

# chapter

# 1

## Cars 101

Intimidated by your car? Afraid to peek under the hood and face the beast that carries you down life's highway? Don't be! Cars actually work on simple principles. If you know how they do their magic, you can control them better. And you can make them more fuel efficient. This first chapter gives you a good look under the hood, showing you how things work—and what to do when they don't. Starting now, you will never be frightened by your car—or your mechanic—again.



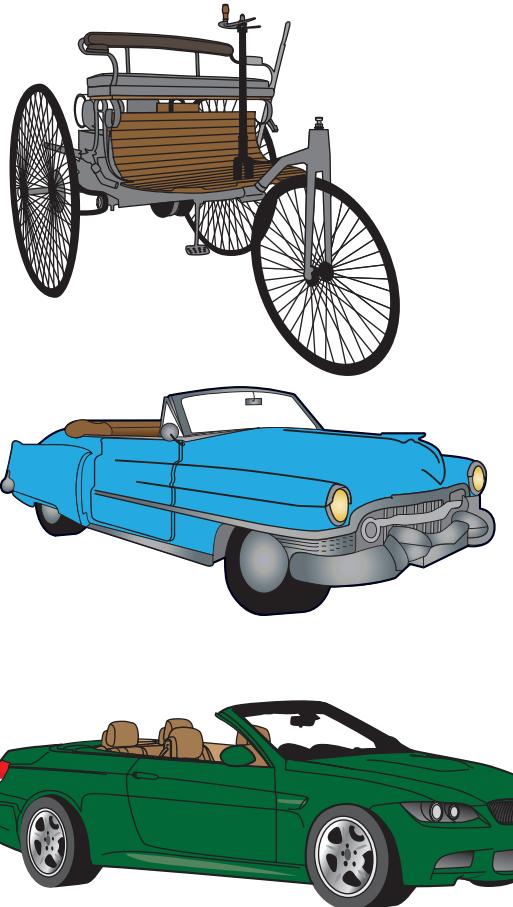
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# How Cars Work

Cars are seemingly complex, and becoming more so every day. However, they operate based on principles that everyone can understand.

## Automobile History 101

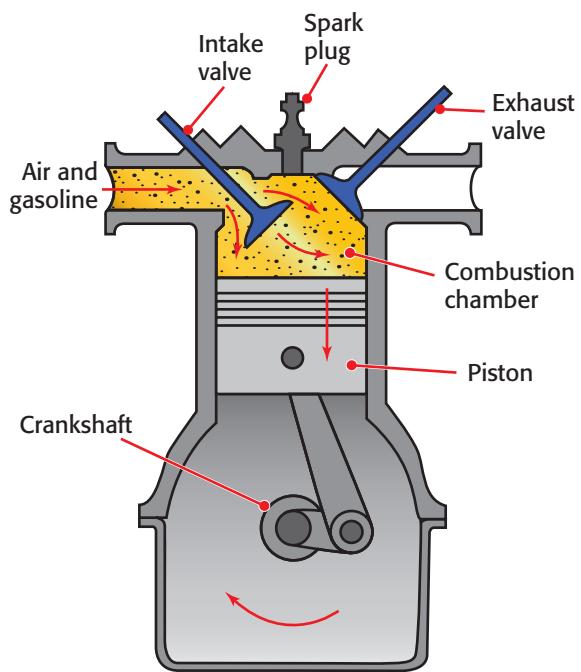
An *automobile* is a self-propelled (auto) vehicle (mobile). The modern automobile design dates back 120 years to when gasoline-fueled engines were installed in carriages formerly pulled by horses. Soon, other components were added to make the ride smoother, faster, and more enjoyable for passengers. Within 25 years, more than 1 million cars and trucks were on the roads and the horse was nearly unemployed.



## Primary Automobile Components

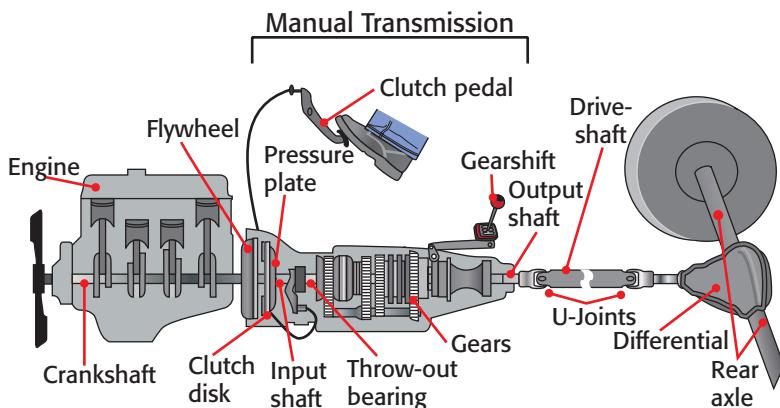
### ENGINE

The **engine** in a car contains cylinders in which thousands of controlled explosions occur every minute the engine is running. The explosions occur when a mixture of gasoline and air is compressed and then ignited by an electric spark. The resulting explosions push the movable bottom wall of the cylinder down, which turns a shaft.



### TRANSMISSION

A **transmission** transmits or moves the engine's rotation power to the wheels in stages using gears. Transmission gears function similarly to the gears on a ten-speed bicycle. A *manual transmission* requires the driver to manually select gears, while an *automatic transmission* selects gears automatically as designed.



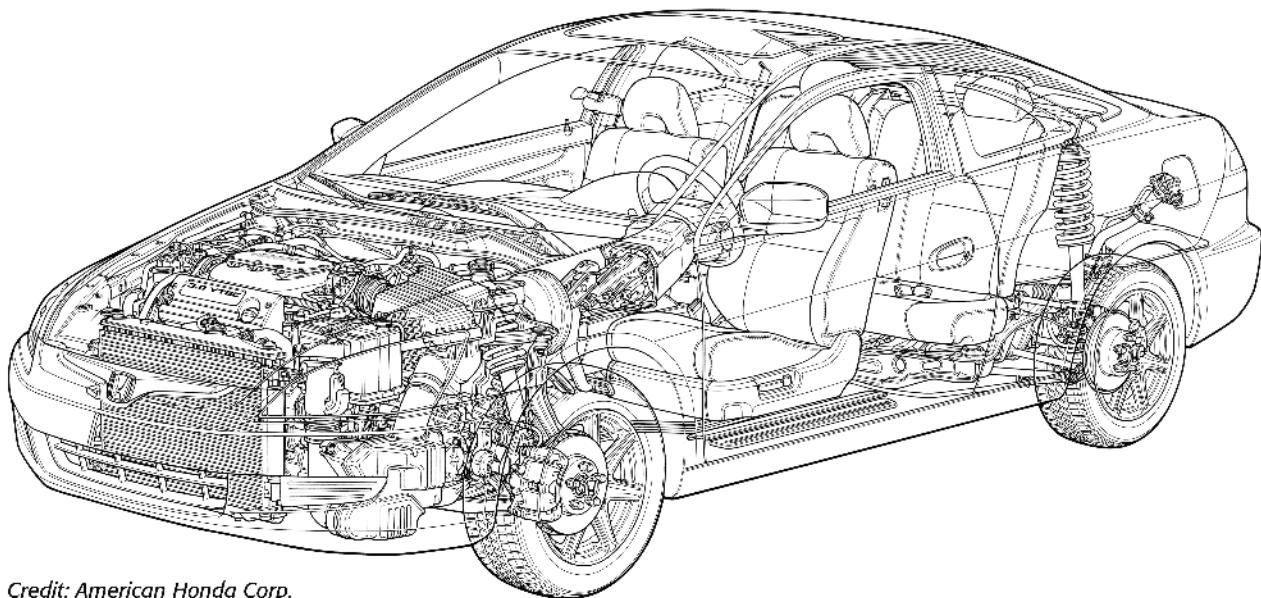
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# How Cars Work (*continued*)

## SUPPORTING SYSTEMS

Everything else in your car supports either the engine and transmission or passenger comfort. To fulfill its function, your car needs:

- Cooling and lubrication (Chapter 4)
- Electricity (Chapter 5)
- Fuel (Chapter 6)
- Wheels and tires (Chapter 7)
- Brakes (Chapter 8)
- Body (Chapter 10)



Credit: American Honda Corp.

### TIP

#### Your Car's Book

For more specific information on your car, read the owner's manual that's probably in the glove compartment. Also, consider buying a repair manual from the manufacturer or an after-market publisher such as Chilton or Haynes, available at larger bookstores.

The best place to start getting to know your car is at the gas station. Take the time while the gas is pumping to distract yourself from the cost and spend some quality time with your car.

What can you do at the pumps? You can select the most appropriate fuel for your car, check fluid levels, do a visual inspection, and make sure that all systems are “go” before pulling back onto the highway.

### Checking Out Your Car While Working the Pump

#### SELECT FUEL

Most fuel stations offer three grades of gasoline, and some also have one grade of diesel fuel. Gas energy is measured in *minimum* octane ratings—87, 89, and 91—marked clearly on the pumps. Which grade should your car use?

All gas-engine cars can operate using 87-octane gasoline, the least expensive grade. Some high-performance engines operate more efficiently with higher grade fuel. Your car’s owner’s manual will indicate which grade of gas the engine was designed to operate on. Alternately, use 87 octane unless the running engine has a pinging sound, called *knocking*, that may damage an engine. Then use higher octane fuel that doesn’t knock.

Diesel is also a petroleum fuel, but not the same as gasoline. Don’t use diesel in a gas engine or vice versa. Note that No. 2 diesel is pumped from a green nozzle.



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# Gas Station Wisdom (*continued*)

## POP THE HOOD

For safety and security, the engine cover, called the *hood* (or *bonnet* in Britain), is latched into place. The hood release latch typically is located under the left side of the dashboard and is often marked HOOD.

- 1 Pull the hood lever inside the car.
- 2 Reach under the center of the partially opened hood and move the safety lever. (The car's owner's manual offers the specific location and instructions.)
- 3 Lift the hood and secure it in place. Many modern cars have a metal support bar across the front of the engine compartment. Lift the bar into place and insert the end into the designated hole on the bottom side of the hood.
- 4 Check the levels of engine oil and other liquids as described later in this book.
- 5 Perform a visual inspection for any obvious liquid leaks, rodent nests, loose caps, or other potential problems.



## WALK AROUND

Once you've firmly closed the hood, walk around the car, inspecting the tires and underside for obvious problems or leaks. Inspect tires for wear, especially uneven wear, as described in Chapter 7 on suspension systems.

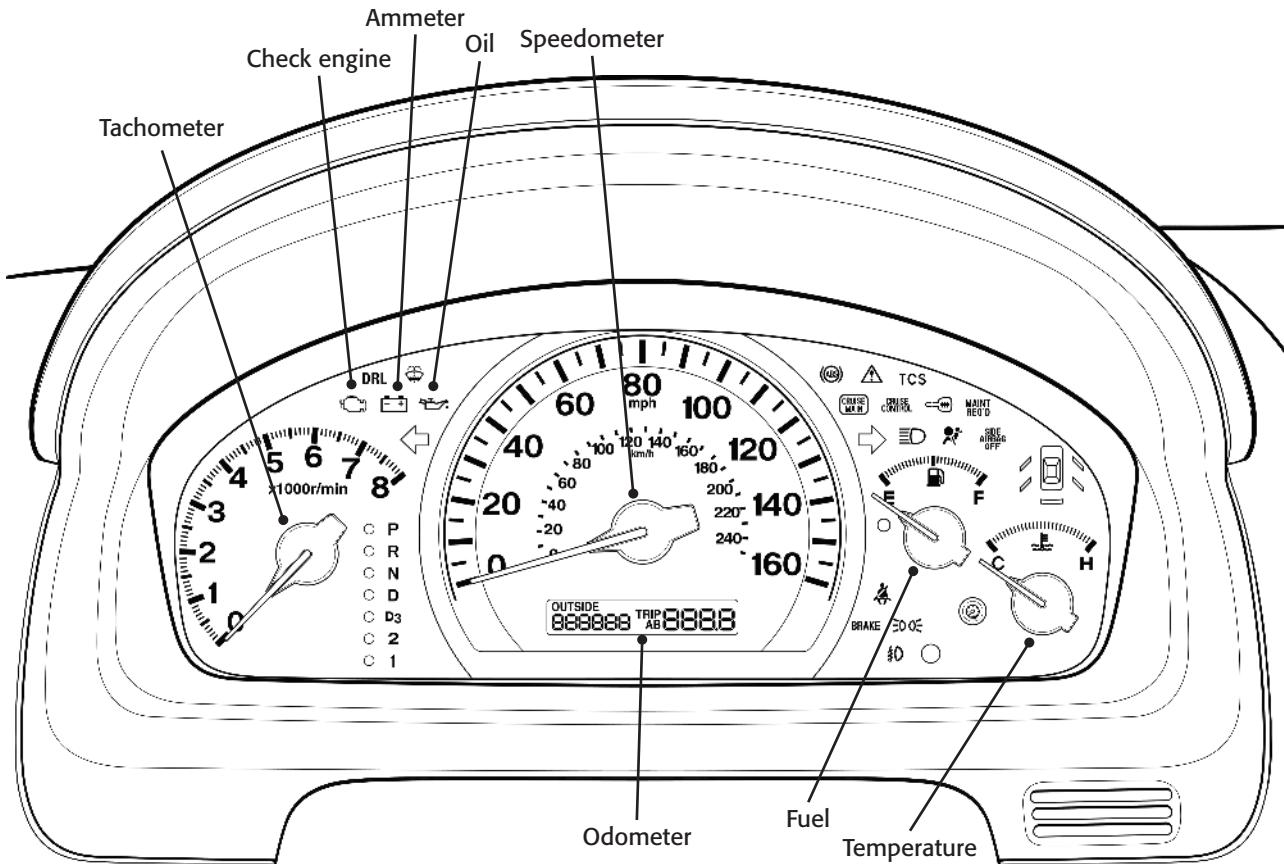


## READ THE GAUGES

Your car has numerous lights and gauges that continually report the condition of its components. To read them, start the car or turn the ignition to the ACCESSORIES position.

- Ammeter gauge or light reports on how well the battery is being recharged by the alternator.
- Temperature gauge or light tells you if the engine is operating too hot.
- Fuel gauge indicates the level of fuel in the tank(s).

You will learn to read and interpret these gauges as well as the car's computer in coming chapters.



Credit: American Honda Corp.

### TIP

#### Use Your Senses

In addition to looking at your car, pay attention to smells under the hood. The smells of burned rubber or plastic or of leaking fuel are warning signs that can alert you to potential problems. Also, listen to your car when it's running well so that you'll recognize the sound when it doesn't run well.

# The Secret of Auto Repair

The complexity of cars over the past century, such as computer-controlled electrical systems, makes taking things apart and repairing them more difficult.

Fortunately, you don't have to rebuild a component anymore. It's easier—and often cheaper—to simply *replace the part*. In fact, that's what auto mechanics usually do. They replace rather than repair defective parts, and so can you, which is the *secret* of modern auto repair.

## Knowing Your Car's Needs

### PREVENTIVE MAINTENANCE

An important step in owning a trouble-free car—and minimizing costly work—is preventive maintenance. Replace oil, filters, and tires before they wear out and cause further damage. This book shows you how to perform basic preventive maintenance on your car step by step. Automotive maintenance is easy—when you know how.

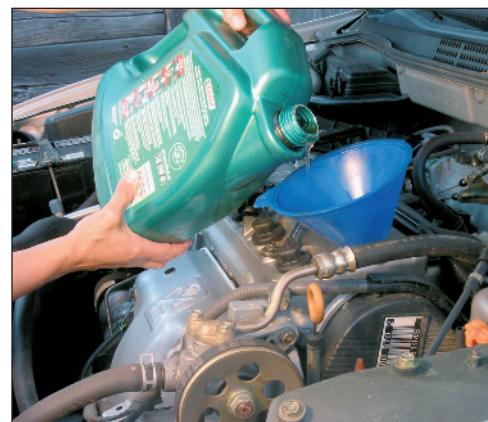
### OBSERVE

Modern cars are easier to drive; however, drivers today also have more distractions, such as cell phones, GPS, and the radio. Beginning at the gas station and continuing every mile that you drive, pay close attention to your car. As you learn more about how it works in this book, you'll detect more of the telltale signs that indicate what is expected and what is a potential problem.



### REPLACE

Replacing a defective part can be a relatively simple job, depending on how difficult it is to get to the problem part. Many automotive parts can be replaced by any car owner. Others require additional instruction from this book or a specific-model repair manual. Still others are most efficiently replaced by a trained mechanic who has the tools and knowledge to make a difficult job look easy. This book helps you identify what you can replace and what you can't.



## TROUBLESHOOT

Troubleshooting is simply comparing what you see to what you expect to see, and then using your knowledge to identify the cause. For example, you observe that the engine doesn't start as easily on mornings after it hasn't been driven for a few days. Knowing how cars work, you believe that a slow leak in a fuel line is robbing the engine of needed fuel when it starts up. A quick inspection confirms your observation and you have solved the problem—and saved yourself some money and future problems.



## TIP

### Troubleshooting Charts

A troubleshooting chart can save you hours of work and many dollars in replacement parts by helping you identify the source of an automotive problem. Your car's repair manual includes troubleshooting tips specific to the make, model, design, and components of your car. If the chart indicates more than one option, perform the easiest or least expensive before trying the others.

STEERING SYSTEM PROBLEMS		
CONDITION	POSSIBLE CAUSE	RESOLUTION
Power steering pump leaks.	1. Fluid, cap and dipstick. 2. Loose or damaged hose connections. 3. Leakage between reservoir and housing. 4. Leakage at pump shaft seal area.	1. Check for indications of false leakage — overfilled reservoir, improperly installed, damaged or lost cap or dipstick. 2. Repair or replace as required. 3. Repair or replace as required. 4. Replace shaft seal or pump.
Noise in steering column. (Squeak or creak)  (Clunk)	1. Steering column cover interference. 2. Steering column out of alignment. 3. Lack of lubrication where horn brush contacts rub plate of steering wheel. 4. Loose steering column mounting bolts. 5. Flex coupling bottoming. 6. Loose pot coupling to steering column bolt. 7. Improper steering gear mesh load.	1. Adjust or reposition as required. 2. Align or adjust as required. 3. Lube or adjust as required. 4. Tighten to specification. 5. Align or adjust as required. 6. Tighten to specification. 7. Readjust to specification.
Excessive Steering Effort	1. Improper oversized tires. 2. Tires not uniform. 3. Tire pressure. 4. Misaligned flexible coupling (if so equipped) to gear interference. 5. Steering wheel to column interference. 6. Steering column alignment 7. Steering linkage or front axle spindle pins for a binding condition or lack of lubrication. 8. Bind in front axle spindle thrust bearings. 9. Steering gear adjustment.	1. Install correct tire and wheel combination. 2. Install correct tire and wheel combination. 3. Adjust air pressure in tires. 4. Align or adjust as required. 5. Align or adjust as required. 6. Align or adjust as required (E-150 — E-350). 7. Lube, inspect, adjust or replace as required. 8. Lube, inspect, adjust or replace as required. 9. Adjust to specification.

# Do-It-Yourself or Not?

Intimidated by the complexity of taking care of your car? Don't be. Owners have been successfully maintaining and repairing their cars for decades. In a couple of pages, you'll learn how troubleshooting and making repairs is even easier than it was two decades ago. You just need knowledge and the proper tools.

## KNOWLEDGE

The primary difference between you and a \$90+-an-hour auto mechanic is knowledge. The mechanic has gone to school to learn about how cars run, diagnostics, and parts replacement. You can pick up the knowledge needed for basic car care and maintenance from this book. With experience, you may decide to tackle increasingly complex repairs on your car. Car care isn't an all-or-nothing task. You can do the jobs that you are comfortable with and leave the heavy lifting to your well-chosen mechanic.

## TOOLS

Another clear difference between mechanics and the typical car owner is tools. A mechanic or repair shop has thousands of dollars invested in specialized tools and diagnostic equipment, while the owner may have a \$50 toolbox. Fortunately, you often can rent more expensive tools for difficult jobs.

The bottom line is that you have options. You can take better care of your car—and be ready to handle problems—by learning more about your car and performing increasingly difficult jobs.



# Finding a Mechanic

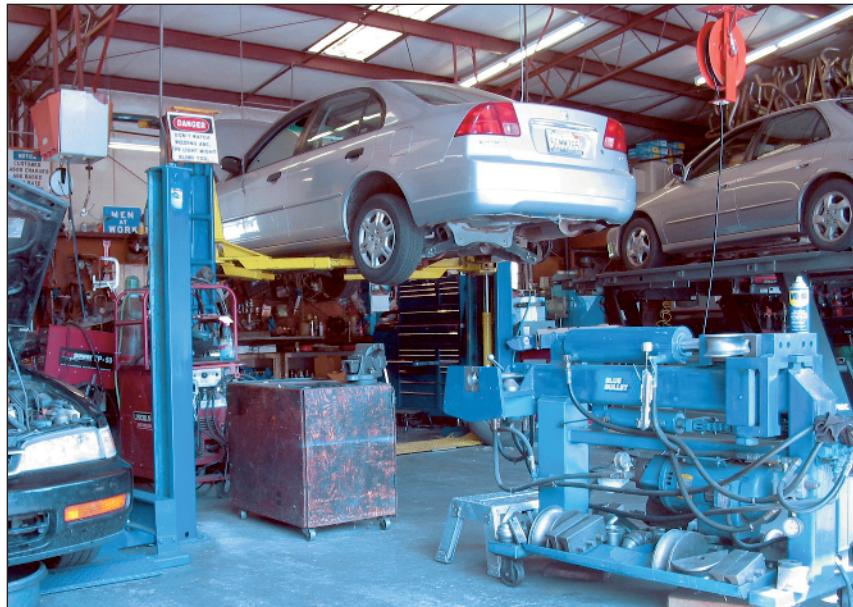
Where is a qualified and honest mechanic when you need one? Well, the best time to find one is when you *don't* need one and when your car doesn't have an emergency that needs to be taken care of.

## **Knowing When You've Found "The One"**

Start looking for a fair and competent mechanic as you take on more responsibility for the care of your car. As you learn more about how your car operates and how to diagnose problems, you'll also learn more about mechanics. The more you know about how your car works, the easier it will be to recognize a trustworthy mechanic. You'll discover that most are specialized: One who may be specially trained in automatic transmissions probably doesn't know as much about fuel injection systems.

The National Institute for Automotive Service Excellence (ASE) and other trade groups offer courses and certification tests for automotive technicians and parts clerks. An ASE mechanic who is certified in all car systems earns the Master Mechanic designation. Of course, if you need only a qualified transmission mechanic, you can select one with ASE certification in that specific area.

certification in transmissions rather than one who does all repairs. Also, some repair shops earn AAA approval.



TIP

## Compare Shop Rates

Many auto mechanics estimate the time required to complete a repair by using recommendations in a flat rate manual. They multiply the time estimate by their hourly shop rate to determine the labor rate. The higher the shop rate, the more expensive the labor charge will be.

# Car Computer Basics

Wouldn't it be great if you could read the mind of your car's computer, just like your mechanic does with engine-analysis tools? You can!

## OBD-II

### WHAT IS OBD-II?

All new cars, light trucks, SUVs, and minivans sold in North America since 1996 are required to have a connection for on-board diagnostics (OBD). The second version, OBD-II, has been the standard for more than a decade. Europe has had EOBD for new gasoline cars since 2001 and diesel cars since 2004.

OBD-readers plug into a connection on the vehicle, read the computer data, and report parameter identification numbers (PIDs). These PIDs can be decoded. P1456, for example, indicates that an EVAP system leak is detected in the fuel tank area. In plain English, the gas cap is loose. Mechanics have been using on-board diagnostics readers for many years.



### FINDING OBD-II DIAGNOSTICS TOOLS

The good news for consumers is that handheld OBD-II diagnostics tools are now available for less than \$100! One popular version is the CarMD ([www.carmd.com](http://www.carmd.com)). With the included instructions and software, car owners can read and interpret the car's diagnostics system. You can use these handy tools to:

- Quickly diagnose problems during an emergency.
- Discuss an automotive problem more accurately with your mechanic.
- Verify the findings of your mechanic.
- Check your car for problems before taking it in for a state-required smog test.
- Check cars and light trucks you are considering for purchase.



## USING THE OBD-II

There are four simple steps to using a consumer-level OBD-II diagnostics tool:

- 1 Insert the data link connector (DLC) into the car's receptacle. (Check your car owner's manual for the DLC location.)
- 2 Within 10 seconds, turn the ignition key to the ON (*not START*) position.
- 3 Wait for the data download to complete.
- 4 Refer to the tool's printed documentation, computer software, or website to decode the data.

Chapter 5 offers more detailed steps for using a consumer OBD-II diagnostics tool. Also refer to instructions that come with the unit.



## FAQ

### How can I know for sure if my car's computer can be read by OBD-II analyzers?

All 1996 and newer vehicles are required to be OBD-II (also known as *OBD2*) compliant. In addition, some 1994 and 1995 cars can be read by OBD-II analyzers. To verify, open your car's hood and look for the VEHICLE EMISSION CONTROL INFORMATION label located on the underside of the hood or near the radiator. If it is compliant, the label will say "OBD-II Certified." Some light-duty diesel pickup trucks and recreational vehicles (RVs) also are OBD-II certified.

