With proper maintenance, you can double and even triple the life of your car and avoid inconvenient or dangerous breakdowns.

All links included here were reviewed and updated October 28, 2019.
Disclaimer

• I am *not* a certified mechanic.
• I’ve never had training as a mechanic.
• I have maintained my own cars.
• The pictures in this presentation were copied from various websites.
• I’m not being paid to endorse any product or websites seen here.
“How Cars Work: An Illustrated Guide to the 250 Most Important Car Parts” by Tom Newton

Available at: https://www.amazon.com/How-Cars-Work-Tom-Newton/dp/0966862309/

Highly recommended. One topic per page. About a half page of text and a half page of pictures.

Written for high school students. Perfect for English as Second Language.
There are a variety of ways to maintain your car. You can take it to the shop on a routine schedule and let professional mechanics fix whatever needs fixing or, you can learn as you go and fix everything yourself. How you choose to maintain your car will fall somewhere between these two extremes. This workshop is designed to introduce you to some Do-It-Yourself maintenance items that are both easy and a little more involved.

Maintaining the Machine

- Follow maintenance schedules.
- Listen to and feel your car’s performance.
- Do something at the first sign of trouble.
- Prevent or fix minor problems before they become big problems or cause an accident.
- Ensure the safety of you, your passengers, and others on the road.
Examples of shops in the Ann Arbor area:

General: (Names are too variable to provide a general idea.)

Collision: Maaco Collision, Whitney’s Collision, Dusty’s Collision

Tires: Belle Tire, Discount Tire, Firestone, Goodyear, Michelin Tire

Transmission: AAMCO Transmissions, Lou’s Wolverine Transmission, Ann Arbor Transmissions

Quick Lube: Uncle Ed’s Oil Shoppe, Victory Lane Quick Oil Change

Muffler: Midas, Tuffy, Mr. Muffler

Dealerships: Dealerships may have additional qualifying name, e.g., Varsity Ford, Gene Butman Ford, Dunning Toyota, Howard Cooper (Honda)

Auto Parts: NAPA, O-Reilly Auto Parts, Advance Auto Parts, AutoZone...
American cities are zoned as residential and commercial.

Car dealerships and repair shops can be found somewhat randomly around town in or on the borders of the commercial areas - not in residential areas.

There is no centralized “Automobile repair zone”.

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Where Do You Find...?

- Google Maps search
  - ann arbor auto repair
  - ann arbor auto service
  - ann arbor tires
  - etc...
- Ask friends and colleagues – word of mouth referrals
Sometimes you will take your car in to fix one thing and the mechanic will come out and say he found some other problems. Do you want them fixed now?

First, get details about the problems he found. Ask, “Can you show me?” What are the problems? What are the parts that need replacing? What service needs to be done? How much will it cost?

Second, ask if these problems are life threatening or not. Could you or someone be injured if you drove another day or two? (Usually not.) Can the problem wait “until you get paid” and then come back later? (Usually yes.)

Get the parts list or service being suggested. Either look on-line or go to an auto parts store. Does it look like something you can replace yourself? Will you have to buy any special tools? Get job estimates from other mechanics. Do you want to trust your life to your abilities?

Now you are in position to decide the best course of action.
## Do it Yourself or Take it to a Mechanic?

<table>
<thead>
<tr>
<th>Do it yourself</th>
<th>Take it to a Mechanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>You <em>can</em> repair a lot on your own and you <em>can</em> save labor costs but…</td>
<td>Anything you either don’t want to or you know you cannot fix on your own</td>
</tr>
<tr>
<td>Are you “handy”?</td>
<td>Check Engine Light on</td>
</tr>
<tr>
<td>Do you have time?</td>
<td>Engine problems</td>
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<td>Do you have the right tools?</td>
<td>Electrical problems</td>
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<td>Are you able to safely store car fluids and oils in your apartment/home?</td>
<td>Transmission problems</td>
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<td>Suspension problems</td>
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Common Breakdown Causes

1. Low or dead battery (car won’t start)
2. Flat tire or damaged wheel
3. Alternator fault (battery dies)
4. Starter motor (car won’t start)
5. Fuel problem (wrong fuel, bad gas, water)
6. Clutch cables (breaks)
7. Spark plugs and spark plug wires
8. Car overheats (radiator debris or low/no coolant)

https://haynes.com/en-us/tips-tutorials/10-most-common-breakdown-causes
The automobile is probably the most complex piece of machinery the average person will operate.
An automobile is a collection of systems.

When you perform maintenance, you address an individual system.

When you experience a problem, first, determine which system has the problem, then try to isolate the part within that system.
Can you identify, 1, 5, 10 components here? (We’ll show the same slide at the end.)

1. Radiator
2. Battery
3. Windshield fluid reservoir
4. Exhaust manifold
5. Air filter container
6. Front top strut support
7. Upper radiator hose
8. Radiator coolant reservoir
9. Oil dip stick
10. Brake master cylinder
Michigan uses lots of salt to de-ice the roads in winter.

Salt buildup corrodes metal especially bottoms of doors and under rim of wheel well.

Go to the self-service car wash and wash the body and spray the underbody as well.
Keep the Interior Clean

Interior maintenance involves basic “home” care. Vacuum, wipe down, don’t smoke, don’t spill coffee, soda, etc.

Get rubber floor mats especially in winter when you regularly bring in snow and other yuck (that’s a technical term).
Wiper blades are easy to replace and can be purchased in the automobile section of many local stores as well as at auto parts stores.

**Likely causes of wiper blade failure.**

**Streaking**
Streaking is the result of rubber that has dried, hardened and cracked. It can also be tree sap, road tar or other substances on the blade rubber. Worn Rubber rounding of the wiping edge of the blade due to excessive use.

**Chattering**
This is a "chattering sound" resulting when the windshield wiper passes over the windshield. It occurs because of the "permanent set" or "curve" in the rubber. Blades usually become warped while the vehicle is parked and the rubber is stationary.

**Split/Torn Rubber**
This can be a result of the effect of the sun's ultraviolet rays and the negative consequences of ozone on the rubber causing the rubber blades to split or tear.

**Shredded Rubber**
This condition is usually caused by the excessive play found in loose fitting or worn adapters. Bent Wiper Frame Washing your car in an automatic car wash is usually the cause of a bent wiper frame
Windshield Wipers
https://www.youtube.com/watch?v=cJN7NqkUd1k

The hot, dry summer season causes even more damage to wiper blades than wet winter weather. The telltale signs are streaks on your windshield, or blades that skip during wiping.

Sometimes, the wiper blade assembly purchased at a retail store, does not work properly. When this happens, return the part and go to the Parts Department of the nearest dealer and purchase there.
There are a variety of manufacturers of fluids. Windshield wiper fluid is probably the cheapest fluid compared to oils and other fluids.
Changing Bulbs

https://www.youtube.com/watch?v=K6v3yvs4YW0

Check your lights somewhat regularly. Don’t wait to get a traffic ticket because you have a light burned out.

If one of your turning blinkers blinks faster than the other, that indicates you have a dead bulb on that side.

Figure out how to get the bulb out. Usually, no tools are needed on the newer cars. Take the bad bulb into the store, match the number on your bulb to the new one on the shelf and replace.

Auto Parts store workers are very helpful to find the part you need.
Ensure that the wheel lug bolts and nuts are not rusted together. All cars should include a simple lug wrench. This is not the easiest tool to use quickly.

Recommend buying a “wheel brace” lug wrench – available at all auto parts stores. Know if your car uses inches or metric sizes. Buy a wrench to match. Rotate tires according to owners manual.

Tire chains are legal in Michigan but the law says they cannot come into contact with the surface of the road. So, they are not usually used here.

Tire Chain Laws by State: https://www.thebalance.com/chain-laws-by-state-1361486

If you move to another area of the country, check with local authorities about the kind of tires needed there.
All four tires should be the same tire size, have the same P number: “P215/65R15”.

When you need to buy a new tire, you’ll need to tell the dealer “P215/65R15”.

Know the air pressure for your tire. Check the pressure at least twice a year about December and June with change in temperature. Look for a number followed by “PSI”, for example 35 PSI.

Highway driving on over- or under-inflated tires can be dangerous.

All four tires should be the same manufacturer and brand. If one or more are different, this tells you that tires have been replaced individually.
The grooves in the new tire allow water to be forced out from under the tire allowing the rubber to stay in contact with the road. On snow and mud, the deeper the groove, the better the traction.

Driving with “bald” tires is dangerous. On snow, you have less traction and on water, at highway speeds, the car can “hydroplane”.

Tires are rated by mileage – typically a tire is only good for 60,000 miles.
Hydroplaning can occur when a combination of speed, tire wear, tire inflation or the depth of water on the pavement causes the tires to lose traction. Essentially, a layer of water creates a barrier between the road and your tires. This barrier can cause you to lose traction and glide or hydroplane across the water's surface.

In wet weather, the tires that have been properly maintained and are in good running condition can cut through the water and maintain contact with the road at speeds less than 50 km/h. In cases where the tires are excessively worn (bald tires) or underinflated, or the water is very deep, you may still hydroplane at slower speeds.

At higher speeds (50 mph and higher), the wedge of water in front of the tires may pass under the tires and the tires will ride on a cushion of water resulting in possible complete loss of traction.
In some parts of the country like here in Southeast Michigan, weather conditions and heavy traffic can contribute to the creation of holes that we call potholes.

If you hit one “hard”, you may damage your tire or wheel or cause a misalignment which will create unusual tire wear or any and all of these problems.

If you hit a hole hard enough to bend the rim, your tire will go flat immediately and you’ll need to change your tire, then take the tire and rim to get a new rim.
Wheel Alignment Overview
https://www.youtube.com/watch?v=MiYJwJvbFoQ

This chart also includes information on how problems with inflation or suspension show up in the tire.
Camber, Caster, Toe are alignment terms.

The car needs to go in for an alignment if the tires show any wear patterns besides over or under inflation.
You can fix an inflation problem.
Check the tire pressure on a "cold" tire, for example, after the car has been parked for the night. Don't check tire pressure after you've been driving. The friction of the tires on the road creates heat and will give you the wrong reading.

You should keep a tire pressure gauge in your car’s glove box.

You can find air pumps at gas stations (pay to use) and at tire stores (usually free to use).
Local store locations can be found on the company website:

Belle Tire  
http://www.belletire.com/

Discount Tire  
https://www.discounttire.com/

Michelin Tire  
https://www.michelinman.com/home

Firestone Tire  
https://www.firestonetire.com/

Goodyear Tire  
https://www.goodyear.com/
There are more area tire shops than can be listed in this presentation.
Fuel is pumped from the gas tank to the engine and “sprayed” at the Fuel Injector. Air is drawn in through the air cleaner and passes a few sensors on the way to the engine. Fuel and air are mixed at the fuel injector. The vacuum cycle of the cylinder draws in fuel and air. On the exhaust cycle, the combusted fuel is pushed out through the exhaust.

Some problems affecting engine performance:
Dirty air filter impedes air flow.
Dirty fuel injector impedes fuel flow
Water (from condensation) in gas tank decreases combustibility of fuel
Damaged spark plug doesn’t burn all fuel
Dirty valves leak air or exhaust.
Dirty sensors send inaccurate information to the car’s computer.
Dirty oil decreases ability of engine parts to move smoothly and thus increases engine wear, decreasing life of engine.

Keep the inside of your engine system clean. Air filters are easy to replace. Change
the oil filter with each oil change. Keep the gas tank more than half full. An empty tank allows more room for water vapor to collect and get into the gas system.
Air Filters
Various shapes, sizes and colors
A dirty filter impedes air flow which negatively affects the performance of the engine.
A dirty filter allows airborne particles to enter the engine
How to Change an Air Filter

https://www.youtube.com/watch?v=70zbXIJon5I

http://www.2carpros.com/how_to/change_air_filter.htm

A vehicle's air filter is a replaceable cleansing unit. In most cases an air filter can be replaced in under 5 minutes. The air filter should be changed according to the owner’s manual or more often depending on driving conditions.

To determine if your air cleaner needs to be changed remove the air filter housing retainer clips or screws and remove the filter, gently tap the air filter, if you see dust falling from the air cleaner it is filled to capacity and replacement is needed.
The internal combustion engine generates heat. The engine block is designed with cavities for coolant to flow through it. A water pump attached to the engine circulates the coolant. Cooling of the coolant occurs as air blows across the radiator fins (forced convection). A smaller “radiator” inside the passenger compartment provides heat to the passengers.

As coolant heats, the system becomes pressurized. NEVER open the radiator after the car has been or is running. SEVERE burns may result! Coolant can be added to the reserve tank. The coolant should be “clean”. Dirty coolant inhibits cooling ability and may clog the radiator.

Coolant is a 50/50 mix of water and anti-freeze. This mix prevents water from boiling in the summer and freezing in the winter.

Maintain coolant fluid level in the coolant reservoir.

A faulty thermostat (sticking closed) is the most common cause of an engine overheating.

Radiator hoses are simple to replace… if you can reach them.
A dirty radiator reduces the amount of cooling which can lead to overheating.

Keep your radiator clean.

Enough of the radiator can be seen by taking off the radiator cap – ONLY WHEN THE ENGINE IS COLD!!

NEVER remove the radiator cap when the engine is hot. You will get severely burned!
The upper radiator hose tends to fail first due to the high temperature coolant coming from the engine block. The entire hose should feel firm when squeezing. Any change to softness or “mushiness” is a sign the hose is failing.

Replacing a hose requires either a screwdriver or pliers to loosen and tighten the hose clamp.

Most hoses fail from the inside out. .. the primary cause of coolant hose failure as an electrochemical attack on the rubber tube compound in the hose.
All coolant in your car should be a mix of 50% antifreeze and 50% water.

Coolants come as “full strength” or as a 50-50 mix.

Either buy the 50/50 and add directly to the coolant reservoir or buy the full strength and mix this yourself to a 50/50 solution before adding.
If you change your own radiator hoses or flush your own coolant system, NEVER, NEVER, NEVER allow antifreeze to spill on the ground. It tastes sweet to animals. If they drink it they may die. Anti-freeze is a poison.
If you change your own oil, or antifreeze, NEVER! NEVER! NEVER! pour any automobile fluids “down the drain”.

Street drains flow directly into local rivers. Only house drains flow to the waste water treatment plant. (Don’t pour automobile fluids down the house drain either!)

If you change your own automobile fluids, motor oil, coolant, make sure to safely catch all old fluid and store in a safe container and take these to the nearest recycling center.

Recycle Ann Arbor
http://www.recycleannarbor.org/
A transmission is a mass of gears. Your car’s stick shift determines which of these gears are engaged (Park, Reverse, Neutral, Drive). A transmission needs transmission fluid, a kind of oil to keep all the gears running smoothly.

https://www.youtube.com/watch?v=8KDuk2-4s6E&feature=related
New transmission fluid has a reddish, cherry color. The older the fluid, the more brownish color it becomes.

Transmission fluid should be between cherry-red (on the right) and reddish-brown (in the middle).
Small cars tend to have one “serpentine” belt. Older and larger cars and pickup trucks may have multiple belts.

Unless you have the proper tools, it is probably best to let the mechanic replace this.
Replacing a belt is a relatively inexpensive maintenance cost compared to the cost of replacing your engine if this belt breaks!

Replace any belt that looks worn, cracked or has frayed edges.

*To inspect a serpentine belt for wear, turn the engine off and twist the belt slightly. If the V-ribs show excessive cracks or chucks are missing, have the belt replaced immediately before it fails.*
WARNING: Batteries can also explode. When a battery charges, it gives off hydrogen gas. Hydrogen is flammable and can explode if a spark occurs near the battery (as when connecting a jumper cable, see safe jump start procedure below).

DO NOT smoke around a battery, or use anything that produces an open flame or spark. The photo below shows what can happen to a battery when a spark causes it to explode.

DO NOT attempt to jump start or recharge a frozen battery. Remove the battery from the vehicle, bring it into a warm room and let it thaw before charging or testing.

Always wear safety glasses when jump starting a battery (to protect your eyes), and gloves when handling a battery (to protect your hands).
Bad terminal decreases electrical conduction, reduces ability of alternator to recharge battery and hence reduces battery life.

Make sure your battery terminals remain corrosion-free.

Batteries contain dangerous acids. Always wear long sleeve shirts, gloves and protective eye wear when working with batteries.

Read more about battery maintenance and safety before doing any work on or replacing your battery!

Follow safety procedures and you can replace the battery yourself.
Cleaning Car Battery Terminals
http://www.youtube.com/watch?v=xRYIY-KAQVk

Notice in this video he is wearing safety glasses and rubber gloves !!!
The spark plug creates a spark that ignites the air fuel mixture in the engine cylinder to create an explosion that will push down on the piston, which turns the crankshaft which powers the wheels/tires. The “spark” is delivered by the distributor/ignition module and sent through spark plug wires to the spark plug.

If the air gap on the spark plug becomes too wide (usually caused by wear of the positive electrode) the electrical charge may not be able to jump the gap. This is called a misfire. A misfire will decrease performance and fuel economy, and if left unaddressed, may cause damage.

A bad wire can also cause a misfire. If there’s no spark at all (car won’t start and battery is known to be good), the problem may be the distributor or coil (on older cars) or in the ignition module (on newer cars).
How to Change Spark Plugs
https://www.youtube.com/watch?v=C6A1keWQAeE

Over the life of the car, if a cylinder’s plug has the same problem each time the plug is replaced, then there may be a problem in the cylinder signaling a larger more expensive problem, for example, bad piston rings or a bad valve seal.

You need a special spark plug socket wrench to do this job. Sparks plugs and tools are not expensive.
Engine oil cycles through the engine keeping all the moving parts well lubricated. Make sure the filter is changed with every oil change to prevent the build-up of contaminants that create sludge.

Really dirty oil or “sludge” inhibits the lubrication of moving parts.
Change your oil and oil filter every 3,000 – 5,000 miles. Follow the owners manual.

If a car emits a blueish exhaust, this means the engine is burning oil. This indicates a serious (and expensive to repair) engine problem; bad piston rings or a bad valve seal. Also, one or more spark plugs will be oil fouled.
Change Car Oil
https://www.youtube.com/watch?v=G0Xnf6d6sz0

Changing oil can be a do-it-yourself task but you need the proper tools and safety equipment to do it. And then you need to take the old oil and filter to a recycle center. And so many people prefer to take the car to a shop where they take care of all that for you.
A Couple Area Oil Shops

Uncle Ed’s Oil Shoppe
https://www.uncleedsoil.com/default.aspx

Victory Lane
https://victorylane.net/

These stations also perform a wide variety of other engine checks… all very quickly!

These are only a couple of the many area auto service centers.
Brakes work via brake (hydraulic) fluid. Push the pedal compresses the fluid through the brake lines which pushes out the cylinder at the wheel which either squeezes the disk or pushes against the drum which stops the car.

Possible problems:

1. Leaks at the cylinders.
2. Fluid becomes “dirty” (air gets into the lines) and so fluid loses its ability to exert pressure. This may be felt as a “soft” brake. Remedy: bleed brake lines, add new fluid.
3. The friction of the brake pads and shoes against the disk and drum will eventually wear out the pads and shoes. This may be felt as “soft” brakes.
4. If the pad/shoe is too worn down, the metal it is attached to may come in contact with the disk/drum. Result is a ‘squealing’ sound – metal on metal – no braking ability. If you hear squealing, you may need new brakes.
5. If the disk or drum is “scored”, grooves cut into the metal, this decreases braking ability. Remedy- disk/drums to shop to have them “turned”, a layer of metal cut off to eliminate or decrease the groove.
Change Car Brakes
https://www.youtube.com/watch?v=bPC1As0rH1I

Typically the front brake is a disc brake. Sometime both front and back may be disc brakes.
The wheel attaches to the five bolts. The disc turns with the wheel. The disc moves between the two brake pads.
Pushing the brake pedal causes the brake pads to squeeze the disc.
On cars not driven for a while, the brake discs (especially) may get rusty. Do not drive (and try to stop). Use a little fine sand paper to clean the rust off.
Illustrates how the brake pads (and shoes) wear down with use. City driving with its constant “stop and go” will wear out brakes faster than highway driving where you don’t use the brakes much. Thus, you cannot rely on miles driven to determine when to replace your brakes.

Take your tires off once a year and check how much brake pad remains. Front and back brakes don’t necessarily wear at the same rate. Check both. If the pads wear down to the steal, there is no braking.
Typically the back brake is a drum brake. Left view shows how drum fits over brake assembly. The drum is all you see after you take off the wheel. The drum is designed to slide off but may be rusty and take a little effort to work loose.

The brake drum turns with the wheel.

The cylinder at the top pushes the brake shoes outward against the turning drum.

Possible problems:

The cylinder may leak. You must take the brake drum off to see if you have this problem.

The brake shoes/pads wear out.
The bad seal picture illustrates a brake fluid leak in the drum cylinder.
If your car or someone else’s car won’t start, one quick “fix” is to try to start off another car. If the battery is the problem, then the car should start.

Connect the positive (+) clamp to the positive terminal of the healthy battery and the other positive clamp to the corresponding terminal of the dead battery.

Next, the negative (-), or ground, terminal on the good battery and, finally, the negative clamp to the engine block, frame or other grounded metal as far as possible from the battery.

You want to avoid sparks in the vicinity of the explosive hydrogen gas that emits from the battery. Do not connect it to the ground terminal.

If you needed the jump to start your car, then get your battery checked and/or replaced as soon as possible.
These pictures were taken in a local Meijer department store. You may also find some general car parts in Wal-Mart, for example, air and oil filters, wiper blades, various fluids, and light bulbs. These sort of department stores however do NOT stock car-specific parts.

For these and more specific parts for your car, you need to go to a car parts store.
How to Find Your Part

In the parts book

The parts book is organized by Year, and then by Manufacturer and then by Model. You will also need to know some details about your engine, for example, is your engine a single or double overhead cam? Does your engine have turbo or not?

Once you find your car in the leftmost column, the remaining columns list the part number for your car.
Fram (http://www.fram.com/) is just one of the many parts manufacturers.

The Fram site is shown here for this presentation to be consistent.
A sample of area parts stores. In some cases, these parts stores might not have the specific part you need.

You can also purchase car parts from the car dealer’s Service Desk.

AutoZone
https://www.autozone.com/

Advance Auto Parts
https://shop.advanceautoparts.com/

Car Quest Auto Parts
https://www.carquest.com/

O’Reilly Auto Parts
https://www.oreillyauto.com/
If you own a car, it is helpful to have a basic set of tools. This small set will be used in 80-90% of most car (and home) maintenance tasks.

The “Craftsman” brand has been a long recognized as a quality tool.

There’s an old saying, “Take care of your tools and your tools will take care of you.”

This one-time purchase could be with you your entire life.

It’s good to keep some tools in the car. A hand-tool might be needed in an on-road emergency.
Easy Tool Storage
More “How To” Information

- Refer to your car’s owners manual.
- Know your car’s make, model, and year.
- Ann Arbor District Library – Car Repair Manuals
- Car parts store employees – very helpful
- Internet sites and YouTube videos
Now…. How many components can you identify (or you recognize but may not remember the English name)?

1. Radiator
2. Battery
3. Windshield fluid reservoir
4. Exhaust manifold
5. Air filter container
6. Front top strut support
7. Upper radiator hose
8. Radiator coolant reservoir
9. Oil dip stick
10. Brake master cylinder