FOOD, SEX & MONEY: HOW HOT CARS AND THE HUMAN BODY ARE ALIKE

Unlocking the Auto Know Guide to Consumer Confidence in Vehicle Maintenance & Safety

DRIVERS AUTO KNOW

Celebrity Mechanic, Audra Fordin, AS SEEN ON:

- TODAY
- Inside Edition
- Live With Kelly and Ryan
- MotorWeek
- Racheal Ray Show
- CNN
- Children's Museum Exhibit
- MSNBC
- ABC
- The Weather Channel
- Diane Sawyer

and so much more!

Mechanically Yours,

Audra

Celebrity Mechanic
Auto Shop Owner
Founder of WomenAutoKnow.com
& DriversAutoKnow.com

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Introduction

Cars can be complex, until you take a closer look.

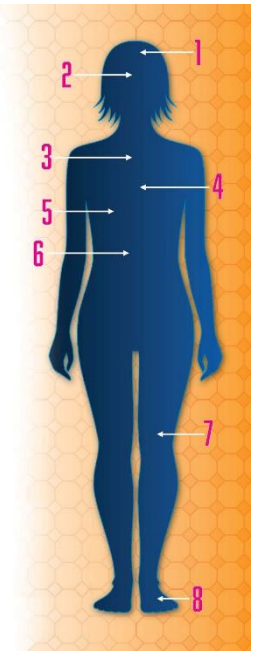
A bit of information can go a long way. That's what this guide is all about. Empowering. Educating. Inspiring.

But it's more than that. It's about knowing that you, the driver, have access and choices. It's about making car education mainstream, with bite-sized learning that helps to eliminate fear. In fact, the purpose of this book is not to make you a mechanic, (although some could be inspired to), the objective is to inform and bring a sense of confidence and understanding to readers. Ready to take a closer look?

A Visual Analogy: Hot Cars and the Human Body

Your car is no different than the human body. Think FOOD, SEX & MONEY. By using the images on this page as a reference, the parts of the body are categorized into numbers 1 through 8 to correlate with key parts of the automobile.

A well-maintained vehicle is reliable and dependable, is safe and gets good fuel economy. You've heard it said that in real estate it's all about location, location, location. Guess what? With vehicles it's all about maintenance, maintenance, maintenance. Yes, maintenance is simply the best way to keep your vehicle in top working condition, be safer, run better, and live a longer healthier life.



1. BRAIN & IMMUNE SYSTEM

Dash lights are like synapses in your brain telling you how your vehicle is feeling. Look at the colors of the icons on the dashboard. They're like those on a traffic light:

Green: Go baby, go!
Yellow: Budget! Have some money set aside for maintenance
Red: Full Stop! Something needs ASAP attention

2. SENSES AND SIGHT

Use your intuition and pay attention. 90% of accidents are caused by poor visibility. You need to see and others need to see you. We check to ensure you have a great sense of sight, smell, look & feel.

Tail Light • Brake Light • Windshield Wipers • Mirrors • Headlight & Lenses

3. DIGESTIVE SYSTEM

Fuel and energy is the food that makes your vehicle go. To keep your vehicle running healthy and smooth, know what your car eats. It MATTERS! We check the health of your car's digestive system.

4. GOTTA HAVE HEART

You can't deny the MacDaddy of all hardworking electrical parts. One loose connection and you're dead. We check your battery, starting and charging system.

5. RESPIRATORY SYSTEM

Have you ever ran a marathon while having an asthma attack? Every breath you take counts, and that philosophy carries over to your vehicle. If a filter is dirty, it puts a strain on the system it filters. We check your exhaust and filters.

Air • Cabin • Fuel • Oil • Transmission

6. CIRCULATORY SYSTEM

Your circulatory system keeps blood pumping through your veins, like the fluids that run through the systems in your vehicle. We check your fluids.

Motor oil • Power Steering • Brake • Battery Coolant* • Transmission • Washer

7. REFLEXES

No matter how cat-like your reflexes are, if your vehicle's brakes aren't working properly, you're in trouble. We check

8. CHECK YOUR RUBBER

Neglect will cause you to break down, get stuck on the road, waste your time and waste your money. Rubber is used to transport fluids to each system, and support structure of your vehicle. Being proactive offsets system failure. We check your rubbers.

Tires • Belts • Hoses • Boots • Bushing

1. DASH LIGHTS AND WIRING

Green means go baby, go!
Yellow means we'll check your maintenance schedule.
Red means full stop. We'll let you know what that full stop ASAP light is about.

2. SENSES AND SIGHTS

- Windshield Cracked
- Wiper Condition
- Headlight Lens Oxidized, Broken or Dim
- Brake Light
- Side Light
- Tail Light
- Look for Leaks, Smell & Sounds

3. FUEL AND ENERGY SYSTEMS

Fuel and energy is the food that makes your vehicle go. To keep your vehicle healthy and running smooth, know what your car eats, it matters! We help maintain your digestive system.

4. STARTING & CHARGING SYSTEM

We check terminals, corrosion & age.

5. FILTERS & EXHAUST

Oil • Cabin • Fuel • Air • Transmission • Air Conditioning

6. FLUIDS

- Brake
- Battery Coolant
- Transmission
- Motor Oil
- Power Steering
- Washer Fluid Always Filled

7. BRAKES, SUSPENSION & STEERING

- Brake Condition
- Suspension Front End

8. RUBBERS

BELTS	BOOTS	BUSHINGS
Cracked	Cracked	Worn
Frayed	Leaking	Broken
Worn	Worn	Split
	Split	Stressed

HOSES	TIRES
Soft	Cracks
Bubble	Date
Cracked	Sidewall
Leaking	Tread
	Alignment

Overview

Let’s dive into the fascinating world where modern cars and human bodies share surprising similarities!

Just like the body, cars need oxygen and fuel to keep running smoothly. In this book, you'll discover the intriguing parallels between the two, from the way both systems require stored energy to be replaced to how they convert chemical energy into kinetic energy for movement and heat.

Learn how regular maintenance for your car is just as crucial as taking care of your own body. Understand why it’s essential to pay attention to warning signs and conduct routine check-ups to ensure both stay in top shape. Each chapter covers one of eight (8) essential parts of the car! We make it easy, fun, and memorable.

The most frequent questions to mechanics and repair shops owners are:

- How much will that cost?
- Is that necessary? Why?
- How long is this going to take?

We get it! So, this comprehensive guide, learn how to talk ‘auto shop’, and help you get ahead of these questions. Repair shops want customers to feel empowered and confident; it makes for good communication and business. No one wins when folks feel uncertain or intimidated walking into or leaving an auto repair shop. Gain essential knowledge to navigate the world of car repairs.

Let’s get started on the journey to better understand and care for your vehicle – and yourself! We dive into the discussion of maintenance, safety, and repair of your vehicle; all are equivalent to self-care.

Auto Shop Lingo

Being in an auto repair shop can feel like there is a different language in the air -- talk of carburetors, camshafts, and alignments. However, there are a few key terms every car owner auto know. We’ll be addressing this throughout the book.

Feeling anxious about visiting an auto shop is common, but with some education and effort this can be overcome. By following some simple steps, anyone can experience confidence and familiarity when going to a repair shop.

Understanding your car, researching reputable shops, and maintaining records of past work are essential steps in directing the auto repair process. With these precautions, you can drive away knowing you've received top-notch service for your vehicle.

By taking a few simple steps, become more at ease walking into an auto shop and leave knowing you got great service, respect and repairs that will keep you safe on the road, all for a fair price.

1. **Know your car.** Take some time to flip through your owner's manual to find out how your specific make and model of car communicates, what the engine light means and what to do about it.

2. If you notice it drives funny, smells peculiar or sounds odd, there's probably something going on! Don't ignore your gut instincts. You're the one who drives the car, and you know it best. Make sure you mention anything that is out of the ordinary to the mechanic.

3. **Shop around.** Unless your car breaks directly in front of an auto repair shop, we recommend you do your homework on which shop to use. Ask friends, coworkers and family members which shops and mechanics they recommend and trust, and just as importantly, which ones they don't. In our free app or platform, be sure to write a review of your experience.

4. **Full disclosure.** Show the mechanic your records. Even if you're not the best at maintaining a perfect service history, keep receipts for all work you've had done so that the mechanic can have an idea of what they're dealing with. Use the free app or our platform to store all your information in one place.

Chapter 1: Preventative Maintenance

In healthcare, there are many actions taken to stay well or to avoid risk with respect to our bodies, eyesight, teeth, and hearing. They all involve seeing a professional(s) during the year. Preventive auto maintenance is a lot like that – it entails making an appointment to visit professional technicians who perform various vehicle maintenance prior to a component breakage or breakdown. Well-being and safety are the common denominator of both.

Did You Know? Only 25% of states in the US require an annual inspection. It's no coincidence that the states that do not have these annual inspections are indeed the same ones that have the highest accident rates related to preventive maintenance. The longer a vehicle is on the road and the older it gets, the more prone it is to mechanical failure.

If you live in a state that does not have mandated inspections, it is incumbent on the vehicle owner to either be a very competent do-it-yourselfer, or, keep a good calendar and notes to stay on top of repairs and maintenance.

Read the FAQs below to better understand preventative maintenance and its purpose.

How often should preventive maintenance services be performed on my car?

Your owner's manual outlines the services needed at various mileage intervals. At minimum, follow these recommendations. Remember that this can vary based upon how you drive and in what conditions you operate your vehicle.

My vehicle is new and still under warranty. Do I still need to have preventive maintenance performed?

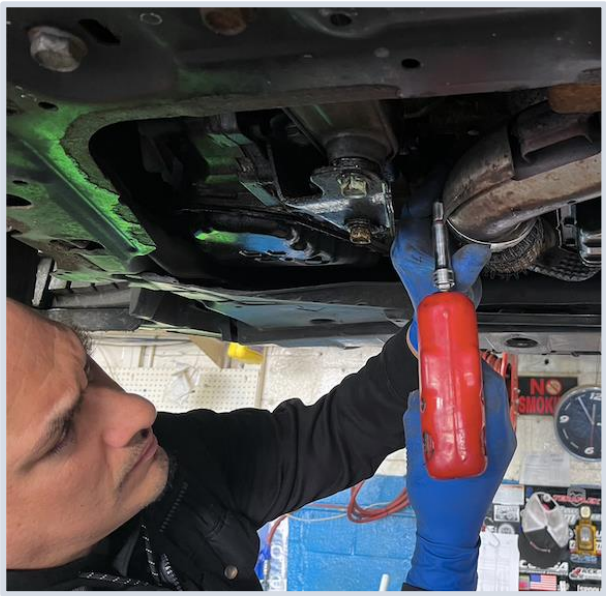
Yes. Your vehicle owner's manual lists several preventive maintenance services that need to be performed at certain mileage intervals to keep your new vehicle safe and your warranty in effect.

Do I have to visit a dealership to have work performed to maintain my new vehicle warranty?

No. The Magnuson-Moss Act of 1975 empowers consumers today with knowledge, ensuring that you make informed decisions and navigate the marketplace with confidence. As the owner of the vehicle, you have the right to choose where you take your vehicle for maintenance and repairs. Just make sure the repair shop you visit uses the appropriate certified parts and procedures from that manufacturer. This will help you maintain your new vehicle warranty. Make sure they guarantee their work, and that you get and keep the receipt.

When must I take my vehicle back to the dealership?

If you must take your vehicle back to your local car dealer, usually due to the recall of a certain component on the vehicle, your authorized dealer is your only option to have the recalled component repaired at no charge with this notification. Otherwise, you can perform all other maintenance and non-warranty repair needs on all the vehicles you own at one location, and if you are so inclined, you can even do it yourself. Remember to keep all receipts.



How will preventive maintenance save me money and time?

We know you're busy; and your time is valuable. Being without your ride for any amount of time is certainly not convenient. Doing multiple preventive maintenance services together in one visit is beneficial. This reduces the number of stops to the shop in a year.

Together, help your shop maintain your vehicle so that it serves you reliably for many years. Statistics show again and again that a well-maintained vehicle is less likely to have an unexpected breakdown and is less costly in the long run.

Can I bring all my vehicles to one location for service?

Absolutely. Preventive maintenance services are designed to work on all vehicles and not just one or two auto manufacturers. Why? The answer is simple: more than likely, your family owns more than one brand of vehicle. It would be too much of an inconvenience for you to take one brand of vehicle to one repair facility and your other vehicle to another for service. Most of the preventive maintenance services are similar with most vehicle manufacturers today.

So, allowing one shop to perform preventive maintenance on all your vehicles makes sense; you're building a relationship, and caring for your vehicle; it's about service not sales. Of course, there will be additional services that some specific vehicle manufacturers require to be performed at certain mileage intervals. When you cross that bridge, talk about it with your trusted shop and see what steps are necessary.

Important Steps to locate a Repair Shop

When you don't feel well, you visit the doctor. If you are new to a city or are looking for a new specialist, you research as well as asking family, friends, and colleagues for their best recommendations. Do the same to keep your vehicle feeling well. Haven't had the best success with a mechanic? Ok, well it's time to ASK, ASK, And ASK. Who do your friends use? What has their experience been and what has made them trust this repair shop? Check DriverAutoKnow.com to locate PLEDGED Repair Shops near you.

The one who is going to care for your car is no different than choosing the physician to care for you and your family. When locating a good auto mechanic, it is no different. Sure, you can go to any shop, like the first med or 24-hour clinic, and leave it up to chance that you will encounter waiting (way) longer than necessary, not being greeted or spoken to properly, and your visit with the specialist is rushed and you felt they didn't ask a lot of questions and barely made eye contact. Right! We've all experienced this at some time. To avoid this, below are some empowering things to do when you want to locate a trustworthy and reputable repair shop.

- Are the repairs guaranteed (a 1 year or 12,000 miles is not too much to ask)
- Go in for a simple service. Stick around and see what kind of operation they have.
- Make sure Repair Shop is PLEDGEDs
- Can you see the repairs - before and after?
- Is the bathroom clean? Do you feel comfortable in the waiting area?
- Do they talk to you in words that you understand?
- When you can comfortably answer yes to these questions, put their number in your cell phone.

Again, find the mechanic before you need one.

The last place you want to be is stuck in a shop with a broken car and have no options. Already having a trusting relationship in place makes all the difference when it's time for auto maintenance.

The Cost of ignoring Repairs is Mental Health

It can be easy to push certain tasks to the back burner, especially when they don't seem immediately urgent. For many, car maintenance can fall into this category. We might delay that oil change or ignore a strange noise under the hood, thinking we'll get to it later. However, neglecting our cars can have more than just financial consequences—it can take a toll on our mental health.

Imagine this scenario: You've been putting off taking the car to the mechanic for weeks. Then, one day, as you're driving to an important meeting or rushing to pick up your kids, your car suddenly breaks down. Panic sets in as you try to figure out what went wrong and how you're going to 'fix' it. At that moment, anxiety and stress levels shoot through the roof.

This scenario is familiar for many. What started as a minor inconvenience becomes a full-blown crisis, leaving a feeling of overwhelm.

What if instead of waiting for something to go wrong, we took proactive steps to maintain our vehicles and prevent breakdowns from happening in the first place? Not only would this save us time and money in the long run, but it would leave us with a positive mindset and peace of mind. Make your technician your ally; when you are at the repair shop wrapping up a vehicle transaction, ask them when you are to return. Put that date into your phone or the free DriversAutoKnow app or web platform as a reminder.

Being proactive about car maintenance means staying on top of routine tasks like oil changes, tire rotations, and brake inspections. It means paying attention to any unusual sounds or vibrations and addressing them promptly.

By regaining a sense of control over our lives and reducing the likelihood of experiencing a car-related crisis and alleviating some of the anxiety that comes with the uncertainty of vehicle ownership. It does require time, effort, and money. However, your future self will thank you.

Navigating Car Repairs with No Emergency Fund

In an ideal world, every car owner would have a well-stocked emergency fund to cover unexpected repairs. Unfortunately, reality often tells a different story. Many individuals find themselves facing the harsh reality of automotive maintenance without a financial cushion to soften the blow. Life circumstances, financial constraints, and competing priorities can all contribute to the inability to build or maintain an emergency fund. The absence of such a fund can take a toll on mental well-being. So, what can one do when caught in this precarious situation?

While the lack of an emergency fund for car repairs may seem like an insurmountable obstacle, there are steps one can take to assist in such a crisis:

- Grab a friend and attend an auto know workshop or online class that covers the routine oil changes, tire rotations, and brake inspections. Or visit DriversAutoKnow.com to see our helpful and educational videos. These educational platforms provide insight and confidence to save money and time. Ask when our next workshop is.

- Explore alternative financing options such as credit cards with low-interest rates, or payment plans offered by a trusted repair shop. While not ideal, these solutions can provide temporary relief.

- Some communities have programs or resources for individuals facing financial hardship, including help with transportation-related expenses. Google and reach out to local organizations or government agencies to inquire about available support.

- In cases where repairs are prohibitively expensive, explore alternative transportation options such as public transit, carpooling, or ridesharing services. While not always preferred or convenient, these alternatives can provide temporary relief.

Proper Car Maintenance is Self-Care

Often, self-care is associated with activities like meditation, exercise, or doing something good for oneself. However, there's a lesser-known aspect of self-care that can significantly impact our mental well-being: proper car maintenance. Yup, true!

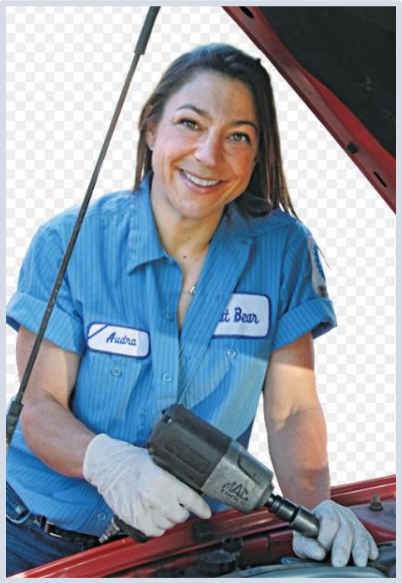
Let's explore how something as mundane as visiting the repair shop or following your car manual can have a positive impact on your mental health.

- When you actively engage in tasks like checking the oil, monitoring tire pressure, or scheduling regular service appointments, you're demonstrating to yourself that you're empowered, capable, and proactive. This can translate into increased confidence and a greater sense of control over other areas of your life.

- Car maintenance requires attention to detail and a thoughtful approach. Whether you're inspecting the brakes, changing the air filter, or simply washing your car, these activities demand your focus and attention. Engaging in such tasks can serve as a new form of aliveness and awareness, overcoming limiting thoughts or actions from the past.
- Putting off car maintenance can lead to costly repairs. By staying on top of regular maintenance tasks and addressing issues promptly, you're not only prolonging the lifespan of your vehicle but also safeguarding your financial well-being. The peace of mind that comes from knowing you're taking proactive steps to prevent major expenses can alleviate financial pressure and contribute to overall emotional well-being.

Standard Preventive Maintenance, by Mileage

Use the 'Mileage Service Recommendations' below to help guide you with your vehicle's preventive maintenance. Check your owner's manual for specifics to your make and model.



3K Mile Service (every 3 months)

- Visual inspection
- Oil and filter change
- Up to 5 quarts
- Look for coupons on DriversAutoKnow for approved partner filters
- Oil upgrade for nominal charge (if synthetic is optional for your vehicle)
- Lubrication
- Battery, starter, and alternator test Cooling system test
- Inspection
- Tire pressure and wear check (don't forget the spare!)
- Review of current "good conditions"
- Review of possible needed services based on current conditions.
- Review of any services recommended by your vehicle manufacturer.
- Wash your car

7,500 Mile Service (Seasonal@7,500)

- All the services performed at 3K
- Thorough road test if needed
- Wash and wax your car

15,000 Mile Service (Seasonal@15K)

As the mileage goes up, so does the price. Even though this service may cost a bit more, don't skip it. Your vehicle owner's manual will list specific items that need to be looked at, addressed, changed,

or cleaned at 15,000 miles. Skipping this can void your warranty. Plan for this service and be sure to log all your past services in the www.DriversAutoKnow.com member profile or free app to keep your records in order. Here's what's included on the 15K:

- All the services performed at 3K
- Thorough road test if needed
- Air filter inspection
- Cabin air filter inspection
- Fuel filter replacement (most vehicles)
- Wheel alignment
- PCV valve replacement (Most vehicles)
- Wash, wax and buff your car

30,000 Mile Service

This service is the most comprehensive in the industry, second to the 60K and includes:

- All the services performed at 3K
- Thorough road test if needed
- Air filter inspection
- Cabin air filter inspection
- Fuel filter replacement (when applicable)
- Wheel alignment only, when necessary, but this is the time to make sure the front end is checked
- PCV valve replacement (most vehicles)
- Fuel injection cleaning –
- Top engine cleaning (throttle plate, plenum, and intake) as manufacture suggests
- Timing belt review (60K)
- Pamper your vehicle and give it a full detail, from bumper to bumper

Standard Preventive Maintenance, by Part

Fluids

- **Oil Change**
  Regular oil - every 3,000 miles.
  Synthetic oil - every 7,000 miles.

- **Oil filter**
  Replace with every oil change.

- **Transmission fluid**
  Check while the engine is on.
  Change fluid when dirty or every 30,000 miles.

- **Antifreeze or Coolant**

Never open this system when hot! The fluid is under pressure and that hot liquid will blow out like a shaken champagne bottle.
Change fluid every 30,000 miles. If the fluid is low, check for a leak.

- **Brake fluid**
  Change fluid every 30,000 miles. If the fluid is low, check for a leak or if the brake pads need replaced.

- **Differential fluid**
  Check fluid level with every oil change. Change fluid every 4 years.

- **Washer fluid**
  This is the only fluid you can safely overfill!
  Check often and fill as necessary. Use low temperature washer fluid in the winter to prevent it from freezing.

Filters

- **Fuel filter**
  A restricted fuel filter will shorten the life of the fuel pump. Replace every 24,000 miles.
  - Power steering fluids.
  - Replace every 30,000 miles. If the fluid is low, check for a leak.

- **Air filter**
  Check with every oil change. Replace at least annually and when dirty.

- **Cabin air filter**
  Replace annually.

Other

- **Steering and suspension**
  Inspect annually.

- **Tire pressure**
  Check every time you fill up with gas. Check tread for uneven wear, cuts, bruises, or bubbles on the side wall.

- **Lights**
  Replace bulbs if they burn out.
  Check fuses if multiple lights are not working.

- **Exhaust system**
  Check for leaks with every tune-up. The emissions can allow carbon monoxide vapors into the cabin; this is important as emissions are lethal.

- **Battery and cables**
  Ensure the battery is mounted securely and the battery connections are clean, tight, and corrosion-free.

  Once the battery is 3 years old, test annually and replace if necessary. Remember, your battery has a birth date and an expiration date – know when it will die and be ready to replace it *before* that happens.

- **Belts and hoses**
  Inspect with every oil change. Check the belts and hoses to see if they are brittle, cracked, worn, swollen, frayed, glazed, show excessive wear, or if their movements are restricted.

Chapter 2: Safety First

Whether your car is five days or five years old, take some time getting to know the ins and outs of your owner's manual, practice some basic maintenance techniques, and purchase a few basic tools and supplies will keep you safer as well as keep your vehicle on the road longer. Always wear safety glasses. In this section, you will find tips for:

- Safety
- Maintenance – do what, when?
- Opening the hood
- Replacing a brake light bulb
- Unclogging the A/C drain hose
- Changing the air filter
- Changing a flat tire
- Checking the radiator fluid
- Checking/Adding motor oil
- Jump starting the battery
- Changing the wiper blades
- Replacing the cabin air filter
- Changing a fuse
- Adjusting the headlights
- Removing rust spots
- Checking tire pressure

Safety Tips

First things first. There are a few things to keep in mind while looking around your car or performing any maintenance. These rules are easy, and they are **IMPORTANT**, take the time to read them all. Even the ones that sound like common sense are worth repeating.

Safety Tip #1. Never turn your car on in an enclosed space—like your garage.
Carbon monoxide is a lethally toxic gas, and it comes out of your car's exhaust pipe. It's also odorless, which means you won't be able to smell the gas if it makes its way into your home. NEVER keep your car running in the garage with the garage door closed. Not even in the winter when it's freezing outside, and you'd rather keep the door closed while your car warms up. Open the garage door to let the carbon monoxide out.

Safety Tip #2. Heed the "Warning - Static Electricity" sign at the gas station.
Most of us have experienced running on carpet wearing socks, then touching someone who gets a "shock?" Well, socks and carpets are not the only conditions that create a static charge. Charge can be built up for a while in the car, and if you "shock" your gas tank, it's going to be smart! To avoid this, when getting out of your vehicle at the gas station, simply touch the car door before picking up the fuel nozzle.

Safety Tip #3. Before you open the hood, take the keys with you.

When going to look under the hood, be sure to take the remote starter fob or keys out of the car. If you're children, or anyone else, in the car or nearby, be aware and take extra care of the fob or keys to ensure it won't be triggered while having a look under the hood.

Safety Tip #4. Don't get caught in moving parts under the hood.

There are belts and fans and other things whirling around under the hood. It's ok to pop the hood while the car is running but be extra careful and aware of potential dangers. Make sure nothing is hanging or dangling. Pull back your hair, necklace, tie, or scarf, for example. Also, roll up sleeves, and tuck shirts into pants.

Safety Tip #5. Be extra cautious when changing a flat tire. 3 rules in 1.

1. Keep hazard lights on and open the hood to alert others on the road.
2. Keep the emergency brake on.
3. Never put your body under a vehicle. The jack could be unsteady or break. Slide the donut or spare under the car until you are ready to put it on the car. Then, slide the flat under the car and remove only when the spare is on, and the jack is ready to be lowered. This will provide back-up safety just in case there is a jack failure.

Safety Tip #6. NEVER open the cooling system (radiator cap) when the car is hot.

The radiator fluid under the cap is pressurized and very, very hot. Picture a volcano erupting, or a shaken soda can. You get the point. Do not attempt, ever.

Safety Tip #7. Don't touch battery corrosion with bare hands.

Corrosion looks like white or green crystal-like substance on the car's battery. Its battery acid and can (more likely, will) irritate your skin. It may even cause acid burn. How can you avoid getting burnt? Simple. Wear gloves, long sleeves, and eye protection if you need to clean this dirty substance off. If you touch the corrosion accidentally, **DO NOT** touch your eyes, nose, mouth, door handle, or really anything else until you wash your hands thoroughly.

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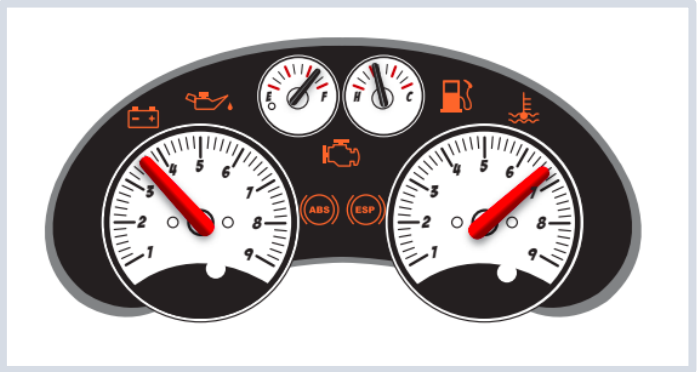
Chapter 3: ESSENTIAL #1 - Brain and the Immune System

[Dashboard Engine Lights]

Dash lights are like the synapses in your brain telling you how your vehicle is feeling. Anytime a warning light comes on, it is an indication that something needs your attention. The colors of the icons on the dashboard correlate to those on a traffic light, see below.



GREEN: GO.
ALL SYSTEMS ARE CLEAR.

YELLOW: SLOW DOWN.
CAUTION: PUT SOME MONEY ASIDE.

RED: FULL STOP.
THIS NEEDS ATTENTION, NOW.

Engine Lights and What They Mean

While the response times vary model to model and car to car, below are general maintenance timelines for dashboard lights and how quickly you need to act. With these overviews below, learn more about the dashboard lights. And see the DIY step-by step directions to try changing or repairing some of these systems yourself.

Electrical light. Many minor electrical issues can be fixed easily by simply replacing a fuse. Look in the owner's manual to find out where the fuses for your vehicle's components are. Once you identify which one is on the brink, remove the fuse and check to see if the filament is broken. Filaments are the little wires in the plastic part of the fuse. If this is broken, replace the fuse with the size that is noted in the owner's manual. If the fuse blows again or no longer is functioning, bring it to your repair shop to have it checked.

With these overviews, learn more about the dashboard lights. **Low oil pressure light.** Should this light illuminate while driving, pull over when at a safe spot and check the oil level. Top up if necessary.

Air bag warning light. If the airbag warning light comes on when the ignition is engaged, there may be a supplemental issue with the restraint system, or that the airbag is faulty. Note: Some vehicles are opposite, meaning the light is designed to come on when the ignition is turned on. Know which is correct for your vehicle and watch for when it's not acting as it should.

Air bag off. This light comes on approximately 6 seconds after the vehicle is started with no adult in the seat. If weight sensors detect an adult is in the front seat, the light will then shut off.

Charging system warning light. If the light stays on, there may be a malfunction in the alternator or battery, and this must be tended to.

Electronic stability control (ESC). This system is designed to stabilize the vehicle while navigating turns and corners. ESC systems check where you are steering and where the vehicle is going. It is not a substitute for safe driving practices. The road condition, driver steering, and input can all affect whether ESC will be effective in preventing loss of vehicle control. If the driver manually turns the ESC off, the system will automatically turn itself back on when the vehicle is restarted.

Anti-lock brake system (ABS). The ABS is designed to prevent wheel lock-up during sudden braking and while navigating imperfect road surfaces (e.g., loose gravel and ice). If the light comes on while driving, it needs to be checked, as fluid levels or speed sensors could be impacted.

Chapter 4: ESSENTIAL #2 - Senses and Sight

[Windshield - Wipers - Headlights & Lenses - Brake Lights – Mirrors]

Senses to Understand Your Vehicle Use your intuition and senses and pay attention. 90% of accidents are caused by poor visibility. When driving, you need to see, and others must have visibility of your vehicle. Here in this chapter, we discuss how imperative it is to have a great sense of sight, smell, look & feel! Cars are complex computers and machines; however, you can use your senses to decode their messages effectively.

Listen for unusual sounds, smell for strange odors, and observe any leaks or drips to detect potential issues. Pay attention to how your car feels while driving, knowing any vibrations or changes in performance. By using your senses wisely, you can catch problems early and keep your car running smoothly.

Additionally, familiarize yourself with common car troubles and their potential causes. From squeals to clunks, understanding these noises can help you diagnose issues before they escalate.

Remember, your senses are powerful tools for maintaining your car's health. So, next time you're behind the wheel, trust your instincts and stay attuned to your car's signals. Do you hear a grinding noise when you step on the brakes? Do you hear a tapping when you accelerate? Cars make noises when they are in pain, just like babies do! Any unusual noises that come from your car should be checked out. You'd never ignore a crying baby… so don't ignore your 4-wheel baby when it's talking to you.

Rule of thumb for maintenance senses:

- Use your **senses** to make sense of your car.
- When **hearing** unusual sounds, s**mell** funky odors or see odd-colored puddles, these are good signs that something is up. Rule #1. Stay calm.
- Use your **eyes** to watch gauges, check warning lights, notice drips, leaks, and any clouds of smoke.
- Use your **ears** to pick up any weird noises that are generated by the vehicle.
- Use your **nose** to warn you of any strange smells.
- Any vibrations, shimmying, shaking, or rattling aren't great signs if they're coming from your car.

See our DIY chapter to easily grasp how to clean and polish your vehicle's headlights.

Here are some troublesome noises and potential causes:

Squeal.
A shrill, sharp noise, usually related to engine speed: Loose or worn power steering, fan, or air conditioning belt.
A slight sharp noise, related to either engine speed or vehicle speed: Loose wheel cover, Loose or bent fan blade, Stuck valve lifter or low engine oil.

Screech.
A high-pitched, piercing metallic sound; usually occurs while the vehicle is in motion: Caused by brake wear indicators to let the driver know it's time for maintenance.

Rumble.
A low-pitched rhythmic sound: Defective exhaust pipe, converter, or muffler, Worn universal joint or other drive-line components.

Ping.
A high-pitched metallic tapping sound, related to engine speed: Usually caused by using gas with a lower octane rating than recommended. Check the owner's manual for the proper octane rating. If the problem persists, engine ignition timing could be at fault.

Heavy Knock.
A rhythmic pounding sound: Worn crankshaft or connecting rod bearings, Loose transmission torque converter.

Clunk.
A random thumping sound: loose shock absorber or other suspension component. Loose exhaust pipe or muffler.

Notice the way your car **feels,** particularly how it accelerates and performs. If your car is guzzling gas or draining fluids faster than usual, it’s thirsty. Find out why. Any vibrations, shimmying, shaking, or rattling probably aren’t great signs if coming from your car.

Here are some shakes and shimmies that aren’t good vibrations.

Steering.
Misaligned front wheels and/or worn steering components, such as the idler or ball joint, can cause wandering or difficulty steering in a straight line.

Pulling.
The vehicle's tendency to steer to the left or right can be caused by something as routine as under-inflated tires or as serious as a damaged or misaligned front end.

Ride and Handling.
Worn shock absorbers or other suspension components - or improper tire inflation - can contribute to poor cornering.

While there is no hard and fast rule about when to replace shock absorbers or struts, try this test: Bounce the vehicle up and down hard at each wheel and then let go. See how many times the vehicle

bounces. Weak shocks will allow the vehicle to bounce twice or more. This might make for a fun theme park ride, it's not good for you or your car.

Springs do not normally wear out and do not need replacement unless one corner of the vehicle is lower than the others. Overloading your vehicle can damage the springs.

Balance tires properly. An unbalanced or improperly balanced tire causes a vehicle to vibrate and may wear steering and suspension components prematurely.

Once you've sensed something is off, try to figure out when it happens, and what may trigger it. Does it occur only when you speed up or slow down? Does it happen when the car is cold or warm? Does it happen all the time or only occasionally? Try to pinpoint exactly when you first noticed the problem so that you can better diagnose the issue.

Fluids
Your car has fluids just like your body does. And just like the fluids in the human body, the color, smell, and consistency of these fluids can help you spot a problem in the pipes; er, so to speak.

Engine Oil.
Dark and dirty is a problem. Think golden blonde, like the shade of expensive highlights, that's what clean, healthy engine oil should look like. To check your oil, look for the cap marked "OIL" toward the front of your engine**.**

IMPORTANT: ONLY check your oil with the engine OFF!
Checking your oil is super simple and takes about one minute. Make it a habit of checking your oil every two weeks. Don't wait until the "*check oil"* light comes on or hear clunking from the engine. Preferably check the oil level when the engine is cool, or at least 30 minutes after the car was last driven. It's best if your car is parked on a level surface rather than an incline.

What you will need:

- Paper towel or rag
- To add oil: purchase the correct type of oil for your car and a funnel (a paper funnel from a gas station works well)

Instructions:

- Open the hood.
- Find the oil dipstick handle. In most modern cars, it is a brightly colored handle conveniently labeled "oil." • Pull out the dipstick.
- Wipe the dipstick with a paper towel or rag to clean it so you get an accurate reading.
- Replace the dipstick and make sure it is pushed all the way back in place.
- Remove the dipstick again.
- Hold the dipstick horizontally and examine the end of it.
- At the end of the dipstick, see markings and some oil. The markings will usually be two notches, two holes, or a range of hash marks. The top of the oil line should sit between the

two markings on the dipstick. • Add oil if the oil level reads low. Do it right away if you can't see any oil on the dipstick. (See instructions for adding oil below.)

- Replace the oil dipstick and make sure it's in all the way.

Transmission Fluid.
With vehicles, transmission fluid is essential! So, transmit away. Transmission fluid communicates a lot about your vehicle. In most cars if you have an automatic transmission, you'll have a dipstick located toward the back of the engine, usually on the passenger side. Verify its location in your owner's manual. You should always check transmission fluid when it is warm. Drive your car around the block before checking. Follow the same steps to check your oil to get an accurate reading.

If you have a manual transmission, there is no dipstick, and you'll have to crawl under the vehicle and remove a fill plug. This is probably best done by a mechanic.

Engine Coolant.
Despite its name, coolant can get **Hot**! The pressure in the car's system can send burning coolant splashing if you open the cap when the engine is still hot, so ***WAIT UNTIL IT COOLS DOWN!***

Clean coolant comes in all colors of the rainbow. Red, orange, yellow, green, blue and purple depending on what kind you use. When the fluid is dull or rusty looking, it is dirty. Most cars have an overflow bottle for engine coolant. This will have level markings. Try to keep the coolant between the two markings.

Power Steering Fluid.
Same as the transmission fluid, perfect in pink, but dirty in merlot coloring. This fluid is used to help vehicles easily turn. In the old days, power steering was optional. That means that people had to manually crank the steering wheel hard to make slow turns. If you don't remember those times, try running out of power steering fluid and you'll know exactly what it was like. Power steering fluid should be checked when the car is warmed up. Look for the power steering reservoir in your engine and use the same dipstick method to check the level and color.

Brake Fluid.
The brake fluid is clean, and it is pale yellow – Almost clear (you get the picture). The color that designated the fluid is not clean is a dirty light brown one.

Locate the brake fluid reservoir in the engine and look for markings on the side of the plastic. This will allow you to see what the brake fluid level is without having to open the cap. If you must open it to check the level, make sure you don't spill any on the car because aside from looking like urine, this fluid makes an excellent paint remover.

Wiper Fluid.
It's easy to remember the clean color of wiper fluid as light blue, as it rarely gets dirty. This fluid is used to keep windshields clean. Most windshield fluid reservoirs are easy to locate, but some newer cars have played hide and seek with them. You'll know when you need to add fluid by looking at the reservoir or when wipers make a horrible, nails-on-the chalkboard sound. Don't worry about spilling or overfilling it. The worst wiper fluid can do is clean the surrounding engine parts.

Two Fluid Takeaways:

1. Avoid spills when adding fluids by using a funnel.
2. Track how often you add fluids. Frequent additions indicate leaks/engine wear.

Be Nosey & Speak Up

When arriving at the shop, stay involved, ask questions to know what is going on with your car. Ask as many questions as you feel you need to. Ask the mechanic how to prevent your car trouble from happening in the future. Ask if there is something you could have, or should have done, to avoid it.

Show the mechanic the list of items you noticed wrong with your car. Go over each item that caused concern, however, don't tell them what you think the problem is. Resist the temptation to diagnose the trouble yourself (even though you might be able to). The mechanic is the expert. Their job is like that of a doctor – you tell them where it hurts, and they tell you what's wrong. Leave it up to the car doctor to prescribe the cure.

MUST DO's:

1. Get the shop labor rate and an estimate before leaving your vehicle.
2. Ask to be called in there for any additional charges or repairs.
3. Ask to see the replaced parts and the new ones after they are installed.
4. Leave contact information where you can be reached.

MUST ASK:

5. What is important to do right now?
6. What can wait?
7. What can be done in the future?
8. What is the time frame needed for the repairs?
9. What is the cost of the repair?
10. If some repairs are done together, will the labor cost be less? Can a discount be applied?

Before leaving the shop make sure you understand what work the mechanic will be doing. Ask them to tell you exactly what they plan to work on, why they are going to work on it, what it will accomplish, and how much it will cost. No surprises! If there are additional repairs mentioned, make sure you understand why they are necessary.

One way to be sure that the repair work you want gets correctly done is to speak directly to the foreman, supervisor or technician who will be overseeing working on your car. Get their name. If the issue is drivability, take a test drive with the mechanic so that both of you are on the same page.

Chapter 5: ESSENTIAL #3 - Digestive System

[Fuel & Energy are the Food for Your Car's Digestive System]

As humans our bodies need oxygen and food to keep going in the same way cars need fuel and oxygen for combustion. In a car, the starter motor kicks over the engine before oxygen consuming fuels can take over. This happens in a way that is so like how anaerobic energy is processed in the human body. Both systems also require stored energy to be replaced.

Fuel and energy are that food that makes your vehicle go. To keep your vehicle healthy and running smooth, you auto know what it likes to eat. It matters!

Save on Fuel

Did you know? Personal vehicles and trucks account for an estimated 75% of the nation's energy supply. Since it is so vital for our personal use, let's look at some ways below to mitigate a vehicle's digestive problems:

Tire Pressure. When your car's feet are not working properly, they can't move the car in the best way possible. Under inflated tires make the engine work harder and uses more gas. Be sure to pump those tires up and maintain the correct amount of air in them.

Air Filter. When your lungs are full of air that has a poor air quality index, you gasp for breath and absorb oxygen poorly. Your car's air filter works the same way as your lungs. Check your air filter every 10K to 15K miles to make sure it is free of carbon build-up and can circulate air efficiently. The better your car breathes, the better it will digest fuel and the less money will be spent on gas.

Carbon Build-Up. No one likes plaque build-up on their teeth. It feels like your teeth are unclean, which is an accurate feeling. Your fuel injectors and Throttle body, the component that help inject fuel into all the parts of the car's engine, also develop plaque in the form of carbon build-up. When this happens, engines use more fuel than necessary to get the job done.

Think of a fuel injection cleaning like a cleansing and rinsing you get at the dentist. If you get it done regularly, it isn't so bad. If you wait a long time between cleanings, it can be tough to remove. The best way to keep carbon build-up from occurring is to have regular fuel-injection cleanings. You can even add (fuel injection cleaner additive) to your gas tank to minimize carbon build-up between cleanings, and you'll save big bucks. Now, that's something to smile about!

Junk in Your Trunk. Too much junk in the trunk of your car is something you don't want. The more weight being dragged, the more gas your vehicle needs to consume. Lighten the load and you can keep some extra weight in your wallet!

Accelerating. Every time you punch the gas pedal, you are using more gas. In the city, stop and go driving and heavy accelerating will end up costing you. Slow down and drive at a steady speed as much as possible to save on gas.

Idle Time. If you are sitting anywhere for any length of time, like at the drive-through or at a friend's house, turn the engine off. Idling will use fuel unnecessarily and still gets you nowhere.

Plan Your Trip. If you have errands to run, map out a route that allows you to use the least amount of mileage. Short trips require constant turning on and off the engine and can use more gas than long, steady trips.

Pick the Right Octane

With gas-powered vehicles, the engine burns fuel. In other words, engines are an internal combustion and burns fuel internally, kind of like your body burns the fuel and food that you consume. The engine allows a mixture of air and fuel into the combustion area and a piston compresses the mixture. Spark plugs ignite this mixture causing an internal explosion that produces the power to run the engine.

Do you use regular, high premium, super-charged, double espresso, and turbo shot gasoline? Do you know what kind of gasoline is to be consistently used in your vehicle? It used to be easy to fill up. Just pull up to the tank, pop the fuel door, punch one button and fill up.

Now you must swipe, enter your passcode, your middle name, and your favorite color, decide if you want stamps, coffee, or a receipt, all before you even choose what type of gas to use. But seriously, octane does make a difference with your car's performance, so it is important to know which level you need for your vehicle.

The octane rating itself tells how much gasoline can be compressed before it ignites spontaneously. If gasoline ever ignites by compression rather than from the spark plug, it will cause the engine to knock.

Take regular gasoline with an 87-octane rating for example. This grade of gasoline would require less compression than gasoline with a 93-octane rating. Another way to look at it is the higher the octane, the slower the fuel burns, whereas a lower octane rated gasoline burns faster. Again, think of high-octane calories and the body. Food that is rich in fiber, protein and complex carbohydrates will burn more slowly; while simple carbs that are low in nutritional value will burn faster.

How do Hybrids Digest Fuel?

Hybrid vehicles are attractive for several reasons. They usually require less regular maintenance and can save you a ton in fuel costs. They also leave a smaller carbon footprint, a big selling point, much like EV's. But they come with higher price tags, more expensive repairs and in some state's higher taxes than other vehicles. We will address EV's and hybrids in a later chapter.

Gasoline operated vehicles consume gasoline, pure and simple. Hybrids consume alternative fuel. Think of it like organic food. It does the same thing as regular food full of preservatives and additives, but it is digested differently.

The most common forms of alternative fuel

- ***Biodiesel*** – This type of fuel is harvested from nuts and beans, really! The oil we use for cooking, like peanut oil, is altered so that it can be used in engines. The advantage of using biodiesel fuel is that it is biodegradable and non-toxic. The disadvantage is that it is not widely available in the United States yet. In Europe, it is rapidly gaining popularity, but prices are higher than gasoline. Going green comes at a price but is worth it for many drivers.
- ***Ethanol*** – This is a form of alcohol derived from sugar cane or corn. When it is used for fuel, it is usually mixed with gasoline. This "gasohol" is blended at a 10% ethanol/90% gas mixture. Most Flex Fuel cars run on this type of fuel with ratio mixtures ranging from 10/90 to 15/85. Ethanol based fuel is a little less expensive than gasoline but is not as efficient and will probably result in poorer gas mileage.
- ***Natural Gas*** – Who knew that natural gas, the kind used for heating and cooking, can also be used to power vehicles? Although it is not readily available to the general population, many commercial trucking, taxi and bus companies have their own natural gas pumps and use it regularly in their vehicles.
- ***Electricity*** – it is estimated that about 10% of all cars purchased in 2023 are EV's. These are rapidly gaining popularity and are expensive, roomy, sporty and can save you a ton of money on gas! As more models are switching from gas-powered to EV, look for this type of vehicle to become more affordable.

As we become more globally conscious of the effect of carbon, our world moves closer toward an emission's free existence. Diesel vehicles are slowly being phased out in various parts of the world and gas might not be far behind. Imagine if diesel and combustion engines in America were a thing of the past. Gas stations would have to change their main product. Charging stations will emerge! Adjustments for battery recycling, hydrogen fuel and charging stations will be the new business to get into. New business models are coming.

Zero emissions sound great! But what will the cost of such a huge surge in electricity demand be? Will we rely on more coal (emissions burning coal), or will we turn to wind turbines, solar panels, or hydrogen to provide electricity? Only time will tell how we will adapt and adjust as we continue rolling forward with alternative fuel options.

Emissions Explained – Finally!

Carbon monoxide, nitrogen oxides and hydro-carbons - these might sound like the ingredients you find in highly preserved junk food, but they are not. They are byproducts of a combustion engine at work. That's right, these tongue twisters are what your car produces when it drives you from home to work to school and shopping. In 1970, the Clean Air Act was created and in 1990 was amended to limit the amount of nasty stuff that cars produce, specifically, the emissions. Car manufacturers developed certain mechanisms to help keep emissions at a minimum.

Emission control mechanisms include:

Catalytic Converter

This part of the Vehicle is designed to allow for hydrocarbons additional oxidation, so they are not pumped back into the air. A catalytic converter can be found on the exhaust system by the top of the muffler. A honeycomb filter aids in the processing of the chemical, and acts as a catalyst (hence, the name catalytic converter). When carbon monoxide and hydrocarbons go over this catalyst, they are converted to water and carbon dioxide. The catalytic converter cleans the exhaust and allows the process to work more efficiently. With the introduction of the catalytic converter came the push

toward unleaded fuel because leaded fuel creates a coating on the converter that prevents it from working properly.

PCV Valve
The Positive Crankcase Ventilation (PCV) system redirects the toxic vapors produced from combustion engines so that they are diluted. The amount of dilution and total fuel/air mixture is critical to the engine's performance. When your vehicle is sitting idle, only a small number of vapors are let into the intake. When cruising at highway speeds, more vapors can be tolerated because of the increased engine pressure, so more vapors are allowed in. Problems with the PCV Valve can lead to broken or cracked seals and Poor engine performance.

EGR Valve
An Exhaust Gas Recirculation Valve measures how much exhaust gas enters the intake system. The purpose of the EGR Valve is to keep the combustion chamber at the right temperature. If the chamber is too high, toxic nitrogen oxides can be emitted.

Evaporative Controls

What do charcoal, gas and vents have in common? They are all used to cook a slamming' barbecue! They are also used to keep fuel vapors from escaping into the atmosphere. In older cars, from the 70's and 80's, gas caps were vented, and gas vapors escaped from gas tanks into the atmosphere. When the automobile industry started focusing on diminishing emissions, they designed the fuel evaporative control system to keep vapors in the gas tank.

Fuel vapors stick to charcoal and a charcoal canister holds the vapors until the engine starts. When it cranks, the engine then draws the fuel vapors into the engine and burns them off. For this system to work correctly, the gas tank must have a sealed cap, unlike the vented ones of olden days. Charcoal canisters work with a filter and should be checked or replaced during periodic tune-ups. If your gas mileage starts to drop, check the charcoal filter when you look for a cause.

Air Injection
Another process that effectively eliminates emissions is the Air Injection System. Combustion engines work with oxygen, heat, and fuel. If the exhaust manifold is hot and we add oxygen, any excess fuel will combust. This will not power the engine but will reduce hydro-carbon emissions. Because this process occurs after the combustion, it has no effect on the performance of the engine. Keep the Air Injection System maintained by inspecting it regularly.

You AUTO Know These Codes

Everything is based around computers nowadays. And cars are computers. When you take newer models in for a tune-up, it's probably because a flashing light has appeared on the dashboard, or a mysterious code has popped up somewhere.

Common Engine Computer Codes and What They Mean*:*

- **P0300/P0310 – MISFIRE!** This can be caused by a few things, like the spark plugs, ignition coils, fuel injectors, spark plug wires or a combination of all these things. Even the computer itself can be on the fritz and cause one of these codes.
- **P0440/P0310 – Evaporative Emissions Control System (aka: EVAP):** The purpose of the EVAP is to decrease the number of emissions from your car. Think of this system as a going green type of process, involving several mechanisms, including the gas cap, the seal or the charcoal canister that traps fuel vapors. All these things are made to help keep our air clean and keep nasty fumes from polluting the atmosphere.
- **P0420 – Catalytic Converter of O2 Sensor:** We've all heard that dreaded term "O2 Sensor," but let's explain this in case you are not familiar with it. What the O2 Sensor does is regulate the gas and oxygen mixture that cycles through the engine. A proper mixture of gas and oxygen is essential for keeping the catalytic converter performing correctly and efficiently keeping those toxic exhaust fumes from damaging the environment.

Other codes are a little more obvious… like Smoke Signals! Any type of smoke coming from your car should be investigated, even if it's coming from inside the vehicle. An electric fire or burned wire can create smoke from the inside of the car just as easily as overheating or exhaust can create smoke on the outside of your car.

- **Smoke:** Smoke coming from a tailpipe could indicate that the gas/oxygen mixture is off and could also point to gasket problems. Any smoke could cause damage and even be dangerous to your health so always get it checked out!
- **Blue Smoke**: Blue smoke coming from the back end of a vehicle is most likely the result of oil being burned with gasoline. If there are some blue skies billowing out of your tailpipe, adding oil may be required. We suggest if there is any oil leak or burning, it could cause damage to other car parts. Get this checked out.
- **White Smoke:** White smoke can come from several things, including condensation or anti-freeze.
- **Black Smoke:** If it looks like a motorcycle and rides like a motorcycle, it probably IS a motorcycle. However, if it sounds like a motorcycle, it might be a car with an exhaust problem. Any revving that causes big plumes of black smoke to shoot out the tailpipe probably has an exhaust issue. Even though this might sound and look cool, it is not. In fact, the carbon dioxide that comes out of the exhaust is toxic and deadly. If you notice any black smoke coming from your caboose, get it checked right away!

Unfortunately, you can't crack all your car's codes with a sniff or by looking in your OMV. Bring the car into the repair shop, and have it hooked up to a special computer that reads diagnostic code and find out what diagnostic procedure needs to be done to correct the problem.

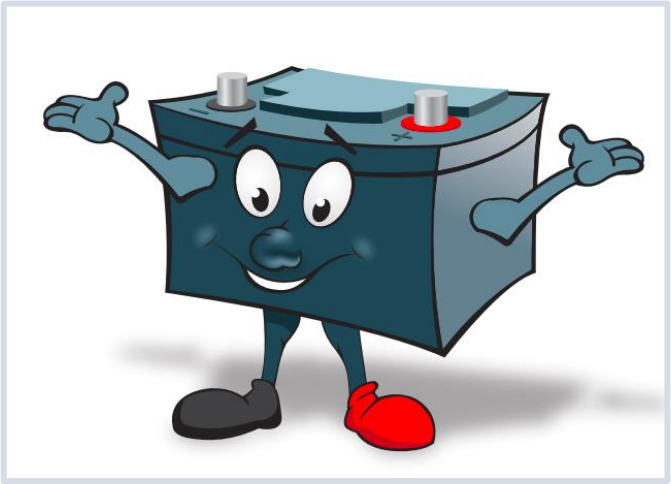
What You AUTO Know about Car's Digestion

1. Keep your car maintained because a fit car uses fuel more efficiently than an out of shape one.
2. Many things can cause your car to have digestion problems, like tire pressure, dirty air filter, over acceleration and junk in your trunk.
3. The energy produced by one gallon of gas is equal to the energy in over 100 fast food hamburgers!
4. Low octane can damage cars that require high octane fuel.
5. If your car requires low octane fuel, high octane is only going to damage your wallet!
6. Hybrids use organic fuel, like biodiesel, ethanol, and flex fuel.
7. Natural gas can be used for cooking, heating and even to power car engines!
8. Emissions contain carbon monoxide, nitrogen oxides and hydrocarbons.
9. Emissions are toxic and deadly.
10. Any codes or smoke signals displayed by your car can indicate a problem with exhaust, emissions, or something else.

Chapter 6: ESSENTIAL #4 - You Gotta Have Heart

[Your Vehicles Heart is its Starting and Charging Systems]

The Battery is the Heart of the Car



When your cell phone battery dies, you recharge it. When the remote-control batteries stop functioning, they are immediately replaced. With cars, the alternator recharges the battery until it no longer holds a charge and then it needs to be replaced.

Car batteries power the engine. When your car is running, the alternator, which is driven by the engine, charges the battery. It creates electricity, 13.6-14.3 volts to be precise, and recharges the battery to its original state of charge. Like when you fully charge your cell phone, minus the cute green battery icon.

The Alternator of the Engine is Pivotal

Most people think that the motor or the transmission is the most important part of the car. But really, the alternator is the hardest working component of the vehicle's engine. It never stops, literally! Every time your car is running, the alternator is working. It continually creates electricity to provide the engine, and important accessories, with power.

When the car battery dies or starts to lose its juice, some of those accessories, like those on the dashboard, may work – or they may not. They don't need much power, but they still need power, and they get it from your battery.

The common cure for an ailing battery is a jump start. But beware, jump starting can overload your alternator and might even kill it. If this happens to you, replace, or recharge your battery before doing damage to the alternator.

Belt Too Tight?

So how does this work? Well, most vehicles have a ribbed belt connected to the alternator that rotates the armature inside of it, which makes it generate power. If this belt breaks, drivers are not going anywhere. Belt tension is important. Too loose or too tight is not good for your alternator belt. The fit should be taut, allowing enough tension to keep it turning.

Under or Over Charged is Not Good

If your alternator undercharges the battery, providing less than 13.6 volts, it can mean idle time in your future. If the system overcharges the battery, providing more than 14.5 volts, other problems can arise like a seeping or leading battery. Think of it like eating too much at Thanksgiving. Too much and the belly will swell, and possibly leak. Your battery will do the same thing if it is overcharged.

Check your alternator using a voltmeter on the battery terminals when your engine is idle.

A quick and easy way to check the vehicle's cardiac system is to start it and turn on the headlights. If they are dim, the alternator isn't producing enough juice. If they get brighter as the engine is revved, the alternator is pumping some current to the battery, but not enough. If the headlights are bright and don't change when the car is idle or revved, all is in order and pumping just fine.

Common Battery Issues

The battery provides power to the car. Without it, the car wouldn't have the charge, the electricity it needs to do its job. Before we go any further, let's make sure you know where to locate the battery. Pop the top, take a minute and find it. It's usually a rectangular shaped box with two large silver bolts or knobs, called terminals. If you can't find it, check your OMV.

Some vehicles don't have a battery that is visible under the hood. Instead, they have a positive charge cable and a negative charge cable. You can also use any unpainted part of the body of the car for the negative charge connection because your car is grounded.

Once the battery is located, diagnose any minor problems that you may be having.

Dirty Terminals

Your battery's terminals connect the battery to the charger or alternator. This is what allows the electrical current to get from one part to another. Most terminals look like large knobs or bolts on the top of the battery. They are usually labeled with a plus sign (+) for positive charge and a negative sign (-) for a negative charge. The plus sign is usually red and the negative sign black.

Corrosion on the battery terminals can result in a poor charge. This dirt and debris that builds up on the battery is caused by battery acid and should not be touched with bare hands. Make sure to wear gloves when cleaning the terminals. Check for any white or powdery residue on the terminal. If there is, follow these steps:

- Whip up a corrosion cleaning solution using 1 tablespoon baking soda and 1 cup of water. Use an old toothbrush and dip it in this mixture and scrub the terminals. Any wire brush or hairbrush will also work.
- Soda works too! Believe it or not, carbonated soda is good for cleaning battery acid! [Imagine what it does for our digestive systems.] Be sure to wipe the terminals clean with water afterwards.

If you can start your car after cleaning the terminals, the problem has been solved. Now go give yourself a high-five!

A Bad Connection

The cable of the battery runs from each of the terminals to the alternator or charger. If these are not hooked up to the terminals properly, a poor charge or no charge at all will occur. Simply tighten the connection and you're good to go.

Look for a clamp that connects the cables to the terminals with a bolt. Get a wrench and tighten the bolts down until they are snug. This will cause the cable to get better contact with the terminal. Check the clamp and if it jiggles, tighten it up a little more. DO NOT over tighten the bolt because it could do more damage.

Start your vehicle and see if this corrects the problem.

Jump Starting a Car

If you have already cleaned the terminals and checked the cable connections and your car still doesn't start, a jump is in order next for your car. The good news is, if you could handle those fixes, you are ready for this step.

Before we begin, pay attention to a few words of caution:

DON'T JUMP-START A FROZEN/CRACKED BATTERY! THE BATTERY COULD EXPLODE!!

If there are cracks in the battery casing, don't try to jump-start it;

Ensure you have all the jumper cables. If not, buy these at any automotive store, super-stores, or home improvement stores. Jumper cables work by drawing power from a working and charged battery and transferring some of that power to a dead battery.

Here's one big difference between our cars and bodies. Even when a battery is completely dead, like absolutely no sign of life whatsoever, it can quickly be revived with just a little power. Once that happens, the vehicle's alternator or charger does the rest, and your car will be fully back to life in no time.

After you have the cables, take the booster car (that would be the one that runs) and park it close enough to the dead car so that the cables can reach each car. Pop the hood and make sure the booster car is on and running before you attach the cables.

ALWAYS attach and disconnect the jumper cables in the following order*:*

ATTACH cables in the following order:

1. **Red Clamp on Red (+) Terminal** on your dead car
2. **Red Clamp on Red (+) Terminal** on the booster car
3. **Black Clamp on Black (-) Terminal** on the booster car
4. **Black Clamp on Black (-) Terminal** on your dead car

Leave both cars running when you disconnect the cables.

DISCONNECT cables in the following order:

1. **Black Clamp from Black (-) Terminal** on your dead car
2. **Black Clamp from Black (-) Terminal** on the booster car
3. **Red Clamp from Red (+) Terminal** on the booster car
4. **Red Clamp from Red (+) Terminal** on your dead car

Once the cables are on, attempt to start the dead car. If it starts, let it run for 20 minutes before turning it off. You can do this while idle or driving. This allows the alternator plenty of time to recharge that battery.

If the car doesn't start, check the connection, and wait a few minutes, then try again. If your car still won't start, time to catch a ride home or to the auto parts store for a new battery. Call a tow, a friend, or AAA.

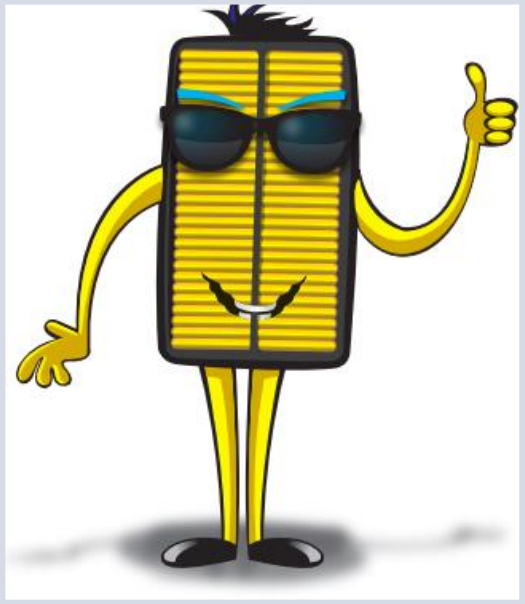
No matter the next steps, make sure to lock your car in a safely lit place. Be sure to have it fixed or towed as soon as possible.

What You AUTO Know About the Battery

1. Jumping the battery can sometimes cause an overload and kill your alternator.
2. Your alternator belt shouldn't be too tight or too loose.
3. Under charge (less than 13.6 volts) can cause dim lights and other problems.
4. Over charge (more than 14.5 volts) can cause a weeping or leaking battery.
5. Alternators can get sick, just like people.
6. **ALWAYS** disconnect your battery **BEFORE** you disconnect your alternator wiring.
7. Dirty terminals can be cleaned with a baking soda/water combo or soda.
8. **NEVER** let your jumper cable clamps touch when you are jumping the car.
9. **NEVER** charge a cracked or frozen battery, it could explode!

Chapter 7: ESSENTIAL #5 - Respiratory System

[Air – Cabin – Fuel – Transmission - Oil]



Is Your Car Breathing Easy?

Your **AIR FILTER** acts like the lungs for your car. If the filter is dirty, it can't do its job and your engine won't be able to suck enough air into the combustion chambers. The engine will then run rich, meaning with too much gas and not enough air. When this happens, your car will lose power and run roughly. That annoying "check engine" light may also come on and you absolutely don't want that to happen.

Neglecting the air filter can cause a lot of problems. Although you may not have permanent damage to your engine, some abrasive and harmful contaminants will probably find their way into the combustion chamber. The easiest way to maintain your air filter is to check it. And the good news is you don't even need an x-ray machine!

Look for any signs of dirt on your air filter. The filter should be white. If it is dirty, it probably needs to be replaced. You can purchase an air filter from any auto parts store.

Air Cabin Filter – HVAC Filter

If you've ever been on an airplane, you've heard the term "cabin pressure." This is the amount of pressure required in the cabin to maintain breathable air. The cabin of your car also holds breathable air. If the air in your car's cabin is dirty, this can be easily remedied by rolling down your windows. Or we would recommend replacing the air cabin filter.

In the 1990's, manufacturers came up with a filter designed to purify the air in the cabin, appropriately called the Air Cabin Filter or HVAC – which stands for Heat Ventilation Air Conditioner. This helps keep the air coming into the car, and the air that is being recirculated in the car, clean and pure.

The air cabin filter should be replaced every 12,000 to 15,000 miles, every year, or when the smell gets to you.

Musty odors inside a car can be caused by:

a. The dirty laundry you threw on the backseat.
b. Your sneakers
c. Body odor
d. A dirty air cabin filter… and 'D' is correct!

Replacing Air Cabin Filters

Locate the air cabin filter under the dash or under the hood in the back by the firewall. Remove the screws or clips that hold the access cover in place, and remove the cover, and slide the filter out of the housing. Replace it with a brand-new filter (preferably the one designated in your OMV) and replace the cover.

Are You Putting Out Toxic Fumes?

Not only is it important to keep the air inside of your car clean, it's also important to keep the air outside of your car clean. Again, think of the human body. We need clean air going in and trying to keep the toxic and smelly air coming out to a minimum. Think of how bad the air smells after you eat chili or baked beans! Even though your human exhaust fumes may not actually damage the global atmosphere, they certainly can wreak havoc in a small environment.

The fumes that your car emits are like human fumes, except it *has* been proven that they are extremely harmful to the environment. Exhaust fumes are made up of carbon monoxide, hydrocarbons and nitrogen oxides that are created during the combustion process. Just like human exhaust, these fumes come out of the tailpipe.

Background

In 1977, somebody finally got a whiff of what was happening to our beautiful planet and set limits to how much of these pollutants could be released from the car. Manufacturers had to comply and began developing control devices and ultimately, the self-adjusting engine. When these first came out, they were called feedback fuel control systems. To measure the amount of fuel content in the exhaust stream, an oxygen sensor was installed on the exhaust system. This sensor would send a signal to a microprocessor that would read the measurement and adjust the air/fuel ratio to meet the limits.

As computer technology advanced, the ignition spark timing was adjusted as well and additional emission controls were added to the vehicle operating system. Some of these control devices include the ***PCV Valve, Air Pump, Charcoal Canister, Catalytic Converter*** and ***EGR Valve***. The emissions system will notify the driver of any malfunction in the control through a light on the dash. This notification is time stamped with a special code so when it is inspected by a mechanic, they can properly diagnose the problem.

Catalytic Converter

All cars today have emissions control systems perform three functions:

1. Aid in providing more complete combustion to produce fewer nasty by-products.
2. Reduce excessive hydrocarbons from getting into the air.
3. Provide an extra area for combustion and oxidation to occur.

The third function is made possible by the catalytic converter. It is called this because it acts like a catalyst (something that helps speed things up) for the combustion and oxidation. The converter looks like a muffler but performs a different job. Rather than being open to release fumes, the converter houses a honeycomb structure or pellets made of palladium or platinum.

When toxins enter the converter, they are oxidized (or converted, get it?) into water and carbon dioxide. The converter cleans the nasty toxins and as it does, it creates heat. If your car produces a lot of bad toxins, the converter will work extra hard and heat up more. When this happens, you can sometimes see a glow; please note that a glow from your converter is not a good sign. This will eventually damage the converter.

Another thing that causes the converter to heat up is leaded fuel. In the old days cars ran on leaded fuel. But lead creates a coating on the honeycomb or pellets and causes them to stop working. This makes the converter totally useless. When emissions systems were introduced, unleaded fuel became the staple for most vehicles in our country.

Positive Crankcase Ventilation System

Yeah, it's way easier to say PCV than positive crankcase ventilation, right? This system recycles the vapors produced during the combustion process. When the fumes and toxins are produced in the crankcase, they are sent back into the air/fuel intake system so they can be burned up during combustion rather than having them enter and burn up our atmosphere.

Combustion vapors will change the air/fuel mixture and dilute it, which can cause problems if not carefully monitored. That's where the PCV valve comes in. It controls and measures the mixture to keep it balanced. It also makes sure that when the car is idle, only a small number of vapors enter the intake system. And when the car is cruising along, it allows more vapors to enter the system because the pressure in the engine is high enough to tolerate it.

Even though it's not expensive, the PCV valve has a very important job and causes some serious problems if it isn't working properly. Not only can dirty toxins enter the air or your intake system, but the vapors can enter the air filter housing too. A clogged or PCV valve can also create too much pressure and lead to engine and poor engine performance. If the wrong valve is installed or the system has any leaks oil can get pulled from the engine, which can lead to major repairs. Pay attention if your engine is idling rough or you notice any oil leaks. The PCV valve may be to blame.

Exhaust Gas Recirculation Valve

The exhaust gas recirculation valve circulates exhaust gas! This valve meters a tiny amount of exhaust gas back into the intake system to reduce the amount of heat in the combustion chamber. Because exhaust gas also dilutes the sensitive air/fuel mixture, it acts as a secret ingredient that keeps the balance just right to ensure the proper combustion temperature. If the combustion chamber gets too hot it creates excess nitrogen oxides, which are very, very bad for the environment.

The EGR is very good at doing its job. But like with anything good, there is always a downside. The EGR's downside is that it sends exhaust gas into the engine intake system, and engines don't like exhaust gas. That's why the amount of exhaust coming in is carefully controlled through the onboard computer, using vacuum and electrical switches, and other small accessories. Because the EGR system causes poorer engine performance by adding exhaust gas to the intake and diluting that precious air/fuel mixture, it doesn't perform when the engine is cold or when the engine requires full throttle power.

Fuel Evaporative Controls

When emissions systems came on the scene, every engine and exhaust component was examined to see how best to reduce pollutants and toxins. One solution was to trap the evaporative emissions that escape from the carburetor and the gas tank. Using a fuel evaporative control system, a charcoal

filter traps the fuel vapors. When the engine is started up, these vapors are sucked back into the engine through a vacuum so they can be burned up with the air/fuel mixture. Pretty amazing, really!

But to do that, the gas tank needs to be sealed so that no vapors escape. And as you guessed it, the introduction of the sealed gas tank filler cap! Ta Da! This sealed cap replaced the older, vented caps that used to release fumes and vapors into the atmosphere. Gas tanks themselves were also redesigned so the vapors have enough room to be stored and filtered to the charcoal canister. Once there, a purge valve controls the number of vapors released back into the engine. This valve is controlled by a vacuum and if the vacuum or valve goes bad, the engine draws too much fuel and messes up the air/fuel mixture.

The problems that can arise from a bad purge valve, vacuum or canister are rough riding and fouled up spark plugs. Therefore, if you want to ride smoothly and fire properly then check the charcoal filter or the entire system when you notice a drop in mileage.

Air Injection

Thanks to the air injection system, or AIS, this feature helps reduce the emissions created during combustion. Fuel, heat, and oxygen are required for combustion. If one of these three elements is missing, no boom! The exhaust manifold is hot enough to provide heat for combustion. So, all there is to do is add a little oxygen and any fuel that's hanging out in there will ignite. This combustion does not actually power the engine in any way but does cut down on the number of harmful hydrocarbons that are created.

The combustion in the engine and the combustion in the exhaust manifold are different in a few ways. The exhaust manifold combustions don't produce power for the engine. Also, it isn't controlled like the combustion in the combustion chamber in the engine. And you know what can happen when you have uncontrolled combustion – lots of booms. These explosions are the result of too much fuel in the manifold and they can sound like popping.

You also have excessive fuel in the combustion manifold when the car decelerates. When this happens, the air injection system is automatically shut off using a diverter valve. This valve moves the air from the manifold after the combustion process has occurred, so it doesn't affect the performance of the engine. Maintaining this system only requires inspections of the air pump drive belt.

What You AUTO Know to Keep Your Car Breathing Easy

1. Your air filter keeps your car breathing easy!
2. Your air cabin (HVAC) filter keeps YOU breathing' easy!
3. A musty odor inside your car can be from dirty laundry in the backseat, those gym sneakers, body odor **OR** a dirty air cabin filter (correct).
4. Parts of the Emissions System include: the PCV Valve, Air Pump, Charcoal Canister, Catalytic Converter and EGR Valve.
5. Catalytic converters can overheat when too many toxins are present in your exhaust.
6. The PCV valve practices recycling by sending vapors produced in the crankcase back to the intake system rather than into the atmosphere.
7. The EGR (exhaust gas recycling system) doesn't perform when the engine is cold!
8. Before emissions controls, vented gas caps used to release gas vapors into the environment. Mm mm, no irony, as this was a time in our history when smoking was cool, too.
9. Replacing a dirty air filter can improve your gas mileage by up to 10%!

Chapter 8: ESSENTIAL #6 - Circulatory System

[Power Steering – Brakes – Battery Coolant – Washer Fluid – Motor Oil]

Coolant Overview

A car's engine will always be hot but should never be too hot. Coolant was developed to keep vehicles from getting overheated. When hitting the road, your car's engine kicks into gear and produces an enormous amount of heat. Small explosions in the engine push that heat through the engine into the spark plugs. This creates the spark that ignites the fuel and keeps it rolling! But if this heat gets out of control, the only place you'll be rolling is into a nearby auto repair shop.

Liquid coolant surges through every part of your engine, keeping it at an optimal temperature. This prevents it from overheating and getting damaged. It also prevents the engine from getting too cold and releasing emissions into the atmosphere. Coolant is designed to work in hot and cold climates. In other words, your car will stay comfortably cozy in snow and summer with the right cooling system.

The two main types of cooling systems are liquid and air. Most older cars use air cooling systems and newer cars use liquid cooling systems. In liquid systems, tubes and pockets work together like human blood vessels and arteries to carry liquid coolant through the various engine parts. Coolant is first poured into a reservoir. A water pump next pumps the coolant through the engine block where the cylinders heat it. It then moves to the cylinder head and combustion chambers where it gets even hotter. Next it moves past the thermostat into the radiator.

A thermostat measures and controls the coolant temperature, in the same way our body's temperature measures our body's circulation. The car's radiator cools the coolant down so it can keep the engine cool. The radiator cap helps regulate the pressure in the radiator. Hoses that connect the radiator and heater system to the engine help warm the coolant up on frigid days.

Once the coolant has made its way through the engine and has absorbed the heat, it passes through the front of the car through the radiator. When the outside air hits the coolant, it seeps back into the grill. The lower radiator hose next carries the chilled coolant back to the water pump where it is now ready to absorb heat and start its journey all over again. The coolant in our cars works much like the blood flow in the human body's circulatory system. In our bodies, blood flows to all our body parts and then back to our heart, is pumped out and flows to our body parts and back again. Think wash, rinse, and repeat. This is exactly how the coolant is processed in a car.

To keep the coolant running smoothly and doing its job, replace it every 2 years. The radiator cap, thermostat and hoses should be visually inspected every time you have a tune-up.

Coolant is also called Antifreeze. The reservoir that holds the coolant is usually clear so that you can check the level without having to remove the cap. Remember, NEVER remove the radiator cap when the car is hot. The amount of pressure in the radiator can cause it to explode, so always let your car cool down before you remove the radiator cap.

Coolant is available in every color of the rainbow. These colors don't just keep your engine pretty, they help to identify when your coolant is bad. When the 2-year check-up arrives, see if the coolant has changed from its original hue to a dirty, rusty color. If it has, it's time for a change. While you're under the hood, check the hoses and thermostat too.

Fun Facts about Antifreeze

- **Coolant** (aka: Antifreeze) must stay cool in hot temperatures and keep from freezing in cold ones. It also must lubricate the engine parts and keep rust from forming. Go Coolant!
- **Coolant** comes in all colors of the rainbow, and you need to put in the same color that it already has. Do not mix colors.
- **Coolant** is a mixture of antifreeze and water. The usual ration for engines is 50/50. If there is too little antifreeze, the mixture could freeze. If there is too little water, the mixture could boil.
- **Coolant** is poisonous and should never be left in areas that small children, pets, or animals can get to it. Its sweet smell is tempting but ingesting it can be lethal.

The Car's Circulatory Systems

Radiator

The radiator takes the heat from the engine and moves it away from the car. The core of the radiator is made of aluminum strips that kind of look like an A/C filter in a home. But be careful, these strips are sharp! There is a plastic tank connected to each end of the radiator with gaskets. A hose on the top of the radiator lets the coolant in the tank and a hose on the bottom spits the coolant back out. On automatic transmissions, there is an additional tank inside one of these tanks that circulates transmission fluid so it can also be kept cool.

Radiator Fan

Just like any fan, the radiator fan on the back of the radiator is designed to keep the radiator and fluid cool. When driving, air rushes in through the radiator and helps cool the coolant. But when you stop, there is no air. The radiator fan keeps air circulating through the radiator whether moving or stopped. The car's computer controls the radiator fan. If the temperature of the engine gets too hot, a sensor sends a message, and the computer lets the fan know it needs to get to work. Some cars also have a second radiator for the air conditioning called a condenser. This also must be kept cool with a fan that kicks on when the air conditioning is on.

Reserve Tank and Radiator Pressure Cap

Radiators are sealed to prevent leaks. Because of this, pressure builds up when the coolant is heated. This is the way the radiator is designed. In fact, it is made to withstand coolant temperatures more than 250 degrees. To maintain proper pressure within the radiator, a pressure cap is used. This cap is made with a spring so that it can release pressure when needed to keep the coolant and pressure at the proper level.

When there is too much pressure inside the radiator, the cap opens and lets off a small amount of coolant into a reserve tank. With less coolant, the engine creates a vacuum when it cools down. As this happens, the radiator cap acts like a plunger and sucks some of the coolant from the reserve tank back into the radiator.

Water Pump

The water pump moves the coolant through the radiator into the engine block and will kick on when the engine is running. Water pumps are made up of cast iron or aluminum and are powered by a fan belt, serpentine belt, or timing belt. The pump is sealed to the engine block with a gasket to keep any coolant from leaking out.

Thermostat

Unlike a thermometer, the thermostat is a valve that takes the temperature of the coolant and opens and closes to allow coolant to flow or not to flow through the radiator. When the coolant is too cool, it is sent back to the engine rather than being filtered through the radiator. This keeps the engine from getting some areas of hot coolant and other areas of cool coolant.

Thermostats are usually found near the radiator hose attached to the engine with a gasket or silicone. One of the big myths with thermostats is that it's easier to find overheating problems if you take the thermostat out. **This is false.** In fact, without a thermostat, coolant could run hot and not be able to cool the engine down properly causing overheating problems, not solutions.

Bypass System

Think heart bypass here. Our hearts have valves and hoses, so to speak, and so does our car's circulatory system. When the thermostat valve closes, hoses or steel tubes carry coolant back to the engine while bypassing the radiator.

Freeze out Plugs

Engine blocks are manufactured with holes at the bottom so that coolant can flow through. These holes must be plugged with Freeze out Plugs which are steel cups or discs that will usually last as long as your engine. But in the 'old days', people used water in their radiator rather than antifreeze. Or they would use water in the summer and then "remember" to switch to antifreeze in the winter. The problem with water is that it freezes and causes the engine to expand. When this happened, the plugs would freeze up, expand, and pop out, cracking the plugs and sometimes the engine.

These plugs would also rust out quickly when they were immersed in water. Antifreeze is made with rust inhibitors, but if it is not changed every few years, rust can still form causing plug problems. Freeze out plugs are usually on the side of the engine and are not easy, or inexpensive, to replace. Make sure to maintain antifreeze properly to avoid plug problems.

Head Gaskets and Intake Manifold

Combustion engines are made to be sealed as tight as possible. But they still need gaskets to seal off any water or gasses. The head gasket works hard to keep fluids flowing properly without leaking into the combustion chamber. If your car overheats, it can cause a problem with the head gasket and will create leaks with combustion gasses, coolant, and other fluids like oil.

Blown head gaskets are more common in some engines than others. Any overheating should be addressed immediately. If you see signs that your car is getting too hot to handle, pull over and let that baby cool down to avoid head gasket problems.

Purchasing a new head gasket is a big deal. They are, contrary to what we've all heard, relatively expensive. But it's not going to do anything unless it's installed… and that's where some pain comes in! It takes a lot of labor hours to take apart the engine and pop that on. Head gasket replacement repairs are usually in the thousands. And yet coolant costs a few bucks. The paradox is real.

A V-type, or V-shaped engines have two head gaskets which adds at least 25% more to the labor price. Another painful part of head gasket repair is that until the engine is taken apart, there's no way of knowing whether there is damage to the cylinder head or other mechanisms.

Heater Core

The heater core is made up of a small radiator type component connected to the cooling system by two rubber hoses. Hot coolant travels from the water pump to the heater core through one hose and returns to the engine through the other hose. A fan sucks air through the core and mixes it with air from outside of the car and air conditioning. This is how the climate of the interior of the car is controlled. The heater core is also responsible for regulating the temperature of the defroster, heat, and air vents.

Hoses

Rubber hoses are all over your engine. They work like arteries and blood vessels in our bodies. They transport fluid back and forth to various parts of your engine and all the components. Radiator hoses consist of an upper and lower hose that move coolant from the radiator to the engine. Heater hoses carry coolant to the heater core. When the coolant does not need to be cooled, it travels through a bypass hose that sends it back to the engine.

These hoses are made to handle a lot of pressure, kind of like pantyhose. And similarly, when we pull on an old, worn-out pair of pantyhose, we get runs and rips. Your car's hoses can also break down over time and need replacing. When you go shopping for new hoses, make sure they are the right size for your car.

Servicing your Circulatory System

We've already talked about the hazards of overheating. We sweat, can get dizzy, breathe heavily, and get thirsty. Imagine what happens to your car! What might cost a few bucks in a power drink, deodorant, and body spray to fix will cost a whole lot more for your car!

Easy Steps to Keep a Car's Circulatory System Chilled

Flush and Fill. Antifreeze/coolant is the most important fluid to your circulatory system. It is made to help protect the radiator and engine and keeps rust and corrosion at bay. But the elements that protect your car eventually wear out and must be replaced with new antifreeze every 30,000 miles or two years.

A flush and fill means the radiator system is flushed out (empty it completely of old antifreeze) and fill it up with new. This job should be done at a shop that can properly remove your thermostat and replace it with a new one.

Visual Inspection. Check those hoses and belts. Look for any cracking, wear or bulging. Also see if pressure has caused any unsightly swelling. Make sure to read your OMV to find the right hose part number when replacing them. Be sure to install the new hoses in the same direction the old

ones were, and always clamp them tight to keep them secure. When finished, do a quick pressure test to see if the leaks are eliminated.

The timing belt is another essential circulatory element that keeps your water pump working. To get to the timing belt, the engine must be partly disassembled. The belt itself is not too expensive, but the labor is. **It's always a good idea to replace the water pump when you replace the timing belt because you're already paying for the labor.**

Test the Pressure Cap. Radiator caps are made to handle, distribute, and regulate the pressure in the radiator. They have valves that allow the cap to open and close as needed. If the valves aren't working right or the cap is bad, the pressure can get too high or be too low and not allow for proper cooling of fluid. To test the cap, see if it will hold the right amount of pressure for 2 minutes. If not, replace it. The rule of thumb is to replace the radiator cap every 36,000 miles or 3 years. And as always, get a cap that is the right part for your vehicle.

Thermostat Test. The only time you need to check your thermostat is if you are having problems keeping cool. Crank your engine on and get it warmed up, but do NOT overheat it. Once it is warm, turn the car off and check the radiator hoses that go from the engine to the radiator. Be careful, they could be super-hot. If one is cold and the other is hot, your thermostat may be closed and not working right. Take it out and put it in some boiling water. If the thermostat opens at 195 degrees, it is working fine and just needs to be opened. If not, replace it.

Pressure Test. Special pressure tester caps are available for testing the cooling system pressure. They test to see if there is a leak by forcing pressure through the system. Once the car is completely cooled down and full of coolant, remove the radiator cap and replace it with the pressure tester cap. The gauge on the cap will show you how much pressure there is. Allow it to reach the amount of pressure indicated in your OMV.

Once it gets to the desired pressure, check for leaks using a flashlight (usually best done if the car is on a lift). If the pressure begins to drop rapidly or you see a few pounds dropping a few minutes, you could have a leak. Other signs of leaks include residue on the windshield, sweet smelling fumes and antifreeze puddles or sprays shooting out of your radiator or hoses.

Internal Leak Test. This test is conducted if the vehicle keeps losing coolant, but you can't find any leaks. A chemical is used to test the vapors that are in the radiator. If there are exhaust vapors present, the chemical turns yellow, indicating a leak in the head gasket, a cracked block, or cracked head.

Engine Fan Test. When cruising on the open road, the wind blows through your car, creating the necessary circulation to keep your engine cool. But when you are driving slowly or sitting still, your car gets no circulation and so an engine fan is needed. Cars today have electric fans located on the radiator and regulated by a temperature sensor.

Air conditioner condensers also need air to operate the air conditioning system. When circulation stops, cool air from the A/C will start to warm up, so engine fans will kick on when the A/C is on to prevent that from happening.

If the car starts to overheat when you come to a stop, turn on the air conditioning and see if that kicks the fan on. If it doesn't, you might have a faulty temperature sensor in the fan or could have a

bad fan motor. Other culprits could be the fan control system or fan relay switch. Regardless, whatever the problem, get it checked and fixed to prevent getting hot and overheated.

Good Vibrations

Sometimes drivers can feel their car steering wheel vibrate. The first thing most people think of when they feel this is that the car is out of alignment. This can be caused by one or more wheels having excessive "play" or wobbliness at the hub. A mechanic will be able to diagnose what exactly is causing this problem. The first thing will be to check that each wheel is properly fastened to its hub with the right amount of torque on the lug nuts. Once this has been examined, the wheel bearings will be checked. Wheel bearings help extend the life of a vehicle but when they are worn, usually the result of extreme driving, high mileage or good old fashioned four wheeling fun, they can cause the wheels to wobble.

Another possible culprit is "runout," which is how much a wheel moves outside of a perfectly circular rotation. Mechanics and technicians use special equipment to measure runout. If a tire has more than half an inch of run out, it can cause wobbliness and usually requires a new wheel.

Other Causes for Bouncy and Uneven Rides

- **Bad Ball Joints or Tie-Rod Ends** will result in too much play in a tire and ultimately will cause a vibration when you drive.
- **Axle Issues** and bent axles can lead to vibrations. Axles can get bent easily in any sort of collision or even by running over a deep pothole. If it is an axle problem, the vibration usually gets worse with acceleration.
- **Driveshaft**. The driveshaft sends power from the engine to the rear wheels and axles. It spins rapidly and will cause shaking or vibrations if it is bent at all. Inspect the driveshaft if you feel something wiggly.
- **Constant Velocity (CV) Joints**. There are sometimes called "boots," CV joints that cover the ends of axles. If they are in good shape, they will be rubbery, secure, tight and have no noticeable lubricant. If they are worn or torn, they can't protect the way they should, and dirt and dust can get into the axle. If you have a front-wheel drive car, damaged CV joints might have you replacing the axles too, so get them checked.

Transmission

The transmission is one of the most important parts of your baby. You can't get anywhere with a broken one.

You Auto Know the signs of transmission damage:

Any grinding noises (not coming from your teeth)

Any shaking (not coming from the speakers)

Any humming (not coming from you) also slipping or jerking when accelerating can be a symptom

Above are **red flags** that something could be very wrong with the vehicle's transmission.

Transmission problems can appear out of nowhere and with virtually no warning. A small fluid leak can be a clear sign. But many times, when just cruising along, the car overheats. And it's the middle of winter! A big myth is that engines can only overheat in the warm weather. But any stress on the engine, whether in cold or hot weather, can cause the engine to overheat.

The transmission is like a muscle. Imagine it's the dead of winter and it's freezing outside. If you are outside shoveling snow and pushing your muscles to their limit, you can still break out into a sweat. The same thing applies with your engine. Even though it's cold, if the muscle, the transmission of your car, is working excessively by towing heavy loads, rocking back and forth in mud or snow, or continually starting and stopping, it can overheat.

The hotter it gets under the hood, the faster the transmission (muscle) burns fluid (fuel). Think aerobic activity – the more you exercise, the faster your muscle burns the fuel you put into it. But transmission fluid loses a little of its lubrication quality every time it cools down and is reheated. When this happens, the engine parts might stop working properly and can cause stress and ultimately failure to the transmission. So, remember to make sure the transmission fluid is clean and working well.

Transmission Fluid

Lubricants come in all shapes and sizes, and transmission fluid is no exception. Like many other lubricants, transmission fluid is slippery and helps keep moving parts moving smoothly. The transmission fluid is also a coolant and adds viscosity so that engine power can be easily sent from the engine to the transmission. Changing the transmission fluid regularly and on schedule will prevent metal shavings and dirt particles from gumming up the transmission. Ultimately, transmission fluid filled regularly and properly will extend the life of your car's transmission.

Manual Transmission - ***Change every 30K to 60K miles – check OMV***

If you have a manual transmission, also known as a stick shift, you cannot check the transmission fluid on your own. You must go to the shop and have a mechanic use a special tool to remove the plug under your car to check this. Some cars have transmission dipsticks but newer cars block these too so they can only be checked with special equipment. If you see transmission fluid leaking from your car or feel you are having a transmission problem, bring the car to the shop and have them check it right away.

Automatic Transmission - ***Change every 30K to 100K miles – check OMV***

You AUTO know that you can check the transmission fluid on most automatic transmission. First, make sure the car is on a flat surface and that the engine is running at a normal operating temperature. Some OMV's suggest keeping the car in park or neutral, so check. Open the hood and locate the transmission fluid reservoir, usually found on the front passenger side. With the vehicle running – keep the engine on to check this dipstick, wipe it clean with a rag and insert back in the reservoir. Pull it out again after 5 to 10 seconds and check the fluid level.

If your transmission fluid is pink, it's good. If it is merlot in color, it is bad. If the fluid level is low, use a funnel to add more, or use a bottle with an easy pour lid. If you have a small leak, you can add a transmission fluid sealer but larger leaks, like giant puddles on your garage floor, need to be checked and repaired by a mechanic. Even without leaks, transmission fluid levels and quality should be checked at least once a year.

Internal combustion gasoline engines run on a mixture of gasoline and air. The ideal mixture is 14.7 parts of air to one part of gasoline (by weight.) Since gas weighs much more than air, we are talking about a whole lot of air and a tiny bit of gas. One part of gas that is completely vaporized into 14.7 parts of air can produce tremendous power when ignited inside an engine.

Modern Engines Use Energy to Turn the Wheels

Air enters the engine through the air cleaner and proceeds to the throttle plate. The driver controls the amount of air that passes through the throttle plate and into the engine with the gas pedal. It is then distributed through a series of passages called the intake manifold, to each cylinder. At some point after the air cleaner, depending on the engine, fuel is added to the airstream by either a fuel injection system or, in older vehicles, by the carburetor.

Once the fuel is vaporized into the air stream, the mixture is drawn into each cylinder as that cylinder begins its intake stroke. When the piston reaches the bottom of the cylinder, the intake valve closes, and the piston begins moving up in the cylinder compressing the charge. When the piston reaches the top, the spark plug ignites the fuel-air mixture causing a powerful expansion of the gas, which pushes the piston back down with great force against the crankshaft, just like a bicycle rider pushing against the pedals to make the bike go.

How an Engine Works

Since the same process occurs in each cylinder, we will look at one cylinder to see how the four-stroke process works. The four (4) strokes are **Intake, Compression, Power,** and **Exhaust**. The piston travels down on the Intake stroke, up on the Compression stroke, down on the Power stroke and up on the Exhaust stroke.

Intake

As the piston starts down on the Intake stroke, the intake valve opens, and the fuel-air mixture is drawn into the cylinder (like drawing back the plunger on a hypodermic needle to allow fluid to be drawn into the chamber.) When the piston reaches the bottom of the intake stroke, the intake valve closes, trapping the air-fuel mixture in the cylinder.

Compression

The piston moves up and compresses the trapped air fuel mixture that was brought in by the intake stroke. The amount that the mixture is compressed is determined by the compression ratio of the engine. The compression ratio on the average engine is in the range of 8:1 to 10:1. This means that when the piston reaches the top of the cylinder, the air-fuel mixture is squeezed to about one tenth of its original volume.

Power

The spark plugs fire, igniting the compressed air-fuel mixture which produces a powerful expansion of the vapor. The combustion process pushes the piston down the cylinder with great force turning the crankshaft to provide the power to propel the vehicle. Each piston fires at a different time, determined by the engine firing order. By the time the crankshaft completes two revolutions, each cylinder in the engine will have gone through one power stroke.

Exhaust
With the piston at the bottom of the cylinder, the exhaust valve opens to allow the burned exhaust gas to be expelled to the exhaust system. Since the cylinder contains so much pressure, when the valve opens, the gas is expelled with a violent force (that is why a vehicle without a muffler sounds so loud.) The piston travels up to the top of the cylinder pushing all the exhaust out before closing the exhaust valve in preparation for starting the four-stroke process over again.

Oiling System
Oil is the lifeblood of the engine. An engine running without oil will last about as long as a human without blood. Oil is pumped under pressure to all the moving parts of the engine by an oil pump. The oil pump is mounted at the bottom of the engine in the oil pan and is connected by a gear to either the crankshaft or the camshaft. This way, when the engine is turning, the oil pump is pumping. There is an oil pressure sensor near the oil pump that monitors pressure and sends this information to a warning light or a gauge on the dashboard. When the engine starts, the light should go out indicating that there is oil pressure.

Engine Cooling
Internal combustion engines must maintain a stable operating temperature, not too hot and not too cold. With the massive amounts of heat that is generated from the combustion process, if the engine did not have a method for cooling itself, it would quickly self-destruct. Major engine parts can warp causing oil and water leaks and the oil will boil and become useless.

While some engines are air-cooled, most engines are liquid cooled. The water pump circulates coolant throughout the engine, hitting the hot areas around the cylinders and heads and then sends the hot coolant to the radiator to be cooled off.

Engine Balance
Flywheel. A 4-cylinder engine produces a power stroke every half crankshaft revolution, an 8 cylinder, every quarter revolution. This means that a V8 will be smoother running than a 4. To keep the combustion pulses from generating a vibration, a flywheel is attached to the back of the crankshaft. The flywheel is a disk that is about 12 to 15 inches in diameter. On a standard transmission car, the flywheel is a heavy iron disk that doubles as part of the clutch system. On automatic equipped vehicles, the flywheel is a stamped steel plate that mounts the heavy torque converter. The flywheel uses inertia to smooth out the normal engine pulses.

Balance Shaft. Some engines have an inherent rocking motion that produces an annoying vibration while running. To combat this, engineers employ one or more balance shafts. A balance shaft is a heavy shaft that runs through the engine parallel to the crankshaft. This shaft has large weights that, while spinning, offset the rocking motion of the engine by creating an opposite rocking motion of their own.

Intake stroke -- The intake valve opens, letting in air and moving the piston down.
Compression stroke -- The piston moves back up and compresses the air.
Combustion stroke -- As the piston reaches the top, fuel is injected at just the right moment and ignited, forcing the piston back down.
Exhaust stroke -- The piston moves back to the top, pushing out the exhaust created from the combustion out of the exhaust valve.

Remember that a diesel engine has no spark plug, that it intakes air and compresses it, and that it then injects the fuel directly into the combustion chamber (direct injection). It is the heat of the compressed air that lights the fuel in a diesel engine.

Your Engine Is a Friend

When you start your car in the morning, the engine is firing with the help of combustion. Once combustion occurs its all energy from there. Two main components make this possible: gasoline and air…mostly air. Your engine is like your heart, without it your car will not live. Now, air enters in the engine through an air cleaner and then travels to the throttle plate. Shortly after the air is inside of the throttle plate, which is controlled using the gas pedal, it is distributed throughout the cylinders in the engine.

Fuel is then put into the air stream and vaporized by a fuel injection system or by a carburetor. This causes the combustion of gas and air, and it releases a ton of energy for your car to start moving. The pistons in the engine will travel up and down because of the force that is exerted from the combustion. When the piston reaches the top of the cylinder it causes the spark plugs to ignite, and small explosions will occur causing heat energy. This process makes the car GO!

There are so many types of engines, mostly combustion engines, although some diesel and rotary engines will vary. Cars with a lot more power will carry up to 12 cylinders and cars with less power can hold at least 3 cylinders, or anywhere in between. Pistons are connected to a crankshaft, which spins around and around, opening and closing the valves that are located within each cylinder.

This process can be described in four (4) easy steps.

1. First is the intake stroke, which means the piston starts on the bottom and the intake valve is opened, then it traps the gasoline and air combination in the cylinder.
2. Second is compression and this is when the piston moves up and compresses these glasses in a small, confined space.
3. The third step is the power. This is when the spark plug ignites the gasses and causes combustion, pushing the piston down and creating loads of energy to get a car going'.
4. Lastly is the exhaust step and this has to do with the exhaust system as the piston travels up the cylinder it pushes the gasses out of the muffler. This sums it up for engine processes. Be sure to remember that your car needs oil to run without it is like a human trying to breath with no air. Another thing is your engine needs to maintain a constant cooling temperature to keep the engine healthy. Understanding the engine will provide you with information and knowledge that will keep you safe on the road.

The Importance of Oil

Oil is one of the most critical fluids in vehicles. The work it does in the engine is second to none—which means having plenty of clean, fresh oil always flowing through your engine.

Your vehicle's engine has dozens upon dozens of moving parts, and oil provides a protective lubrication that significantly reduces heat and friction. When the oil level decreases or becomes contaminated, much more heat is produced because of the lack of lubrication. This can cause those parts in your engine to warp or even melt.

There are two main causes of oil deficiency in your engine. The first is because of leaks. Engines are such complex systems consisting of various tubes, filters, and ducts. Sometimes the seals combining these parts break down, causing the oil to leak ever so slightly. You'll know this has happened when stains appear on your driveway or garage floor.

The other reason? Like any fluid, engine oil breaks down over time. It can only be heated and reheated so many times before engine oil breaks down and forms a thick black sludge. When this happens, your engine loses that protective layer it once had.

If you wait too long to address your oil, what once could have been a $30, 30-minute auto visit, a week-long engine replacement or re-build costing thousands. There are a lot of different oils out there promising longer life—but the only real secret to preventing significant oil damage is to have a Your Auto Repair every 3,000 miles.

Types of Motor Oil

The motor oil used is always specified by the vehicle manufacturer in your owner's manual. For most passenger car and light truck gasoline engines today, it's any oil that meets the American Petroleum Institutes "SH" rating.

As for the viscosity of oil to use, most new engines today require a multivocality 5W-30 oil for all-round driving. The lighter 5W-30 oils contain friction reducing additives that help improve fuel economy and allow the oil to quickly reach critical upper valve train components when a cold engine is first started. Most engine wear occurs immediately after a cold start, so it's important to have oil that is thin enough to circulate easily -- especially at cold temperatures.

For older engines and ones that are driven at sustained highway speeds during hot weather, 10W-30 or 10W-40 is a good choice. Heavier multi viscosity oils such as 20W-40 are for high rpm, high-load applications primarily and are not recommended for cold weather driving.

Straight weight 30W and 40W oils aren't very popular anymore, but some diehards insist on using them. They say the thicker oil holds up better under high temperature (which it does), increases oil pressure and reduces oil consumption in high mileage engines. But straight 30W and 40W oils are too thick for cold weather and may make an engine hard to start. They may also be too thick to provide adequate start-up lubrication to critical upper valve train components during cold weather. So, switching to a straight 20W oil would be necessary for cold weather driving. Straight 10W oil can also improve cold starting but is very thin and should only be used in sub-zero climates. A multi viscosity 10W-30 or 10W-40 will provide the same cold starting benefits of a 10W oil and the high temperature protection of a 30W or 40W oil.

For the ultimate in high temperature protection, durability and all-round performance, synthetic oils are the way to go. Unfortunately, most synthetic oils cost up to three times as much as ordinary petroleum-based oils. They cost more because synthetics are man-made rather than refined from petroleum. But this improves their performance in virtually every aspect:

- Superior temperature resistance. Synthetics can safely handle higher operating temperatures without oxidizing (burning) or breaking down. The upper limit for most mineral based oils is about 250 to 300 degrees F. Synthetics can take up to 450 degrees F. or higher. This makes synthetics well-suited for turbo applications as well as high rpm and high output engine applications.

- Better low temperature performance. Synthetics flow freely at subzero temperatures, pouring easily at -40- or -50-degrees F. where ordinary oils turn to molasses. This makes for easier cold starts and provides faster upper valve train lubrication during the first critical moments when most engine wear occurs.
- Improved engine performance. Synthetics tend to be more slippery than their petroleum-based counterparts, which improves fuel economy, cuts frictional horsepower losses, and helps the engine run cooler. The difference isn't great, but it can make a noticeable difference.
- Longer oil change intervals. Because synthetics resist oxidation and viscosity breakdown better than ordinary motor oils, some suppliers say oil change intervals can be safely extended -- in some cases stretched to as much as 25,000 miles. Such claims are justified by the fact that synthetics don't break down or sludge up as fast as ordinary mineral-based oils do in use.

CAUTION: For vehicles under warranty, extending the normal change interval is not recommended because failing to follow the OEM's maintenance schedule can void your warranty.

Synthetics

Synthetic oils are available in the same grades as ordinary motor oils (5W-30, 5W-20, and 10W-30) as well as “extended" grades such as 15W-50 and even 5W-50.

There are also lower-cost synthetic "blends" that combine synthetic and petroleum-based oils in the same container. But you can do your own blend to save money by simply substituting a quart or two of synthetic oil for conventional oil when you change oil. Synthetics are compatible with conventional motor oils.

Who should use synthetic oil? The premium-priced oil is best for:

- Turbocharged or supercharged engines
- Performance or high output engines
- Vehicles used for towing (especially during hot weather)
- Vehicles that are operated in extremely cold or hot climates.
- Anyone who wants the ultimate in lubrication and protection.

Oil Changes & What to Expect

The oil change general procedure has not changed over the years. It usually involves jacking up the car and draining the oil from the bottom of the pan. Remove and replace the oil filter. Check the

manual to see what the capacity is for an oil and filter change, as well as the proper oil type and viscosity.

Most European brands have very specific oil requirements for later model cars.

Add the oil, start the engine, and let it run for 20 seconds or so. Shut it off, let the oil settle for a couple minutes, and recheck the level. Aim to have your oil level to the full line point on the marked area. DO NOT OVERFILL. This is as important to engine safety as under-filling an engine. Be sure to record your maintenance either on the maintenance card or use the DriverAutoKnow.com free app to auto maintain this important information.

Final Word

A brand-new engine with little or no wear can probably get by on 7,500-mile oil changes. But as an engine accumulates miles, blowby increases. This dumps more unburned fuel into the crankcase which dilutes the oil. This causes the oil to break down. So, if the oil isn't changed often enough, you can end up with accelerated wear and all the engine problems that come with it (loss of performance and fuel economy, and increased emissions and oil consumption).

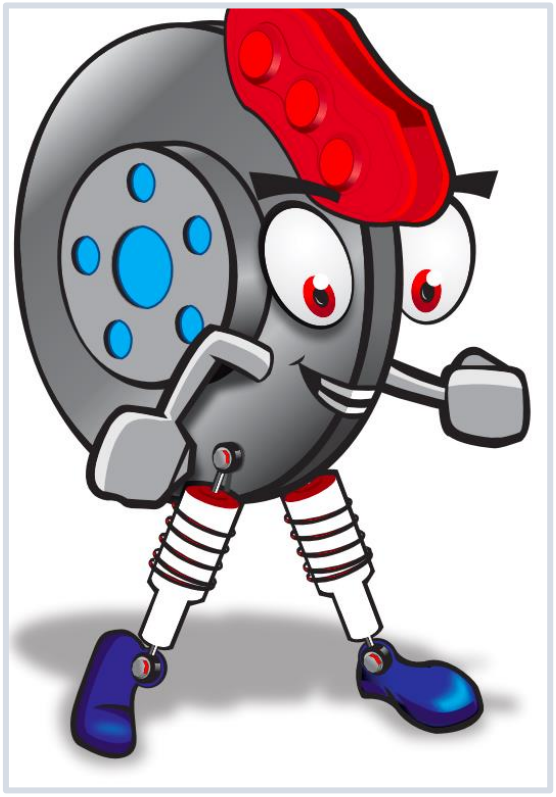
Now, the longer motor oil goes and isn't changed, it gets dirty. If the car has a lot of miles on it, the piston rings may not be as tight as needed, and blow-by gets into the crankcase, which over time dirties the oil. It then makes the oil thicker. Crud in the oil sticks throughout the oil galleys. Once the oil galleys become clogged, the oil cannot drain back down through the engine into the oil pan. The oil builds up in the valve covers, which means there is less oil in the oil pan. Once the galleys are plugged, the bottom of the engine "runs out" of oil (since the oil can't get back down into the bottom). The bearing will seize, and the engine will stop running.

What You AUTO Know about Car's Circulatory Systems

1. Older vehicles use air cooling systems and newer cars (this century) use liquid cooling systems.
2. Your car's circulatory system carries coolant to various parts of your car in the same way our circulatory system carries blood throughout our body.
3. Antifreeze and Coolant are interchangeable terms.
4. Antifreeze comes in three different shades: pink, orange, and green! If it is rusty, it's dirty and time for a change.
5. Antifreeze/Coolant is LETHAL so keep stored away from pets and children.
6. Antifreeze costs a couple of bucks, but without it, you could spend a couple of thousand on a new head gasket!
7. Coolant keeps engine's cool when they get too hot and keeps them warm when they get too cold.
8. Antifreeze is designed to stay liquid in freezing temperatures.
9. Check your antifreeze every 2 years.
10. Driving with the windows down is a great keep cool if you're driving under 40mph.

Chapter 9: ESSENTIAL #7 - Reflexes

[Brakes - Steering – Suspension]



No matter how cat-like your reflexes are, if your vehicle's brakes aren't working properly, you're in trouble. What we cover in this chapter is the immense importance of brakes, steering, front end & suspension; all to ensure your vehicle's reflexes are as good as yours.

Below Are Some Shakes and Shimmies That Aren't Good Vibrations

Steering

Misaligned front wheels wandering or difficulty steering in a straight line all lead to long-term unnecessary expense and troubles on the road. If you've sensed something is a little off, try to figure out when it happens. Does it occur only when you speed up or slow down? Does it happen when the car is cold or warm? Does it happen all the time or only occasionally? Try to pinpoint exactly when you first noticed the problem so that you can better describe what the issue is.

Pulling

The vehicle's tendency to steer to the left or right, can be caused by something as routine as under-inflated tires, or as serious as damaged or misaligned front end.

Ride and Handling

Worn shock absorbers or other suspension components – like improper tire inflation - contribute to poor cornering. While there is no hard and fast rule about when to replace suspension parts try this test: bounce the vehicle up and down hard at each wheel and then let go. See how many times the vehicle bounces. If it's got two or more bounces,

Those weak shocks need to be addressed. Springs do not normally wear out and do not need replacement unless one corner of the vehicle is lower than the others. Overloading your vehicle can damage the springs. • Balance tires properly. An unbalanced or improperly balanced tire causes a vehicle to vibrate and may wear steering and suspension components prematurely. **Steering and suspension – inspect annually.**

Estimated Expense for Brakes - All Cars Vary

- Regenerative brake adjustments, 1 Hour
- *A*djust and clean brakes every 30,000 miles, $150.
- New Calipers Brakes, $1000
- Full Brake Job on a 4-door sedan due to Neglect, $1000+

How to Check Your Brakes

First, **check** for wear by looking at **the brake pads through** the spaces between the wheel's spokes. The outside pad will be pressed against a metal rotor. Generally, there should be at least 1/4 inch of **pad**. **If you measure less** than 1/4 inch of **pad**, you may want to have **your brake pads** inspected or replaced. In most states, they will not pass inspection.

Common Symptoms of Suspension Failure: Diagnosis

Suspension issues can be difficult to diagnose. It's usually easy to tell the symptoms, but identifying the source of the issue is different altogether. Faulty or worn shocks, struts, springs, tie rods or ball joints can wreak havoc on your vehicle and make your car or truck unsafe to drive.

Wear and tear are only an issue if you actively ignore the problem and allow your vehicle to run itself into the ground, so to speak. Pay attention to how your vehicle handles and what you're hearing—and address problems immediately as they arise.

You'll Rarely Walk Away from an Accident with No Damage

Even the slightest fender-bender can have a nasty domino effect on the health of your car or truck. And a slow collision at a 4-way intersection can still result in damage to your suspension system. It may not jump out at you, but small initial signs can grow into significant I-need-a-tow-truck now on the side of the highway in the future. Don't ignore this.

Read on for some of the most common symptoms of problems with suspension parts in your vehicle, especially after an accident.

Pulling to One Side While Driving: Suspension

An underinflated tire is a common reason for your car pulling, and a problem easily fixed.

Pulling to the left or right is the most common sign of suspension or steering problems. It can also be one of the hardest problems to diagnose. Without the help of a professional. Tires need to be aligned precisely for toe-in, caster and camber. Poor alignment means uneven tire wear, annoying pulling, a constant fight with the steering wheel, and even. Decreased gas mileage. Your vehicle could be pulling for any number of reasons:

- Uneven tire pressure
- Uneven tire wear
- Poor alignment
- Bad tie rods or steering rack
- Sticking brake caliper

If you blow through a pothole or climb over a curb, the vehicle's alignment can get out of whack. Sudden changes in alignment don't happen magically. Something broke. It could be a broken spring or control arm.

Shock absorbers, true to the name, are the main culprit when the ride feels "bumpier" than ever. They're designed to keep your tires on the road. When they don't, the car bounces, and passengers do, too. Shocks have fluid which dampen the bouncing. When they leak, their performance suffers, and the absorbers will eventually fail.

Don't Count Out a Worn Leaf Spring

Leaf springs may sometimes cause problems with excessive bouncing. You can double check the possibility of a busted leaf spring by checking if the car or truck seems too "lean" back in a standing position. Many trucks are designed to be "nose down" to accommodate extra weight in the rear. If your pickup truck appears to sit level, it could be extra proof of an issue with a leaf spring. Even the slightest damage from an accident can cause shocks to leak and permanently damage them beyond repair. Get it checked out.

One Corner is Sitting Low

Some slight cosmetic damage from a or pothole doesn't rule out damage to your suspension.

When your car is on level ground, but one corner sits lower than the others, most likely there is a damaged spring. You may notice a clunking noise when going over bumps, and cornering could be compromised, because a damaged spring can't support the weight.

The relationship between the shock and the spring is the main contributor to this problem. A blown shock may cause an overcompensation of the spring and lower sitting height. A blown shock doesn't have a direct impact on height, but it will make a car react poorly in bad road conditions.

Test Springs, Struts and Shocks by Pushing Down on the Trunk

The easiest way to diagnose springs, struts and shocks is by pushing down on the trunk (or the back side of the vehicle), releasing, and listen to how the suspension reacts. If you hear a creaking or squealing sound, you have a suspension problem with the shocks, springs, bushings, or related parts.

Even the slightest loss of height in one or multiple corners of the vehicle could indicate a leak or failure in the shocks or springs. Don't wait until your car is dragging along the road before getting it inspected.

Your Car Nosedives Leans Back, or Rolls

Shocks or struts can need replacement when you notice the following related issues:

- Your car "nose dives" when braking (it leans forward).
- Your vehicle "rolls" to the side when cornering (it leans side-to-side).
- Your car "squats" during acceleration (it leans backward).

Of course, with extreme handling, you could force these things to happen in a vehicle with a brand-new suspension system. What we're pointing to is everyday driving situations. You shouldn't be leaning forward for a routine stop in an intersection.

5 Difficult Steering

Don't expect to escape this kind of damage without some suspension damage.

If steering is particularly difficult, especially when the car is moving slowly, something might be wrong with the steering or front end. Sometimes the steering may feel like it's "slipping" when you turn the wheel or hold it in a turned position. Any number of components in your power steering system could be a source of these issues, including:

- Low power steering fluid
- Worn or lose power steering belt
- Faulty power steering pump
- Leaking power steering rack
- Worn control arm bushings

Bad Vibrations

There are all kinds of vibrations related to an automobile, however, vibrations that occur when applying to the brake indicate there is an issue with the braking system. Since this section is devoted to the brakes, we'll stick to those instances. The most common thing that causes vibrations is warped brake rotors. If you notice that things vibrate more when the brakes are stepped on, the rotors could be to blame.

So how does a rotor get warped? And what is a rotor? The rotor is the shiny, silver disc-shaped part that helps the disc brake system work. Wear and tear can cause the rotor to warp. This happens from excessive overheating, caused by more stopping than the rotor can handle. The calipers and brake pads, which squeeze the brake rotors to make the car stop, cannot grip a warped rotor. When this happens… vibrations occur!

To stop, the calipers and brake pads need to be able to **GET A GRIP** on the rotors. If your car has rear drum brakes, the pads and calipers will have to grip those to stop the car. Regardless of whether yours goes rotor or drum, you should have a brake specialist inspect your brakes.

How Brakes Work

When you slam your foot on the brake pedal, the car transmits the force from your foot to the brakes through a fluid. The brakes themselves require a much greater force than could ever be applied with your leg, therefore, the car multiplies the force from your foot.

The force is multiplied through:

- Mechanical advantage (leverage)
- Hydraulic force multiplication

The braking process:

1. You push on the brake pedal.
2. The pedal moves down and pushes a lever which multiplies the pushing force.
3. The lever moves a piston through a cylinder (four, one for each wheel) filled with brake fluid – but not just any brake fluid – ***hydraulic/hygroscopic*** brake fluid. When the piston goes into the cylinder, it shoves the hydraulic fluid out.
4. The brake fluid flows through a long pipe (aka: hydraulic line) until it gets to a second, wider cylinder. Then it pushes the piston through the larger cylinder with a ton more force.
5. The piston moves the brake pad to the brake disc, causing friction – and that makes heat.
6. This heat slows down the tire and ultimately stops the car.

Brakes can sometimes need to be replaced long before their manufacturer's expiration date. In other words, just because the brakes are warrantied through a certain date doesn't mean they will last that long. There are a variety of factors that can cause brakes to expire before the warranty. Those are covered later in this chapter.

Different Brakes and Brake Components

Disc Brakes
These are used on all four tires on most sedans, particularly luxury sedans, and sports cars. A rotor moves the wheel and pads attached to calipers squeeze the disc when the brake is engaged. This causes the rotor (disc) to heat up and it slows down the rotation of the tire.

Drum Brakes

Some cars will have disc brakes in the front and drum brakes in the rear. Drum brakes have shoes instead of pads. These shoes are attached to a drum, and they push out, instead of squeezing in, against the drum as it rotates, slowing the rotation and causing the car to stop.

Front Brakes
Have you ever slammed on your brakes and noticed how everything in the car winds up on the front seat or near the dashboard? The velocity of the stopping action causes everything to shift forward, which is why seatbelts and airbags are so important. Well, the weight ***OF*** the car, and not just the weight ***IN*** the car, also shifts forward when you brake. Because of this, front brakes always must work harder than the rear brakes and so they tend to naturally wear out faster.

It's okay to replace just the front brakes if your rear brakes are in good condition. If you are having your front brakes inspected, make sure the rear ones get a good once over too. If they need replacing soon, see if you can get a discount by getting them all done at once.

ABS
ABS stands for anti-lock brake systems. These are designed to keep your wheels from locking up when the brakes are slammed. Most cars come standard with ABS, but that wasn't the case just a few decades ago. In an emergency, the driver had to *pump* the brakes to keep the tires from locking up. Now the ABS system does it for you.

The easier you are on any type of brakes, the longer they will last.

Are Your Brakes Sick

Below is checklist to help determine if your brakes or brake components are showing wear and tear:

- Does your car pull to the left or right when you step on the brakes? (Could be the caliper sticking)
- Does your brake pedal resist and require more force to go down? (Loss of power to the brakes)]
- Does the brake pedal feel soft or spongy when you step on it?
- Can you hear disturbing noises, like grinding, squealing, or scraping when you step on your brakes? (Could be worn or low brake pads or pads digging into the rotors.)
- Does the brake pedal go all the way to the floor when you step on it? (Brake fluid leak)
- Are your brakes emitting an unusual smell?
- Does the brake pedal vibrate and pulse when you step on it?
- Does your car not slow when the brakes are applied?

Safety: If you think there might be a problem with your brakes GET **THEM CHECKED!**

Time for a Change

The one thing we haven't talked about is the importance of **brake fluid.** We've mentioned that coolant is vital to keep your engine at the right temperature and prevents your car from overheating. Oil lubricates the engine parts and allows them to constantly move together to work properly. Windshield wiper fluid helps you see, kind of important. And gas gets you going.

Oil, wiper fluid, coolant and gas are vital to the life of your car, **but brake fluid is vital to the life of YOU!**

Did You Know? **50% of drivers haven't changed or added brake fluid, ever!**

Mechanics and technicians should regularly check brake or hygroscopic fluid absorbs moisture from the air. The fluid needs to be free of moisture to keep the brakes from heating up moisture that can get into the lines and corrode the fluid. Even though it might be good for your skin, moisture is terrible for brake fluid. It gets into the fluid and causes debris from the rubber in metal in the brake system to wind up in the fluid. When brake fluid gets old and contaminated it can no longer do its job and becomes unsafe.

Brake failure, especially unexplained brake failure, is usually caused by contaminated brake fluid. When the brakes get hot, they heat the brake fluid up. When the fluid boils, the elements that keep it working start to break down. Over time, this can result in ineffective brake fluid, ineffective brakes, and accidents.

Did You Know? Towing puts extra stress on brake parts and can shorten the life of brake fluid and wears out the brakes more quickly.

Brake fluid is like urine. If it's clean, it's clear or pale yellow. If it is light brown or dark, it is no longer working. The brake fluid reservoir is usually located on the firewall under the hood, closest to the steering wheel. Most newer cars have a clear reservoir with markings on the side so you can check the fluid levels easily. Don't be fooled by old fluid, which is dark and can often make the reservoir

appear fuller than it is. Take off the fluid cap and look in the reservoir. Ideally, you want the fluid up near the top of the maximum line and clear in color.

The type of brake fluid you need will be listed on the lid of the reservoir or on the brake master cylinder. Most cars use Dot **3**, but we recommend you upgrade to **Dot 4** next time you have it changed because it resists moisture better. Pay attention to the fluid level and if you notice you are adding fluid often, have the brake system checked for leaks. And be careful not to get any brake fluid on the car's paint, because brake fluid makes a wonderful paint remover!

A good rule of thumb is to flush and change the brake fluid annually or every two years but check the levels every time you change the oil. This is a preventive measure and will help keep you safer on the road and prevent unnecessary wear and tear on brake parts.

What is a Brake Job Exactly?

A '**Brake Job' is** a term that describes any sort of repair to your brakes and depends on what you are having done. Knowing this lingo can help; and getting the distinctions of what it entails is more important, so you are prepared for the estimate and what is needed to be completed. It can range from simply replacing pads and discs to full replacement of all parts and fluid.

Here are some of the things that may be done when you get your brake job:

- Replacing disc brake pads
- Replacing rear drum shoes
- Resurfacing rear drums
- Resurfacing rotors
- Replacing rotors
- Bleeding brake lines (to get air out and put new fluid in)
- Leak detection
- Parking brake inspection

Additional work that may be required (and cost you extra) includes:

- New drum hardware also brake indicator wear sensors
- Replace or rebuild calipers and cylinders.

One Size Does NOT Fit All

Like shoes, brakes and brake pads come in all different sizes, shapes, and quality levels. And like shoes, the material used to make the pads makes a big difference in how each performs. Cheaper pads may do the job for the short term, but you may not be satisfied with how they perform and how they wear over the long haul. Although all brake pads must meet minimum safety requirements, the cheap ones won't last as long or work as well as the more expensive ones.

Rotors must be replaced when they fall below a thickness specified by safety regulations. They also must be replaced if resurfacing causes them to become too thin. Other reasons you may be required to get new rotors could be cracking, warping, groves or other damage that can prevent the rotors from working properly.

Brake drums are measured in diameter and have the maximum measurement stamped on them. If they are beyond that measurement, they must be replaced. Drums also need to be replaced if resurfacing causes them to exceed that measurement, if they are too misshapen to be resurfaced, if they are cracked or otherwise damaged.

Emergency Brake

The parking brake is a very important part of the safety mechanism in all vehicles. It acts as an emergency brake, which it is sometimes called, if the main braking system fails. In other words, you can pull the lever hard if your brake pedal isn't working, and it is designed to stop your car or prevent rolling when pared on an incline.

Even though most people with automatic transmissions don't use their parking brakes regularly, it is important to engage them every now and then just to keep the lines open and free of corrosion. Using the parking brake also helps the rear brakes adjust properly and maintains the self-adjusting components in caliper pistons.

The parking brake is simply designed. When the parking brake is engaged, it pulls cables or it is electric with sensors connect to a second set of brake shoes. This means both sets of shoes are pushing out against the drums causing extra force. If your vehicle has disc brakes, the parking brake pushes the pads against the rotor the same way the regular braking system does. Rear disc brakes sometimes have locking calipers. If this is the case, it is super-duper important to make sure the parking brake cable is properly adjusted. If not, the brake can drag or not allow the car to move acting as if it is engaged in the worst case, the brake may not stop your car.

One of the biggest problems your brake cables encounter is rust that is why newer cars use electronic sensors. Rust can create corrosion and lead to binding of the cables. If a baby's insides get bound up, it's not fun, and they cry. Similarly, your vehicle brake cables cannot work if they are bound and frozen. Even though the parking brake is not often used, if needed in an emergency, you need all the cables and equalizer links to be working properly.

Tips You AUTO Know About Brakes

Brakes can last up to 30,000 miles or be ready to be replaced in 8,000. It all depends on how you drive and under what conditions. These 10 tips will help you extend the life of your brakes, which is money saving.

1. **Speed Kills.** Hard stops from high speed are the mortal enemy of brakes. More speed hurts in a car accident more than you can imagine. Stopping from 65 mph rather than 55 mph forces the brakes to dissipate about a third more energy.
2. A vehicle motion is called kinetic energy. It's calculated by multiplying half the car's weight by the square of its speed. For the math-challenged, "the square" means speed is multiplied times itself. Brakes sacrifice their lives by turning energy into heat. A little less speed means a lot less kinetic energy — and brake material — needs to be transformed into heat.
3. **No Lefties.** Use only your right foot on the brake pedal. Ever see cars cruising at a constant speed — or accelerating — with brake lights illuminated? By braking with only your right foot, you'll avoid simultaneously pushing both pedals. Also, it'll be easier to resist unnecessary brake taps. That left foot wants in on the action.

4. **Be a Coaster.** Coasting is a surprisingly easy way to get rid of a lot of brake-killing speed. If you must stop at the end of a freeway off-ramp, coasting from 70 down to 50 before braking will significantly reduce brake wear. Time lost will be little or, if cars are queued ahead, none.
5. **Memory Factor.** Memorize places where other drivers inappropriately slow down. Examples include hills which come as a surprise and gentle freeway bends that have many mistakes for hairpin turns. Often, you'll have to coast down to their pace. Plan, and you might be able to change lanes around them. They'll re-pass you on the next downhill or straightaway, but you will have used less brakes and gas.
6. **Look Up and Save.** Look far enough ahead and you'll be able to correctly time stop lights, notice traffic backing up or see cars slowing on an incline that's just become visible. Look beyond the next traffic signal; check out the one after that and, in urban situations, the next and the next. To test how far ahead you look, draw a thin line at eye level on your windshield with a dry erase marker. On level roads, keep your focus above that line and use peripheral vision to position the car within your lane. Then erase the line before a cop asks you why it's there.
7. **Don't Join In.** Many drivers brake just because the vehicle in front of them did. And the first driver touched the brake for no good reason. It'll take a bit of practice to learn to coast when others brake inappropriately.
8. **Lose Some Weight.** Don't carry unnecessary items in the car. Math majors will point out that this won't make a big difference unless hauling barbells. However, some aftermarket parts — especially tires and wheels — can add a lot of weight. More significantly, consider vehicle weight before your next purchase. A heavier vehicle is harder on brakes. And tires. And gas.
9. **Flush It.** Brake fluid needs to be periodically changed. In mechanic-speak it's called 'bleeding and flushing'. Renew your brake fluid, especially if driving an older vehicle. Nothing is gained if you save brake material but the insides of the system rot away. Flushing the brake fluid will make the internal components last longer and the brakes work better. Know that brake fluid naturally attracts water. In an emergency stop or after repeated brake applications, this moisture boils and severely reduces braking effectiveness. Moisture also promotes internal corrosion, which ruins critical rubber seals. Some vehicle manufacturers recommend renewing brake fluid every couple of years. Brake bleeding is inexpensive, and – an easy task for a do-it-yourselfer.
10. **Upgrade.** Don't complain if bargain brakes wear out quickly, but don't expect the most expensive pads to last forever. Today's brake pads are extremely complex. They may contain a dozen or more components and are designed for specific uses. Brake material that best survives heavy-use, high-heat situations may perform poorly for drivers who emphasize economy. A good mechanic or auto parts store should be able to match your needs.
11. **Be Frugal, Not Foolish.** Trying to extend brake life too long will cost a lot of money. If metal touches metal, frugality becomes foolish. A good time to inspect brake material thickness is when tires are rotated.

*Do Not: Don't downshift save brakes. Transmissions (and clutches) cost a lot more than brakes. Race drivers downshift to be in the proper gear to accelerate out of the next turn. If experienced racers are downshifting to reduce speed, their brakes are failing.
*DIYers: With a wheel removed, it's easy to check disc brake pad thickness, as they're open for viewing. It's more difficult with drum brakes because the drum must be removed.

Chapter 10: ESSENTIAL #8 - Check Your Rubbers

[Tires - Hoses - Belts - Boots – Bushings]

Neglect will cause your vehicle to break down, get stuck on the road, waste your time as well as, waste your money. Rubber is used to transport fluids to each system and support the structure of your vehicle. Being Proactive offsets system failure. Check your rubbers.

- Belts and hoses, be sure to inspect every oil change. Check the belts and hoses to see if they are brittle, cracked, worn, swollen, frayed, glazed, show excessive wear, or movements are restricted.
- Tire pressure be sure to check every time you fill up with gas. Check tread for uneven wear, cuts, bruises, cracks, or bubbles on the side wall.
    - Low tire pressure indicates a tire has low pressure. Check the tire pressure and correct ASAP.
- TPMS (tire pressure monitoring system) When this warning light comes on and stays on when there is a problem with the tire pressure monitoring system. If this happens, the system may not monitor the tire pressure correctly.

Did You Know?

- 55% of drivers are comfortable checking their tires and tire pressure. However, that leaves just less than half that cannot tell if their tire treads are legal, and many cannot check tire pressure.
- It is estimated that 1.25 billion gallons of gasoline is wasted due to **improperly inflated tires** each year. This is a cost that can be easily avoided through proper vehicle maintenance.
    - Estimate time: 45 minutes
    - $50 Tire rotation every 7,500 miles
    - $350 - $700+ Cost of tire replacement

Tire Issues

Sometimes fixing the problem can be as simple as inflating an underinflated tire or by rotating the tires. Other times, it could involve a few hours in the shop and complete replacement of key suspension components. Either way, **ignoring these problems only makes things worse**. It won't fix itself.

A rough ride is a clear indicator that shocks or struts could be worn and in need of replacement. When every bump on the road makes your car bounce, that's an indicator of suspension problems and needs to get it checked out.

Try the bounce test, and be careful: When your car is parked, put all your weight on the front end, release, and observe how the vehicle responds. If it bounces back and forth 3 or more times, the shocks and/or struts are worn and need replacing.

An Engine Mount

There are mounts all over the engine to keep it stabilized and to keep it in place. The engine mounts are designed to support just that, the engine. They help maintain the engine to stay on the frame, kind of the same way a good belt or bra helps to support parts of a human body. If your engine mounts are worn or broken, the engine will vibrate and start accelerating. This will cause more weight to be put on other parts not designed to handle the excess weight.

An engine is so heavy that it can shift drastically enough to pull the other parts of the car out of place. If one part of the body isn't properly supported, this can cause damage to other body parts. Ask a chiropractor.

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Chapter 11: Evolution of Cars: Electric

Chapter

In this quick overview, we'll just touch on this extraordinary leap to the evolution from gas powered to electric cars.

Hybrids

Hybrids have an electric motor and a gasoline engine combined to achieve maximum fuel efficiency. How it works is quite simple. The electric motor in a hybrid vehicle acts like a power booster. This gives the engine additional power in the form of electricity, to perform functions that require more energy, like passing other vehicles. This means hybrid vehicles can use smaller, more energy efficient engines. Again, this all adds up to better gas mileage.

To save gas while idling, hybrids have an automatic shut-off feature that engages when the vehicle comes to a complete stop. The engine starts up again when the driver presses the gas pedal. And by assisting in the braking function, hybrid motors help alleviate some of the workload of the gasoline powered engine.

Unlike Electric Vehicles, with hybrids, there is no need to recharge. The hybrid motor doubles as a generator and converts any wasted energy into electricity, giving the battery the extra juice, it needs to keep it properly charged.

It's Electric

In this quick overview, we just barely touch on this extraordinary leap to the transformation of auto transport. Did You Know? The evolution of electric cars began more than 100 years ago.

This may be surprising, but the first prototypes of modern electric vehicles' creators had high hopes for evolution of this technology because this motor was invented much earlier than the internal combustion engine. Moreover, despite the rather indifferent attitude to the environment a century ago, engineers even then clearly understood that electricity is much cleaner energy and, in many ways, more productive than fossil fuels. People were aware of why electric cars are better for the environment.

1832, The First Stage of Evolution

In Aberdeen, Scottish inventor Robert Anderson created an electric vehicle prototype that was brought to life in the small carriage format with an evolutionary motor. This was the first example of how electric cars work.

1913, The Stage is Set

This year, Henry Ford launched a new assembly line for mass Ford T production. This leads to the fact that gasoline cars are becoming two or even three times more affordable than green vehicles, which manufacturers, in turn, have nothing to offer in response to Ford's success. Over the next decade, 15 million units of this highly affordable model would be sold. This was the first prerequisite and answer to the question of why electric cars are so expensive.

Evolution Continues

In the 1970's, the fuel crisis began in the world, caused by the leading world's countries' political conflicts. Fuel prices began to rise. In the 1990's, a regular state restriction wave and regulations concerning emissions of fuel engines once again prompted automakers to develop and green car evolution. In 1990, the world's largest automobile corporation, General Motors, introduced its conceptual electric car, GM Impact. This model's demonstration has become a kind of signal that green vehicles are returning to the interests of major players in this automotive market. However, at this stage, this electric car evolution did not receive rapid development.

2000, Significant Changes

The Toyota Prius becomes incredibly popular around the world. This model was successful thanks to the answer to this question of what that difference between hybrid and electric cars is. On hybrid cars, there is an internal combustion engine and an electric motor. This car was created to save fuel. According to various calculations, hybrids consume on average 20-35% less fuel than cars exclusively on gasoline and diesel.

Tesla, At the Forefront

In 2003, ambitious plans to resurrect the green car market and continue this evolution was announced by a private automaker from California - Tesla Motors. That first company's presentation is devoted to the Tesla Roadster, a sport's electric vehicle model. These first customers received their Tesla Roadster by 2008.

Overview on Electric Vehicles

In recent years, the automotive industry has undergone a significant transformation with the rise of electric vehicles (EVs). These eco-friendly, high-tech machines are changing the way we think about transportation and the environment. In this blog, we'll take a closer look at electric vehicles, their benefits, and their impact on our world.

Electric vehicles (EV) are automobiles that run on electricity instead of traditional gasoline or diesel fuels. They use electric motors powered by rechargeable batteries to move, eliminating the need for internal combustion engines. EVs come in various forms, including fully electric cars, plug-in hybrid vehicles, and even electric bicycles and scooters.

Benefits

- **Environmentally Friendly:** One of the most significant advantages of electric vehicles is their eco-friendliness. EVs produce zero tailpipe emissions, reducing air pollution and greenhouse gas emissions, which is vital for combating climate change.
- **Energy Efficiency:** Electric vehicles are more energy-efficient than their gasoline counterparts. They convert a higher percentage of the energy from the electrical grid to power at the wheels, leading to lower operating costs.

- **Reduced Operating Costs**: EVs have fewer moving parts than traditional vehicles, which means lower maintenance costs. Additionally, electricity is often cheaper than gasoline, resulting in lower fueling expenses.
- **Quiet and Smooth** Operation: Electric vehicles are known for their quiet and smooth operation. They offer a serene driving experience with less noise and vibration, contributing to a more enjoyable ride.
    - **Incentives**: Many governments offer incentives and rebates for EV buyers to encourage the adoption of clean energy transportation. These incentives can include tax credits, reduced registration fees, and access to carpool lanes.

Challenges of Electric Vehicles

Limited Range: Most electric vehicles have a limited driving range on a single charge compared to gasoline powered cars. However, advancements in battery technology are continually improving range capabilities.
Charging Infrastructure: The availability of charging stations varies by region, making long-distance travel a bit more challenging in some areas. Governments and businesses are investing in expanding charging infrastructure.
Limitations When cold: in frigid temperatures, usually around freeing or less, batteries become less efficient. This reduction in energy output, up to 40%, means recharging longer and more frequently.
Higher Upfront Costs: Electric vehicles have a higher upfront purchase price compared to their gasoline counterparts, primarily due to the cost of the battery. However, this cost is decreasing as technology advances.

Factoids You AUTO Know About EV's

- The United States Federal Government has pledged that all vehicles sold in 2035 and beyond will have zero emissions.
- Some municipalities offer reserved, or free parking for electric cars.
- Electric cars have the same torque at all speeds. You don't need to go through different gear changes for different speeds.
- They have full power at all speeds and offer a smooth ride from the get-go,
- This is ideal for stop-and-start city driving and traffic jams.
- It's easy to install a home charging station.
- EV owners spend less on maintenance.
- While EV are cheap to operate, expect higher utility bills.
- The advanced batteries in EV's while having an extended life, will wear out eventually. The estimated life is 12-15 years, or approximately 200,000 miles.

Chapter 12: DIY Tips, Safety & You

Opening the car hood

Sometimes opening the hood can be trickier than you think. There's more to it than just popping the lever inside the car. Knowing how to open the hood is the first step to showing others you know what you're doing. So go ahead and practice!

Safety first: Don't touch the hood if there is smoke or steam coming from underneath it. It's Hot.

Instructions:

1. Find the hood release handle near your knee when sitting in the car. Pull this handle firmly and use and see (and hear) the springs under the hood push the hood up an inch or so.
2. Take the remote starter or keys out of the car. If you're children, or anyone else, in the car or nearby, be aware and take extra care of the fob or keys to ensure it won't be triggered while having a look under the hood.
3. Stand in front of the car and feel under the front of the hood for a latch and a paddle switch. Crouch down and feel or look for it. You may use your flashlight on your phone to help locate. Push or pull the paddle switch to disengage the latch to raise the hood.
4. Find the supporting rod (if your vehicle has one) to prop the hood in an open position. There is usually a hole in the hood to insert the end of the supporting rod. Give it a little tug to make sure it is secure. If your car does not have a rod, the hood is made to stay up on its own. Ensure its secure first before working under the hood.

Taillights

Driving with a burned-out taillight bulb can be both dangerous and expensive. Getting a ticket, or worse yet, getting rear ended is no fun. Most of the time, we don't know a taillight is burnt out unless someone tells us. Taillights are quick and relatively easy to change, so go ahead and follow these steps.

What you will need:

- Screwdriver
- New, replacement bulb
- Gloves
- A friend, neighbor or family member who can reach the brake pedal.

To access the burnt-out bulb, remove the trim and covering behind the taillight itself. That will provide access to the back of the bulb or access to the lens housing area. Remove the lens (the red plastic that covers the bulb) from the body of the car.

Safety first: Bulbs are sensitive and can be contaminated when touched by hand. Always use gloves.

Instructions:

1. Open the trunk.
2. Find the access panel to the lights. Don't be alarmed if you don't see it right away. Sometimes the panel is well hidden, but it is always in the trunk somewhere. Look under the carpet and in the corners. If you still don't see it, check your owner's manual for the location of the rear/taillight panel.
3. **Note of encouragement:** Accessing the assembly is the most difficult part of this task. Once it's located, this will be much simpler next time!
4. Once the access panel has been located, see a small knob on the back that can be twisted by hand. It will remove the back side of the taillight where one can access all the bulbs.
5. Identify the bulb that needs to be replaced by asking the assistant (your friend, family member or neighbor) to start the engine and press the brake pedal. Turn the car off again.
6. Twist and pull the socket to remove the old bulb.
7. Remove the old bulb. For most cars, simply pull out the bulb, but in some cars, you must twist and pull the bulb out.
8. Check the electrical contact where the bulb connects in the socket to make sure it's not burnt**.** Insert the new bulb.
9. Twist the socket back into the assembly.
10. Pop the assembly back into the body and secure the panel closed.
11. Test the lights by asking your friend to turn on the car and press on the brake again. Make sure all the lights are working.
12. If you see someone driving with a burnt-out taillight, let them know. Well done!!

Is liquid residue A/C Condensation?

Have you ever been driving around on a hot summer day with the air conditioner (A/C) on, and you turn a corner and hear a swishing noise like water and…it splashes on your shoes or sandals? *What the heck is that?*

Your car naturally develops condensation while the air conditioning is running. Normally, that condensation drains out of the car and makes a puddle on the ground when parked. When the drain gets clogged, as it sometimes does, the water builds up a car's HVAC system. Hence, when making that turn, the water 'waves' can end up at or on your feet. It's an easy repair. All you need to do is simply clean the tube using air pressure.

What you will need:

- Air gun

Instructions:

1. Look underneath your car for a piece of rubber hose with an open end for the water to get out.
2. Grab an air gun and insert it into the end of the tube.
3. Blow in it.
4. That will do it.

Air Filters Help Breathe Easier

The air filter is the lungs of your engine, so make sure it is in good condition. Check it regularly and change the filter when it's dirty (at least once a year).

What you will need

- A screwdriver, possibly
- New air filter – find out which is needed from the owner's manual or from an auto parts store.

Instructions:

1. Open the hood of the vehicle.
2. Find the air box. It will probably be a rectangular, flat box with a large flexible hose coming from it.
3. This air box will have a few simple clips (or screws) that you can undo with your fingers or screwdriver. Undo them.
4. Pull off the top of the air box to reveal the air filter.
5. Take out the old and put in the new.
6. Secure the top of the air box in place.
7. Close the hood.

Fix-A-Flat – The Old-fashioned Way

Flat tires are the #1 cause of auto emergencies. Whether caused by a blowout at 70 mph or a slow leak from an embedded nail, a flat tire will derail your trip quickly. The key to changing your tire is to have the proper equipment. Most importantly, keep a spare or donut properly inflated and know where to find the jack and iron. In cars with trunks, these tools are usually found there. Many models have a hidden compartment in the trunk or cargo area where the spare, the jack and the tire iron are neatly stored. Sometimes they are hidden under the back seat. Why don't you take a couple minutes today and find out where yours is located and see what else you can find back there?

Note: over one-third of new cars no longer come with a space. This is done to help alleviate weight in modern vehicles.

Remember, these are just general instructions. Please read your owner's manual for the proper procedure for changing a tire on your model and make.

What you will need:

- Lug wrench (wheel nut wrench)
- Tire iron
- Jack – an actual car jack
- Wheel chocks or bricks
- Pry bar or large screwdriver (if your car has hubcaps)
- Rubber mallet (if your car has hubcaps)
- Wheel lock key (if applicable)
- Gloves

Safety first: Always keep the emergency brake on while changing a tire and use the vehicle's flashers.

- Never go underneath a vehicle supported only by a jack. The jack could slip or break. Slide the spare under the car frame as a back-up- safety mechanism while it's jacked up, then slide the flat in place of the spare when you change the tire.
- 086% of roadside accidents happen because people do not see vehicles on the side of the road. If you have flares in your emergency kit, this would be a good time to use them. At the very least, put on your hazard lights and pop the hood so it's easier for drivers to recognize that you are stopped.

Instructions:

1. Pull over to a safe area, preferably on a hard, level surface.
2. Apply the parking brake and remove the key from the ignition. Or fob from the vehicle.
3. Place a wheel chock or brick in front of the wheel on the opposite side of the flat tire. A large chunk of wood or a tree branch works in a pinch. You want something to prevent the car from rolling away.
4. Carefully take out the spare tire (it can be heavy), lug wrench, and tire jack.
5. Set out a reflective signal behind your car like a flare or use a make-up mirror.
6. If your car has hubcaps, remove them using the pry bar, tire iron, or screwdriver.
7. Loosen lug nuts with lug wrench **BEFORE** you raise the car (righty tighty, lefty loosey). Do not remove them completely. Just loosen them enough so that you can easily twist off later.
8. Check your vehicle's instruction manual to find the right place to put the jack in position. Align the jack with its matching jack notch under the car. It will fit like a puzzle piece. Slowly and steadily raise the vehicle until the tire is slightly above the ground. Jacking takes a while so be patient and check to see if the jack stays in place.
9. Consider sliding the spare under the car frame to act as a back-up just in case the jack falls.
10. Once the car is elevated, remove lug nuts with your lug wrench and place them where you won't lose them.
11. Remove the flat tire, place it safely aside or slide under the car in place of the spare, and place the spare tire on.
12. Hand-tighten the lug nuts onto the rim as far as possible. Wiggling the wheel will help in doing this.
13. Tighten the lug nuts with the lug wrench following a star pattern. This sequence helps balance the tire and prevents one side from being over-tightened.

If you have 4 or 6 lug nuts, tighten the first nut, then the opposite nut, then the one clockwise to the right and finally the one opposite (and 2 more if there are 6). If you have 5 lug nuts, follow a star pattern.

14. Remove the flat from under the car and lower the car slowly to the ground by releasing the jack.
15. Use the lug wrench again to tighten the nuts as much as possible. Stand on one end of the lug wrench if you can.
16. Replace the hubcap (if there is one) and gently hammer the edges with a rubber mallet to secure it.
17. Return the damaged tire, jack, lug wrench, and any other tools used to their proper storage area. Now get on your way!
18. As soon as you can, go to a repair shop and have the lug nuts properly tightened.

Note: If you're spare tire is smaller than your other three tires, it is only intended to be used as an emergency spare. Drive at moderate speeds until you have the full-size tire repaired and replaced back on your car.

Cooling Off with Radiator Fluid/Coolant

Automobile engines are made up of lots of little parts that move against each other thousands of times a minute and build up friction (friction = heat). Radiator fluid, or engine coolant as it may be called in your owner's manual, cools the engine down so it doesn't overheat.

Check your radiator fluid once a month. Always have a minimal amount of radiator fluid on hand in the garage in case the levels are low, and you need to add some. While it's normal to lose some fluids periodically, have it checked by a technician as soon as possible if you find yourself having to add engine coolant too often. This can be a sign of a more serious problem and having it repaired quickly will prevent further damage to your car's engine.

What you will need:

- Paper towels and a rag

Instructions:

1. Find the dipstick for the engine coolant. Your owner's manual will tell you where it is and what the proper level of the fluid is for your car.
2. Take out the dipstick and wipe it off. (You do this to clean it, so you get an accurate reading the second time.)
3. Replace the dipstick and make sure it is pushed all the way back in place.
4. Take it out again and check the level against the markings on the dipstick.
5. Replace the dipstick.

Motor Oil

Motor oil keeps engine parts lubricated and functioning properly. Check and change your oil regularly, especially before a long trip because it is the lifeblood of the engine. When the oil is not clean, the engine works harder and wastes gas. If it looks like chocolate syrup, go ahead and schedule that oil change. Also have your engine checked out if you're losing more than a quart every 1000 miles. It can indicate something is wrong.

Checking your oil is super simple and takes about one minute. Make it a habit of checking your oil every two weeks. Don't wait until the "*check oil"* light come on or hear clunking from the engine. Preferably check the oil level when the engine is cool, or at least 30 minutes after the car was last driven. It's best if your car is parked on a level surface rather than an incline.

What you will need:

- Paper towel or rag
- To add oil: purchase the correct type of oil for your car and a funnel (a paper funnel from a gas station works well)

Safety first: Turn off the engine when checking and adding oil.

Instructions:

1. Open the hood.
2. Find the oil dipstick handle. In most modern cars, it is a brightly colored handle conveniently labeled “oil.”
3. Pull out the dipstick.
4. Wipe the dipstick with a paper towel or rag to clean it so you get an accurate reading.
5. Replace the dipstick and make sure it is pushed all the way back in place.
6. Remove the dipstick again.
7. Hold the dipstick horizontally and examine the end of it.
8. At the end of the dipstick, see markings and some oil. The markings will usually be two notches, two holes, or a range of hash marks. The top of the oil line should sit between the two markings on the dipstick.
9. Add oil if the oil level reads low. Do it right away if you can’t see any oil on the dipstick. (See instructions for adding oil below.)
10. Replace the oil dipstick and make sure it’s in all the way.

Instructions for adding oil:

Check the owner’s manual for the type of oil your vehicle requires. On the top of the engine, you should see a cap with a symbol of an oilcan or the word “oil.” This is where to add the oil. Only put in a little at a time and continually check the level using the dipstick to not overfill the oil.

1. Remove the oil fill cap from the engine.
2. Place a funnel in the hole.
3. Pour 1/2 a quart of engine oil into the funnel.
4. Wait a minute.
5. Recheck the oil fill level.
6. If the oil level is still under the lower indicator, repeat steps 3-5. Remove the funnel and replace the oil fill cap.
7. Start the vehicle’s engine and let it run for a few minutes.
8. Stop the engine.
9. Check your oil fill level once more. Make sure the level is still between the two marks.
10. When the oil level reads full (or you at least have enough oil in there to get to the store to buy more), replace the cap and close the hood.

The Battery

A dead battery is usually the culprit if your car won’t start if you have no lights or no radio. You might hear a small ‘click’ when attempting to start the engine. Any number of things can cause the battery to die. Maybe the dome light was left on or the glove box open for a few hours - or days - and it drained the juice. However, if it happens more than once and there’s no evidence of a light left on or another cause, have the battery checked by a technician. It may need to be replaced.

What you will need:

- Jumper cables
- Another vehicle - that runs.

Don't own a pair of jumper cables? For around $30, purchase a good set that can be stored in the trunk or next to the donut or spare tire. Even if you never use them, you're guaranteed to be the hero for someone sometime.

Safety first: There is a very slight possibility of an explosion when jumping your battery. No, we don't want to scare you, rather to inform you so you're aware. Hydrogen gas forms as a battery discharge and loses its fluid. Hydrogen gas is flammable, so a spark from the battery cables could set it off. Major emphasis on the ***slight possibility*** because the gas would have to be dense around the battery for an explosion. This is possible if the battery has been sitting for a long time with little or no air circulation. So, why not just raise the hood and let the engine breathe for a few minutes?

Instructions: Connecting the Cables

1. Park the booster vehicle (that's the one that is running) close to the one that needs to be jumped, but never allow the vehicles to touch.
2. Turn off the ignitions of both vehicles, set the parking brakes, and make sure that both are in either "Park" (automatic transmission) or "Neutral" (manual transmission). Also, turn off all accessories like lights and radios in both vehicles. If the vehicle and you are in a safe area, turn off the hazard flashers, too.
3. Check to see if the battery terminals on either vehicle are corroded. If so, you may want to scrape them with an abrasive such as steel wool to get a solid connection. Don't touch the corrosion with your bare hands. See Safety Tip #7 in this chapter.
4. Clamp one of the positive jumper cable ends (**red**) to the positive battery terminal (labeled with a "**+**" on the battery) of the dead vehicle. Be sure the connection is strong with the clamp securely "biting" onto the battery terminal.
5. Connect the other end of the positive cable (**red**) to the positive battery terminal on the booster vehicle (again, confirm that a "**+**" is next to the battery terminal).
6. Connect the negative cable end (**black**) to the negative battery terminal on the booster car (marked with a "**-**").
7. Finally, attach the other end of the negative cable (**black**) to the negative battery terminal of the dead car. If you don't see the negative terminal, attach the clamp to an unpainted metal surface on the engine of the dead car. Find an unpainted bolt or bracket that is as far from the dead battery as possible.

Safety first: When connecting the jumper cables, make sure they don't dangle into the engine compartment where they could get caught on moving parts (belts, fan, etc.).

8. Start the booster car. Let it idle. If the dead battery is new and was drained by the lights being left on for an extended period, it will probably start immediately after a minute or two. If it is an old battery or it has sat for a long time (more than a month) it will probably take longer to charge it sufficiently.
9. Start the dead vehicle and let the two vehicles idle for a few minutes while connected by the cables. If the dead vehicle refuses to start, don't keep trying or you might damage the starter. If there is the possibility of additional problems, like a lack of fuel, resolve those other issues before trying to start it again.

Disconnecting Cables:

10. Once the dead vehicle is started and running smoothly disconnect the jumper cables in the **reverse** order that they were connected. As you disconnect them, **be careful not to let the dangling cables fall into the engine compartments or touch each other.**
11. Drive the revived car somewhere safe before shutting off the engine. Depending on the battery's condition, it might need to be jumped again. Stay in safe, lit places.
12. After the car starts, let it run for 20 minutes to recharge the battery. Better yet, attach it to a certified battery charger and leave it connected for at least 12 hours. You can also take it to an automotive repair shop for complete charging.

Wiper Blades

We love choices, right? Here's one for your wipers: You can replace the entire blade, which is the complete assembly including the metal frame and the insert. Or replace just the insert (squeegees) of the wiper blades, which is less expensive. It's a few dollars more to replace the blade but is faster to install and provides you with the benefit of better contact with your windshield.

Wiper blades should be replaced when they are cracked, torn, chattering, or not wiping properly. Before replacing the wipers, try cleaning them with windshield washer fluid and a paper towel—maybe they're simply dirty! Every season, check all wipers (for the front windshield, for the rear window, and for the headlights if your car has those). Wiper blades usually last about a year.

Before you toss the old ones away, measure how long they are to remember what size to purchase. Sometimes, the driver and passenger sides are different sizes. Tricky! You can also find this information in the owner's manual or look for blades at the store that fit your car's year, make, and model.

The owner's manual will also explain how to remove the wiper blades and replace them. Some models simply snap on and off, blade and all. Others need to be threaded across the length of the blade and are more tedious. Just because your manual calls for a particular kind of wiper blade doesn't mean that your car won't function with a different one. If your car has a wiper blade that is difficult to change, ask the auto parts store if there are compatible models.

Regardless of which option you choose for replacing the wiper, test them out before driving away. Once the new ones are on, you can pretty much guarantee it won't rain for months. Just kidding. Be sure to fill the wiper fluid reservoir just in case.

Safety first. Always keep wiper fluid in your car and change the wiper blades every year or when they leave that annoying streak on your windshield!

Replacing the Air Cabin Filter

What you will need:

- Screwdriver
- New in-cabin micro-filter

Instructions:

1. Remove both the upper and lower screws of the glove box assembly.
2. Remove the console side finisher.
3. Disengage the filter cover tab to remove the filter cover.

4. Remove the in-cabin micro filter from the blower unit by using the pull tab on the bottom of the filter.
5. Replace with the new in-cabin micro filter and reinstall the cover on the blower unit.
6. Reinstall the glove box assembly.

What to do if You Blow a Fuse!

If any part of the electrical system of your car behaves oddly and some things aren't working (e.g., lights, dashboard gauges, radio, CD player, etc.) the problem may simply be a blown fuse. And it's easy to fix, too!

What you will need:

- About 5 minutes
- This guide and instructions

Instructions:

1. Turn off the car.
2. Locate your fuse block inside the vehicle. The owner's manual will tell you where to find it. The fuse box is usually near the driver's knee under the dash.
3. The fuse box will have a cover. The inside of the cover typically holds extra fuses, a fuse removal tool, and a map to tell you which fuse controls what system in the car. And don't worry, it's easier to read than a road map.
4. Find the blown fuse. Fuses have a wire inside a clear plastic case. There should be a break in the wire of the blown fuse.
5. Replace the fuse with a new fuse of the same rating (they are color coded, so just look for the same color).
6. Start the car and test the system that wasn't working.
7. Replace the fuse box cover.
8. Visit an auto parts store to replace the spare fuse you used so you have it for next time.

Headlight Position

Headlights of a car are to be pointed at the road. If they're shining into the depths of the night sky or too low on the ground, they will be a detriment to the driver, as well as others on the road. Seriously, changing out headlights takes less than three minutes.

What you will need:

- Screwdriver
- Wall, fence, and garage door

Instructions:

1. Park the car on a flat surface facing a wall so you can see where the headlights are shining. Any garage, fence, or building will do. Park your car about 25 feet from the wall and turn the headlights on.
2. Locate screws on the headlight assembly itself. They are aptly named "adjusting screws."
3. Tighten and loosen the adjusting screws to raise and lower the headlight beam. Sit in the driver's seat and see where the lights are pointing. If they are aimed too low or too high, keep adjusting. When they are shining directly straight ahead, you're good to go!

4. If the lights are not aligning no matter how you turn the screws, check, and make sure the headlights are mounted on the car correctly.

Clean and Oxidize Headlights

Enhance visibility tremendously by cleaning and oxidizing the car's headlights.

1. Before beginning, make certain you're working with a clean surface. Spritz your headlights with a mild cleanser and gently wipe away any dirt, particularly, dead bugs, and gunk that may have accumulated on the surface.
2. After cleansing, wipe down the surface with a dry towel or rag. Make sure it's moisture-free.
3. Distribute a fair amount of cleanser - this is the product from the headlight restoration kit, toothpaste, or baking soda – and apply it on thick over the headlight lenses. If you're using baking soda, you'll want to have mixed it with a small amount of water first to make a thick paste. Leave your cleanser on the lens for a few minutes to allow it to dry just a bit.
4. Using circular motions, work your way around the surface of the headlight gently with your brush. Remember, the cleanser you're using is abrasive, so be careful not to gouge into the plastic surface. Notice the yellowness or fogginess disappears from the lens as you work your way around it.

5. Using a clean rag or towel, buff away any residual cleanser from your lens. Spritz any stubborn, dried bits with clean water and then polish until dry with your towel. It's as simple as that. Once you've cleaned up your headlights, you should immediately notice increased visibility and brighter, whiter headlights.

Stopping Rust

Even though rust is common, it is also relatively easy to stop. The key to keep rust from spreading is to detect it as early as possible and treat the affected area thoroughly.

Safety first: When using the oxide conversion fluid, wear safety glasses and gloves. Be sure to avoid getting the fluid on any other parts of the car, like plastic components, bumpers, or mirrors.

What you will need:

- Sandpaper
- Abrasive cloth
- Clean rags
- Gloves
- Safety glasses
- Paint brush

Instructions:

1. Remove as much of the rust as possible. In cases of extensive rust, begin with a coarse file or coarse sandpaper. Gradually work down to finer sandpaper grades. In cases of light rust, start with fine sandpaper and move to an abrasive cloth. Use water to reduce friction and a clean rag to wipe away loose rust.
2. Clean the area, then put gloves and protective eyewear on.
3. Neutralize the remaining rust using an oxide conversion fluid. Locate this product at most auto parts stores. Put a little of the product on the paint brush and apply it to the rust spot. Don't use too much, just enough to cover the area.

4. After the conversion fluid has dried, clean the entire area using a soft, clean cloth and water.
5. The area where rust was removed will be susceptible to new rust forming, so now the metal needs to be protected. Apply several coats of paint or protectant to the surface. When adding the top few layers, gradually extend the coverage area to ensure you're applying a new protective coat to the areas near where rust formed.
6. Keep the area clean. Rust tends to form where debris collects because the moisture erodes the metal's original finish, exposing it to the elements. Occasionally wipe the newly rust-free area with soapy water and a soft cloth or sponge.

Note: Distilled water and vinegar work well to remove rust stains if the rust has discolored areas near it.

Tire Pressure

Want to save money? Make sure to have and maintain the correct tire pressure. Save up to 10% on fuel consumption, tires will last longer. And the air is free! (In most places). Have a look at your tires every time you fill up with gas and check the pressure if any of the four-look low. Otherwise, check the pressure at least seasonally. Tire pressure will drop when it is cold outside.

What you will need:

- Tires
- Tire pressure gauge
- Air compressor

Instructions:

1. Find out what the tire pressure for your car model should be by checking the sticker on the driver's side door jam
2. Unscrew the black tip on the tire nozzle. (Don't lose it.)
3. Press the tire pressure gauge onto the nozzle to get a reading. If you hear a hissing sound, the reading won't be accurate, so try again.
4. If necessary, add air with your portable air compressor or go to the gas station or auto shop. Check the pressure using the gauge to make sure the target has been reached. Release some air if the pressure is too high.
5. If you hear air leaking from the tire as its' being added, you have a hole in your tire and that's a different problem altogether.
6. Be sure to replace the nozzle cap before driving away

Check engine light. If the engine light comes on, this means it is an emission issue; if the light flashes, the problem is more severe and must be checked immediately. It can mean various things, from a loose gas cap to a misfire in the engine.

Supplement: Visual Anatomy of Vehicles

We trust this guide was of assistance and help to you. Save it in your phone for quick access and reference. In final, this chapter provides readers with a visual of:

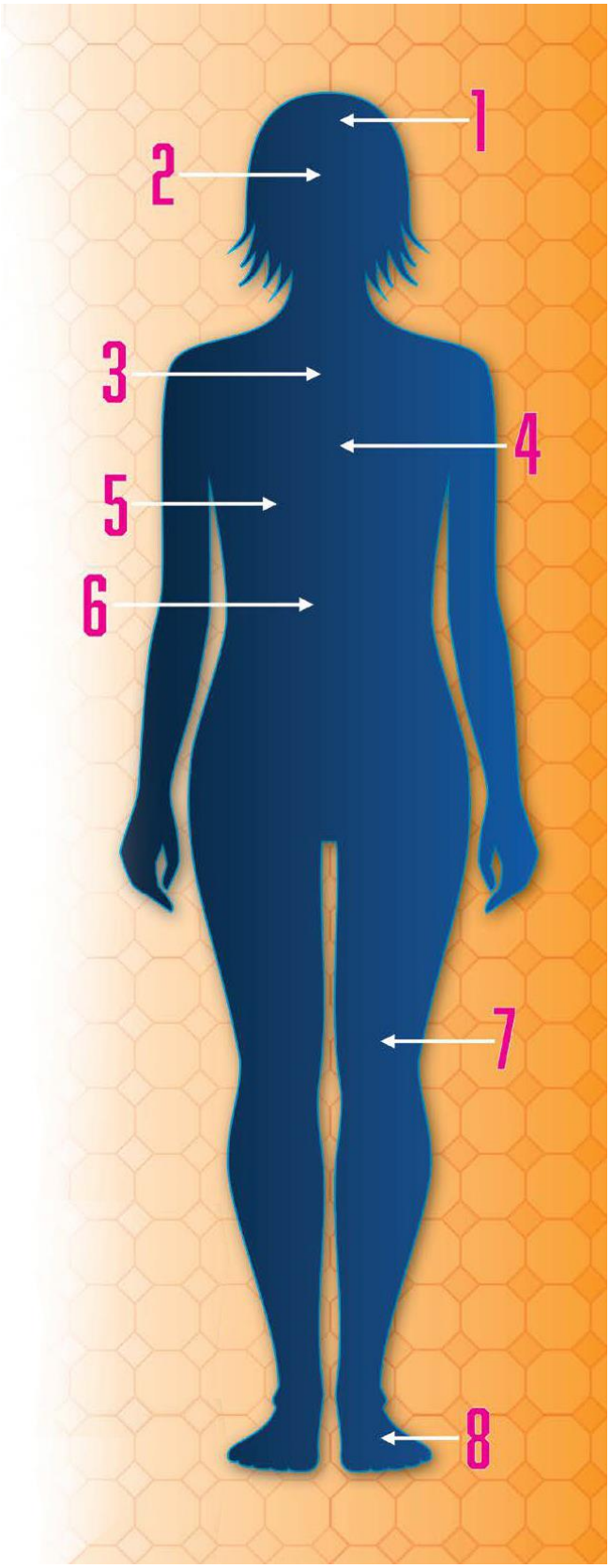
- Parts of the vehicle
- What they do
- What essential human anatomy each part corresponds to

Cars have come a long way. The automobiles of yesterday are truly antiques in the repair sense. Gone are the days of warming up an engine, lubing the ball joints and tuning up breather elements. Today's vehicles are designed to be more efficient, more reliable and more cost effective than ever. Ball joints and front-end fittings are all sealed now.

Tune-ups that used to cover all the rotors, plugs, PVC valves and wires are almost non-existent due to upgrades in engine mechanics. Replacing these components usually doesn't happen until after 30,000 miles, and in some cases, after 100,000.

Remember, regular maintenance tune-ups that occur on today's vehicles consist mostly of replacing and checking fluids and filters. **The following are the most common items checkout out at the repair shop:**

- Oil and Oil Filter
- Coolant/Antifreeze Check and Flush
- Brake System Flush
- Transmission Fluid Change and Check
- Differential/Gear Box/Transfer Case Services
- Power Steering Fluid Change and Check
- Tire Rotation & Balance.
- Air Filters Check and Change
- Fuel Filters Check and Change
- HVAC Filters (Cabin filters)
- Spark Plugs



Other items that are commonly addressed*:*

- Belts and Hoses
- Alignment
- Headlight operation and direction
- Tire pressure
- Battery Charge

[Go to Next Page for]

Visual Part References & How They Correspond to the Human Body

BRAIN & IMMUNE SYSTEM

a network of cells, tissues, and organs that work together to defend the body against attacks by "foreign" invaders

ENDOCRINE SYSTEM

the collection of glands that produce hormones that regulate metabolism, growth, and development

ELECTRICAL SYSTEM

works to deliver and monitor electrical power to various devices and sensors while under control of a computer system

FUSE BOX

a box that holds fuses that ward off an overload to various electrically powered systems and accessories in the car

GAUGE

gauges are visible measuring devices and indicators, and dash lights are messages, such as low gas, check engine. etc. to keep constant communication with the driver

GAUGES & DASH LIGHTS

gauges are visible measuring devices and indicators, and dash lights are messages, such as low gas, check engine. etc. to keep constant communication with the driver

HORSEPOWER

the amount of power the engine produces

IGNITION COIL

Also known as a spark coil; transforms the battery's low voltage into high voltage needed to create an electric spark in the spark plugs to ignite the fuel

IGNITION WIRES

also known as spark plug wires; transfer the spark from the ignition coil to the spark plugs that ignite the air/fuel mixture needed to start the engine

LYMPHATIC SYSTEM

the network of vessels through which lymph drains from the tissues into the blood

NERVOUS SYSTEM

the network of nerve cells and fibers that transmits nerve impulses between parts of the body

OXYGEN SENSOR

mounted in the exhaust manifold to monitor how much unburned oxygen is in the exhaust as it exits the engine

1  **RELAY**

a device that allows you to control a high-current electrical load with a low-current electrical signal

1  **SCANNER**

tools used for assessing what may be wrong with the vehicle when a problem arises; can be plugged into information ports built into the vehicle

1  **SPEED SENSOR (VSS)**

used for reading the speed of a vehicle's wheel rotation

1  **TIRE PRESSURE**

a measure of the amount of air in a vehicle's tires

1  **VEHICLE COMPUTERS**

in charge of monitoring engine emissions, and adjusting the engine to keep emissions as low as possible for optimal efficiency

1  **VEHICLE SENSORS**

internal measurers of different car functions, such as oxygen levels, water sensor, etc. to maintain systems functionality

2  **TAIL LIGHT**

a red light at the rear of a motor vehicle

2  **VISION**

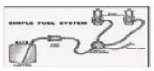
tail light, brake light, windshield wipers, headlights & lens

2  **WIPER BLADES**

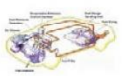
used to remove rain, snow, ice, and debris from a windshield

3  **COWL**

windshield and houses the wipers.

3  **DIGESTIVE SYSTEM**

converts food into energy and basic nutrients to feed the entire body

3  **FUEL SYSTEM**

admits fuel into an internal combustion engine; the prime fuel delivery system

3 INDIVIDUAL HEALTH RECORD

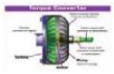
VIN (vehicle identification number), year, make, model, body

3  OWNERS MANUAL

The answer key to your car! This instruction manual details the workings of the car's parts and features, maintenance schedules, DYI and troubleshooting

3  STATE INSPECTION

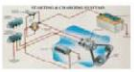
when a vehicle is inspected to ensure that it conforms to regulations governing safety and/or emissions

3  TORQUE

twisting, rotational force generated by the engine

3  VIN

vehicle identification number; 17-digit code that serves as

4  STARTING & CHARGING

engine, battery

4  ALTERNATOR

a generator that produces an alternating current. Alternator charges the battery, which charges the alternator

4  BATTERY

a storage cell for energy

4  HEART

central organ that pumps blood through the circulatory system

4  STARTER

harnesses the power of the automotive battery; once the ignition has started the vehicle, a small amount of current flows through the neutral safety switch and into the starter relay

5  A/C COMPRESSOR

the "heart" of a car's air conditioning system; pressurizes the gas (cooling agent) under high temperatures, and passes it along its respective system

5  A/C CONDENSER

a radiator-like piece of the car, it takes the gas and releases the heat built up in the compressor, cooling it down and converting it into a high-pressure, cool liquid

5  **AIR FILTER**

stops airborne contaminants (dust, pollen & debris) from getting sucked into the car's engine

5  **AIR INDUCTION**

the process of delivering compressed air to the intake of an internal combustion engine so the engine can breathe

5  **CABIN AIR FILTER**

attached to the air-conditioning and heating system, and is the last line of defense in preventing air contaminants and particles from entering the interior of the car

5  **CATALYTIC CONVERTER**

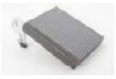
part of the exhaust system, it contains a catalyst that converts toxic pollutants into less harmful ones

5  **CHARCOAL CANISTER**

charcoal placed inside a canister that absorbs harmful fuel vapors so that they are not emitted into the atmosphere; they are later purged out and burned

5  **EGR VALVE**

exhaust gas recirculation; recirculates exhaust gas back into the engine cylinders to lower emission (NOx)

5  **EVAPORATOR CORE**

part of the air conditioning system; the final step of the process, it takes the freon from the ac compressor and pulls it into a vacuum, making the gas cold

5  **EXHAUST**

waste gases expelled from the engine

5  **EXHAUST MANIFOLD**

responsible for collecting exhaust gas from the engine's cylinder heads and sending it down to the exhaust pipe; also prevent toxic exhaust fumes from entering the cabin

5  **EXHAUST SYSTEM**

A system of piping used to guide reaction exhaust gases away from a engine

5  **EXTENSION PIPE**

the pipe through which exhaust gases from an engine are discharged

5  **FRONT PIPE**

external the part of a motor vehicle that supports the windshield and houses the wipers.

5  **INTAKE MANIFOLD**

part of the engine that supplies the fuel/air mixture to the cylinders

5  **OIL FILTER**

designed to remove contaminants from engine oil

5  **RESIGNATOR PIPE**

tunes the car exhaust sound into a note that is not brutal to the ears

5  **RESPIRATORY SYSTEM**

a series of organs responsible for taking in oxygen and expelling carbon dioxide. the primary organs are the lungs, which carry out this exchange of gases as we breathe

5  **TAIL PIPE**

the rear section of the exhaust system of a motor vehicle; where the exhaust gases from the engine are discharged

5  **URINARY SYSTEM**

produces, stores, and eliminates urine, the fluid waste excreted by the kidneys

6  **BATTERY COOLANT**

a generator that produces an alternating current. Alternator charges the battery, battery charges the alternator

6  **BRAKE FLUID**

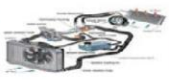
a hydraulic fluid used in brake system; transfers force into pressure to amplify braking force

6  **COOLANT**

aka: antifreeze; protects the internal engine parts and keeps the engine from overheating and freezing

6  **CIRCULATORY SYSTEM**

the system that circulates blood and lymph (fluid containing white blood cells) through the body

6  **COOLING SYSTEM**

the system that circulates blood and lymph (fluid containing white blood cells) through the body

6  **DRAIN**

allows built up condensation of water or other liquid run out

6  **ENGINE/TRANSMISSION**

the engine burns gasoline into motion so that the car can move, and the transmission is the mechanism by which power is transmitted from an engine to the wheels of a motor vehicle

6  **FLUID**

aka: antifreeze; protects the internal engine parts and keeps the engine from overheating and freezing

6  **FREEZE OUT PLUG**

a generator that produces an alternating current. Alternator charges the battery, battery charges the alternator

6  **HEATER CORE**

a heat exchanger between coolant and cabin air.

6  **POWER STEERING FLUID**

fluid pressurized by a small hydraulic pump powered by the engine that makes turning the vehicle easier; increase the ability of the steering mechanism to direct the tires

6  **RACK & PINION**

used for the steering system; converts the rotational movement of the steering wheel into the linear left-right movement of the wheels

6  **RADIATOR**

where heated coolant flows through, and then is returned to the engine

6  **THERMOSTAT**

where heated coolant flows through, and then is returned to the engine

6  **TRANSMISSION**

the mechanism by which power is transmitted from an engine to the wheels of a motor vehicle

6  **WASHER FLUID**

fluid used for cleaning the windshield with the windshield wiper while the vehicle is being driven

6  **WATER PUMP**

circulates water and coolant throughout the engine compartment, keeping the engine from overheating; located in the cooling system.

BALL JOINT

connects the control arms to the steering knuckles

BEARING

set of steel balls held together by a metal ring, helping the wheel spin with little friction; it supports the wheel and goes inside the hub

BRAKE CALIPER

meant to slow the car's wheel by squeezing the brake pads to the brake rotors; essential to the car's ability to stop

BRAKE PADS

the pieces that apply pressure and friction to a car's brake rotors

BRAKES, STEERING, SUSPENSION

No matter how cat-like your reflexes are, if your vehicle's brakes aren't working properly, you're in trouble. We check your brakes, steering, front end and suspension to make sure your vehicle's reflexes are as good as yours are.

CHASSIS

the structure, base frame of a motor vehicle

CONTROL ARM

connects the front suspension of the car to the frame of the car

DRIVE AXLE

important for driving, braking, and steering the car; main purpose is to transfer the engine power and torque from the transmission to the drive wheels

DRIVE SHAFT

converts the torque generated by the engine into usable force to propel the vehicle

HUB

what the bearing on the wheels ride on, and what the axle shaft goes through; 25% of the car's weight rests on it

JOINTS & MOBILITY

MUSCULAR SYSTEM

a system that permits movement of the body

7  **REFLEXES**

involuntary actions performed as responses to stimuli

7  **SHOCK**

used to reduce the impact of the road, an effect of traveling over rough ground, improving ride quality and vehicle handling

7  **SKELETAL SYSTEM**

the frame is the body of the car, and the chassis is the frame plus the "running gear", such as the engine and transmission

7  **SPRING**

allows the wheels to move up to absorb bumps in the road and reduce jolting

7  **STRUT**

used to absorb road shock or bumps by assisting or dampening the spring

7  **TIE ROD END**

the adjustable end to a tie rod, which is a pivot point between the steering system, steering arm, and the wheel. the tie rod end is used to fix the vehicle's alignment

7  **UNIVERSAL JOINT**

part of the driveshaft that connects segments to it. They are important for the engine being able to spin the rear wheels

7  **WHEEL**

rubber, circular shaped ring that provide traction between the vehicle and the road, which provides a flexible cushion that absorbs shock; covers the rim

7  **WHEEL RIM**

makes up the outer circular design design of the wheel on which the inside edge of the tire is mounted on vehicles

ACCESSORY BELT(S)

a single, continuous belt used to drive multiple accessories in an automotive engine, such as the a/c compressor, power-steering pump, water pump, and alternator

CONTROL ARM BUSHING

as a car moves over rough or bumpy surfaces, your bushing allows your suspension parts to move easily.

HEADGASKET

important for driving, braking, and steering the car; main purpose is to transfer the engine power and torque from the transmission to the drive wheels

MOTOR MOUNTS

made of rubber and steel, secures the engine and transmission to the frame, and also absorbs the road shocks and engine vibrations so that the driver does not feel engine movement

RADIATOR HOSE

connects the bottom of the radiator to the water pump of the engine, which keeps coolant flowing through the system

REAR MAIN SEAL

the seal that goes around the crankshaft at the rear of the engine

RUBBERS

tires, belts, hoses, boots, bushing

TIMING BELT

part of the internal combustion engine that synchronizes the rotation of the crankshaft and the camshaft so that the engine's valves open and close at the proper times