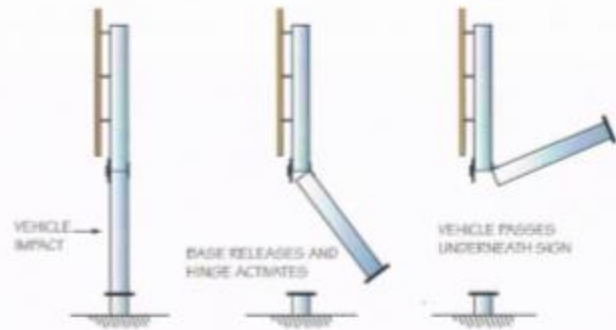
No-zones are danger areas around trucks where crashes are more likely to occur. Some of those no-zones are actual blind spots where your car "disappears" from the view of the truck or bus driver (or where another vehicle on the road "disappears" from your own view). Automobiles also have blind spots.

Terrain is another major consideration in an engineer's design of a new roadway. Sharp curves and steep hills can cause drivers to lose control and run off the road. Engineering gentle curves and grades is the desirable solution. Whenever possible, the road is designed so that it can be driven safely at the posted speed limit. Sometimes, however, the terrain makes it impossible to meet the design speed standard for curves or grades, and in that case, warning signs are posted.

### Roadside Hazards

Keeping motorists alive through good road design also means paying attention to the roadside. In more than one-third of all highway fatalities, the side of the road is a factor. Various factors can cause a vehicle to leave the roadway, including distractions, vehicle malfunctions, traffic situations, and poor road conditions. Whatever the reason, once a vehicle leaves the roadway, the results are often catastrophic. Many roads are lined with "booby traps"—trees, signs, posts, guardrails, or other structures that can mean death for a motorist.

When designing a road, engineers try to leave a clear zone on the side of it, but it is not always possible to construct such forgiving roadside areas along every highway. Engineers strive to provide sides of the road that are free of hazards with enough room for the driver to regain control of the vehicle and come to a safe stop whenever possible.

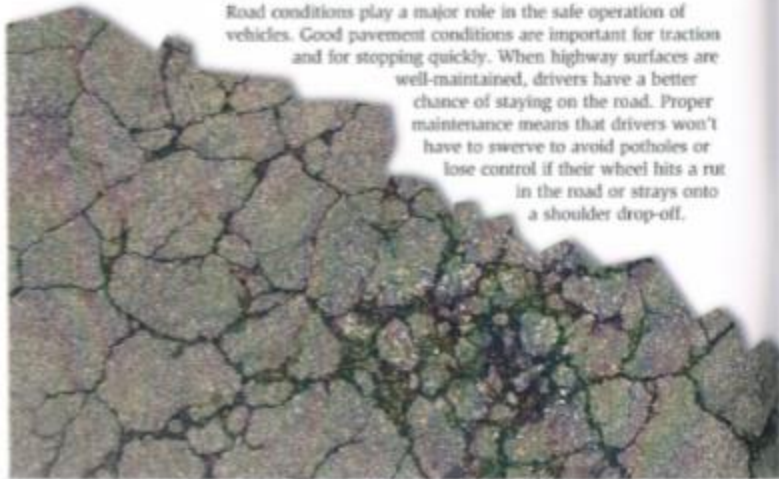


Breakaway sign support

When it is not possible to create an adequate clear zone, roadside objects such as light poles and signposts can be built to yield or break away, which can greatly increase a motorist's chance of survival without serious injury. The ends of bridges and concrete median barriers can be protected by special energy-absorbing crash cushions. In some instances the best method is to eliminate the hazard. Each roadside object is evaluated and removed if it is not needed.

### Road Conditions

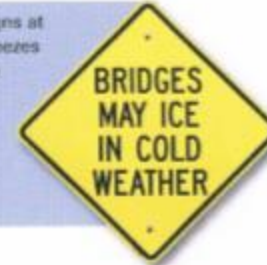
Road conditions play a major role in the safe operation of vehicles. Good pavement conditions are important for traction and for stopping quickly. When highway surfaces are well-maintained, drivers have a better chance of staying on the road. Proper maintenance means that drivers won't have to swerve to avoid potholes or lose control if their wheel hits a rut in the road or strays onto a shoulder drop-off.



Weather plays a critical role in quickly changing road conditions and contributes to many crashes. Rain, even a drizzle, can cause a vehicle's tires to lose contact with the road. When there is too much water on the road, the vehicle's tires can start skimming on the surface of the water instead of gripping the road—a phenomenon known as *hydroplaning*. It can cause loss of control of the vehicle and a possible crash. To help eliminate this hazard, engineers design roads so that rainwater drains quickly to the edges and is carried away by storm drains or ditches. The surface of the pavement can be constructed with roughness or grooves to help tires maintain better traction and avoid skids.

In regions of the country where snow is common, design engineers try to help make winter driving safer. For example, an area beside the street or road can be designed for snow storage. When the snowplows come through, they can clear the road all the way to the curb or the edge of the shoulder. In addition, some cities are experimenting with a special type of concrete that slowly releases ice-melting chemicals as vehicles drive over a bridge in freezing temperatures, thus helping keep the bridge safe for travel. Another fairly recent innovation is electronic signs that post warnings about hazardous conditions such as fog, high winds, or severe snow and ice storms. Sometimes these signs are connected to sensors so that they automatically turn on if visibility or conditions drop below an acceptable limit.

You have probably seen signs at bridges reading "Bridge Freezes Before Pavement." Because the undersides of bridges are exposed to cold air, the bridge deck will freeze first and become icy and slick.



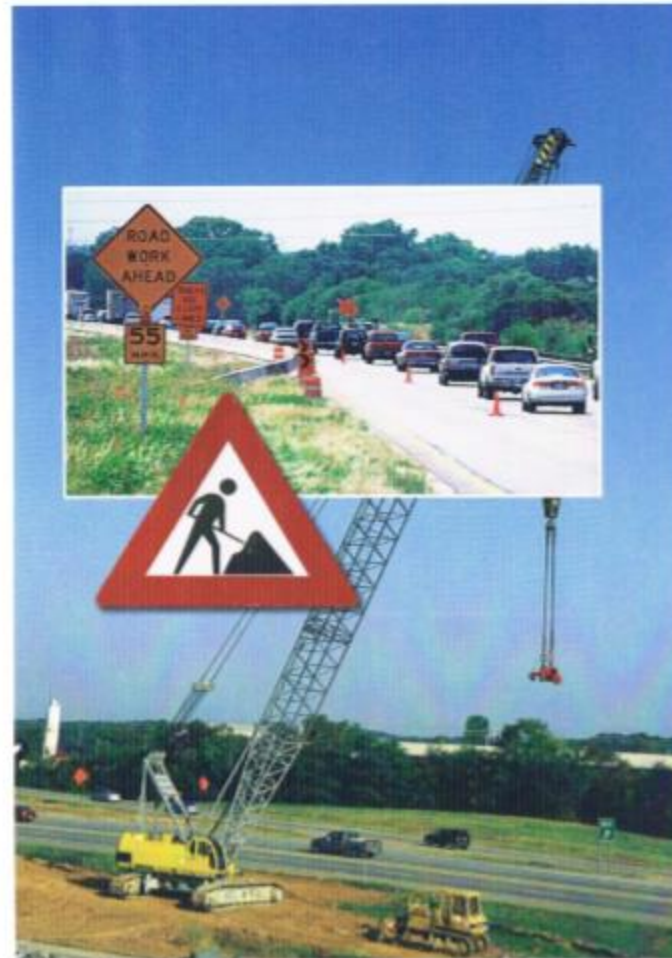
Road construction is a daily inconvenience for most drivers, but it is important to maintain and upgrade our roads and bridges. Repairing them before they deteriorate too much helps prevent accidents and saves taxpayers' money.



#### Highway Work Zones

At construction sites, design engineers must ensure that the work zone is safe for both the workers and the travelers. Every road construction job includes a maintenance and protection of traffic plan. The engineer must decide how to safely handle traffic along the construction route, which requires planning the layout of warning signs, barricades, drums, or cones. Sometimes all traffic is detoured around the site or the construction is staged to keep one or more lanes open at all times. Engineers impose a reduced speed limit, because drivers sometimes become confused even in a well-designed work zone. At slower speeds, drivers have more time to make good decisions.

Every year hundreds of road-construction workers get killed and injured on the job by inattentive drivers who crash through work zones. Always remember to slow down and pay careful attention to safety in traffic construction zones.







## Engineering Safety Into Vehicles

Vehicle accidents cause damage, injuries, and deaths because the crashes impose force on people and property beyond their breaking points. By managing the force—the sudden transfer of energy in a crash—and by controlling the time and the areas it affects, damage and injuries can be reduced. A person can withstand a great deal of force when properly “packaged” for it.

For more than 50 years, manufacturers have been engineering automobiles with increasingly sophisticated safety features. Guiding manufacturers to produce safe vehicles is one of the responsibilities of the Department of Transportation’s National Highway Traffic Safety Administration (NHTSA). The NHTSA works to reduce deaths, injuries, and economic losses from traffic accidents. It establishes and enforces safety performance standards. It also develops programs to prevent crashes and reduce losses before a crash happens, to protect people and property in a crash, and to help reduce the amount of damage after crashes occur.

One way the NHTSA accomplishes its goal of providing safety information is by putting cars and trucks through crash-testing procedures using crash-test dummies. The NHTSA tests include running vehicles head-on into a fixed barrier at 35 miles per hour. Afterward, researchers evaluate the impact on the dummies’ heads, chests, and legs and the reliability of occupant restraint systems such as seat belts and air bags. Due in large part to this testing, today’s passenger vehicles are far more crashworthy than cars and trucks used to be.

Larger, heavier cars tend to be safer in a collision than smaller vehicles. If a smaller car collides with a heavier, larger vehicle, the smaller car and its occupants will suffer much more damage.

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All cars must meet the federal Department of Transportation’s safety standards for crashworthiness.

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## Occupant Restraint Systems

Safety belts are the most effective device for preventing serious injuries and reducing fatalities in motor vehicle crashes. Studies have shown that people who wear seat belts reduce their risk of serious injury by 50 percent and reduce the risk of fatal injury by 45 percent. Safety belts also keep passengers properly positioned to fully benefit from the protection provided by air bags. Research has shown that the chances of being killed are five times greater when the occupant is thrown from a vehicle. Properly worn safety belts help prevent passengers from being ejected. Crash victims who wear safety belts are more likely to be unhurt, alert, and able to escape quickly. Always wear a safety belt and make sure that all other passengers are properly restrained.

The NHTSA says that growing up safe is a four-step process. As children grow, the way they are restrained in a vehicle should grow with them.



**Rear-facing infant seats (back seat).**  
From birth to at least 1 year old  
and at least 20 pounds.



**Booster seats (back seat).**  
From about age 4 to at least  
age 8, unless the child is at  
least 4 feet, 9 inches tall.

**Safety belts (back seat).**  
From when a child reaches  
age 8 or is taller than  
4 feet, 9 inches.



**Forward-facing toddler seats  
(back seat).** From age 1 and  
20 pounds to about age 4 and  
40 pounds.



## Proper Use of Safety Belts

Fasten the seat belt low on the hips and as snugly as possible. This ensures that crash forces will be spread out by the safety belt at the strong hipbone structure rather than across the soft abdominal area, which can easily be injured. The shoulder belt should go over the shoulder and across the chest. Check the manufacturer's instructions to properly adjust safety belts in your vehicle. Only one person should use each safety belt at a time. An adult cannot safely hold and protect a child in a vehicle. A crash impact would pull a child or infant from an adult's arms.

When transporting pets, always confine them to a carrier. This will prevent them from distracting or interfering with the driver and causing an accident. It also will keep them safer in the event of a collision.

## Transporting Young Children Safely

Each year, thousands of children are injured or killed in traffic accidents. The proper use of child safety seats, booster seats, and seat belts can help keep infants, toddlers, and small children safe in a crash.

All children 12 years old and under should always ride properly restrained in the backseat. Children who sit in the front passenger seat, even if they are properly secured in a safety seat, risk injury or death should the vehicle be in a collision that causes the air bag to deploy.

Infants who weigh less than 20 pounds and are under 1 year of age should always ride in a rear-facing child-safety seat. Once a child is more than 1 year old and weighs at least 20 pounds, he or she can use a forward-facing safety seat. There are many different brands of safety seats on the market, so always read the manufacturers' installation instructions very carefully to be certain that the seat is properly installed and will properly protect the child. Children should continue to ride in safety seats until they weigh at least 40 pounds.

Children who weigh 40 to 80 pounds should use a booster seat, which will raise the child up high enough so that the lap and shoulder belts in the backseat will fit correctly. Because seat belts are designed to fit adults, a child should continue to use a booster seat until he or she is at least 4 feet 9 inches tall.



Booster seat

## Air Bags

Side and front air bags have been proven to be effective safety devices. An air bag is a flexible membrane or envelope. When a head-on or nearly head-on collision occurs, air bags inflate rapidly with air or another gas to cushion the vehicle's passengers. The bag has small vent holes that allow the propellant gas to be (relatively) slowly expelled from the bag as the occupant pushes against it.

Air bags should always be used with a safety belt. Air bags supplement the safety belt by reducing the chance that the occupant's head and upper body will strike some part of the vehicle's interior. They also help reduce the risk of serious injury by distributing crash forces more evenly across the occupant's body.

In 1984, the federal government required all newly manufactured cars to have driver's side air bags by 1989. More than 15,000 lives have been saved by air bags in the years since. Initially, most vehicles featured a single air bag, mounted in the steering wheel to protect the driver of the car (who is most at risk for injury). During the 1990s, air bags for front-seat passengers and separate side-impact air bags, placed between the door and occupants, became common. In 1991, Congress mandated that all new passenger vehicles be equipped with driver and passenger air bags by 1998.

Statistics show that passengers in cars equipped with air bags have approximately 30 percent less chance of dying in an accident than in comparable cars without air bags. Despite this, air bags have caused some controversy, as the initial expansion of the bag is a violent event. Air bags deploy and inflate in about  $\frac{1}{10}$ th of a second and have on rare occasions caused serious and sometimes fatal injuries. For example, if unrestrained occupants slide forward in their seats during braking prior to the crash, they may come into direct contact with the air bag module when it deploys.

Even properly restrained drivers who sit very close to the steering wheel can be injured or killed in an airbag deployment. Although manufacturers are always working on ways to improve the effectiveness and lessen the risks of air bags, the National Highway Traffic Safety Administration (NHTSA) recommends that drivers allow at least 10 inches of space between the center of their sternum and the center of the steering wheel.

Children should never ride in the back of a pickup truck, even if the back is covered.

Once deployed, the air bag must be replaced by an authorized service department.

## Other Vehicle Safety Features

Other protective devices typically found in vehicles include a steering column that absorbs the energy of a driver thrown against it rather than remaining rigid. Side-guard beams provide side-impact protection. Headrests protect against whiplash by helping keep the head and neck erect during an impact. Penetration-resistant windshields help keep objects from breaking through glass. Antilaceration glass breaks into fragments without forming sharp edges, helping to reduce cuts.

Air bags are a risk to children seated in the front seat. The force of the air bag deploying can injure or kill a child, which is one of the reasons children under 12 should always be seated in the backseat, properly restrained in a child safety seat or a booster seat.

Still more vehicle safety features include recessed door handles, nonprojecting knobs on the dash panel, breakaway rearview mirrors, padded dashboards, padding on the back of front seats (for backseat passengers), crushable front ends of cars that absorb crash energy, and passenger compartments that resist being crushed. Some vehicles have inflatable rollover curtains that protect occupants against the series of impacts that happen during a rollover.



## What to Look for When Buying a Car

Today's cars offer many safety features either included as standard equipment or available as additional options. Many insurance companies offer discounts if these features are in your car. Here are some important safety features to look for in a vehicle.

If your family is considering buying a sports utility vehicle (SUV), you should know that smaller SUVs are more likely to roll over than cars. Also, these vehicles do not have to comply with the same federal safety standards as cars.

**Traction and Stability Control.** Traction control systems help keep a vehicle's tires from losing contact with the road during acceleration. Stability control systems help prevent a vehicle from skidding sideways. Both are very helpful for keeping a vehicle on course in emergencies or in foul weather.

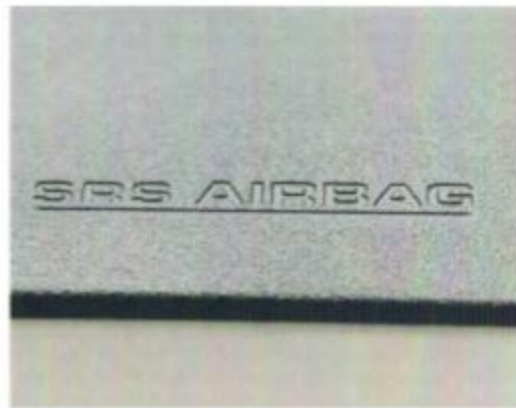
**Antilock Brakes.** When used properly, antilock brakes allow a driver to stop straighter and faster, especially on slick or wet surfaces.

**Safety Belt Tensioners.** Automatic safety belt tensioners instantly make the belt snug in a crash to better protect occupants from being thrown from the car.

**Head Restraints.** Head restraints are designed to prevent front-seat occupants' heads from being snapped back if a vehicle is rear-ended. Some new vehicles also have head restraints for backseat passengers.

**Advanced Front Air Bags.** Vehicles that are equipped with advanced front air bags adjust their inflation force to a passenger's weight and the crash conditions.

**Side-Impact Air Bags.** Side-impact air bags give additional protection to the head and torso during a crash.





## Auto Maintenance and Safety Checkups

A motor vehicle is a complex machine that requires frequent checkups and adjustments to continue to operate safely. Miles of driving gradually wear down all the parts of a vehicle. As parts wear out, unsafe operating conditions develop. Regular vehicle checkups and repairs will help prevent the car's parts from failing because of normal wear and tear. The owner's manual that comes with a vehicle provides valuable information about the maintenance schedule and the proper use of the vehicle's equipment.

You can make the following simple safety-related checks. Have your parent or merit badge counselor observe and supervise your work as you go through the list. These simple checks, along with proper preventive maintenance, will help ensure that the vehicle is in safe operating condition.

### Safety Belts

- Check the belts, buckles, and belt retractors periodically, and make sure that the belts are not twisted or excessively frayed. Check the mounts that hold lap and shoulder belts to the floor and the roof. Inspect them for damage and looseness, and replace any damaged equipment.
- If the belts in the vehicle were worn during a crash, have them inspected and replaced if necessary. The crash may have weakened them and reduced their ability to protect passengers during another crash.
- When belts become dirty, use only mild soap and lukewarm water to clean them.
- Never bleach or dye a belt. This can reduce the belt's overall strength.

### Lights

Properly functioning lights help make a vehicle visible to others at night or during poor weather conditions. They also allow the driver to see other vehicles, pedestrians, and hazards in or near the roadway. You can make the following simple checks on the front lights. First be sure the engine is off, the vehicle is in park, and the parking brake is on. Make sure an adult is present, because you will be using the ignition switch and you will need help checking the lights.



- Turn on the parking lights and check that both front parking lights are lighted.
- Turn the headlights on, and check that they are working. Cars have both low-beam and high-beam lights. The high-beam light allows the driver to see farther down the road at night when other cars are not oncoming. Alternate between the low- and high-beam lights. Be sure that the lights work in each position.
- Move to the front of the car and check that all light lenses are free of dirt. Dirty lenses can greatly decrease the headlights' ability to light the road.
- Check to be sure all dashboard lights are working and all instruments are properly lighted.
- Operate the turn signals to make sure each front and rear directional signal light works. This step may require that the ignition switch be turned on. This should be done by an adult or under close adult supervision. The directional-signal indicators on the dashboard will flash if the turn signals are operating.
- Check the emergency flashing system. Turning the system on will cause all turn-signal lights to flash at the same time. Emergency flashers should not be used during normal driving conditions.
- Using the manual switch, turn on the dome light (interior light). Then turn the manual switch off and open each of the doors (one at a time) to be sure that the interior lights come on automatically.
- If the vehicle has any special lights, such as fog lights, check them also.