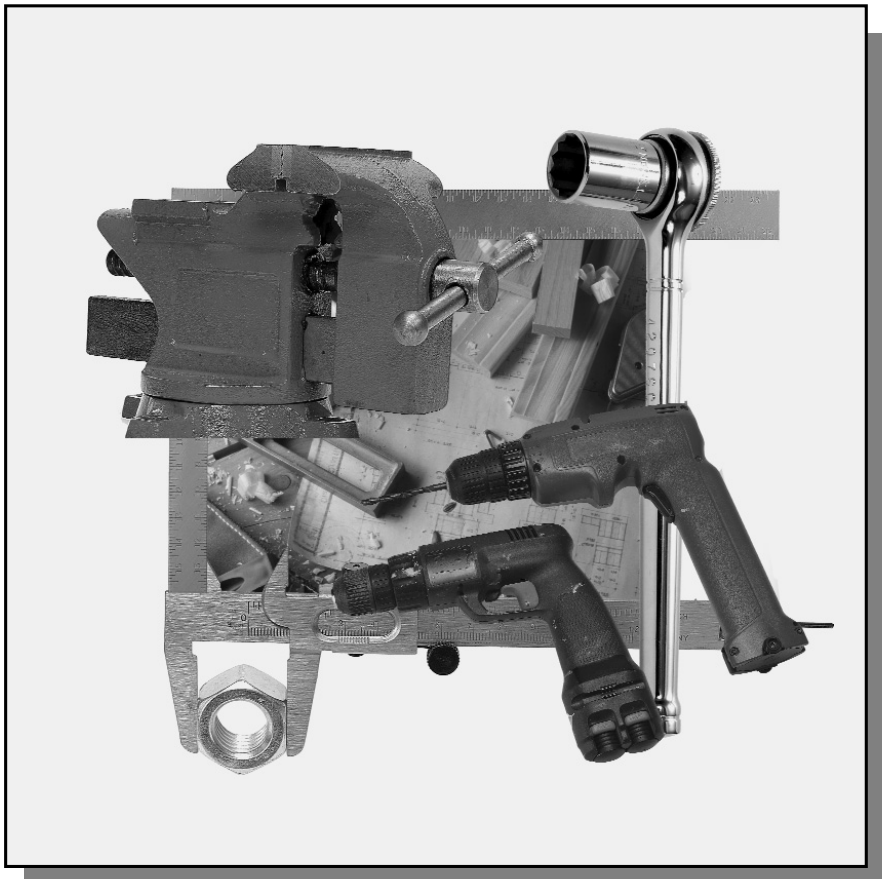
Character and Skills for Home and Careers

This chapter requires a companion activity book in which students respond to questions on text content. Answers are found in the *Teacher's Resource Kit*.



Chapter 1

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Character and Skills for Home and Careers

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CHAPTER 1
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Warning

Students under the age of 18 should not attempt projects described in this course without supervision by a competent adult.

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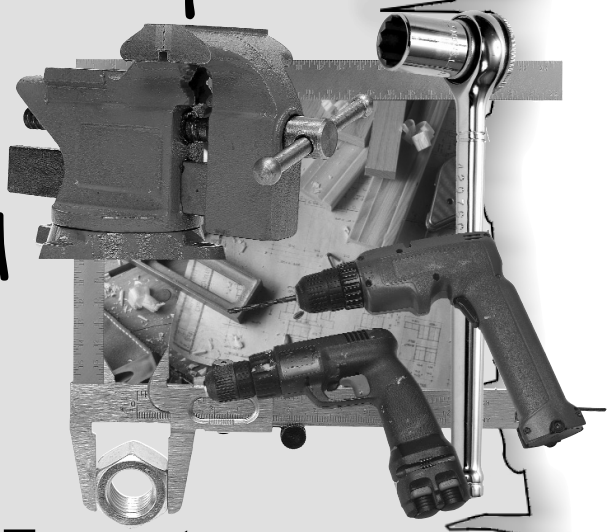
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"To be a success in any line of work requires courage, persistence, a willingness to pinch and go without many pleasures and pastimes while you are young and getting a good start in life."



—Lee De Forest



Lesson 1

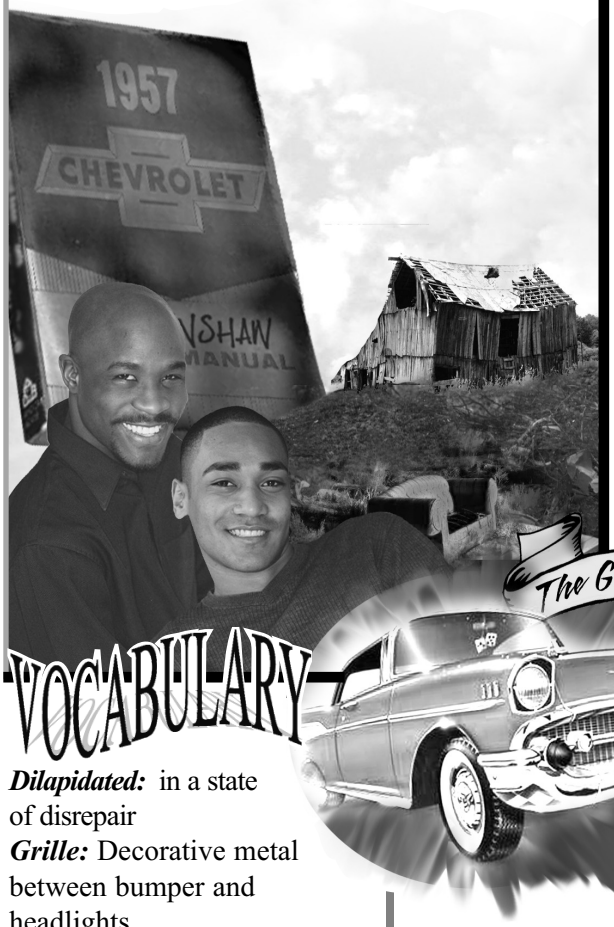
Automotive

Chapter 1

Section 1

Lessons 1-5

THE DISCOVERY



The day was a bright, sunny Saturday in June, just a week after school had been let out for the summer. James had awakened early and gone outside where he mindlessly tossed a basketball at the goal in his backyard. In a few minutes, his dad came out of the house and inquired, "What are your plans this morning, James?"

"Oh, not much, Dad. To tell you the truth, I am kind of bored: I just came out here looking for something to do."

"Out of school only a week, and you already don't know what to do with yourself?" Dad grinned and added, "Well, maybe I have a solution to your problem. Put away the ball, grab your cap and let's go for a ride."

James could not imagine what his dad had in mind. Whatever it was, he knew that it was better than sitting around the house watching television or playing video games. After snatching his cap, James bolted through the door to join his dad in the front seat of the family pickup truck.

Dad was grinning as he turned left out of the driveway, made a right turn and drove southward out of town. He glanced at James as he spoke, "On my way home from work the other day, I saw something that reminded me of when I was a teenager just like you. I thought that you might like to see it, too."

As they passed the old, abandoned Booker T. Washington High School near the edge of town, Dad commented, "That is where your grandpa and I attended school. There's a great difference between that old school and the new school you attend!"

After traveling a bit farther, Dad turned into the driveway of an old house that was surrounded by junk of every type imaginable. In the back of the property sagged a ***dilapidated*** shed.

"Here we are!" Dad exclaimed in an excited voice.

VOCABULARY

Dilapidated: in a state of disrepair
Grille: Decorative metal between bumper and headlights
Radiator: cooling device for water-cooled engines
Battery: storage device for electrical power, usually 6 or 12 volts
Fan belt: drives water pump and other car accessories
Headlight ring: chrome ring around headlight to cover headlight adjustments
Hubcap: device which attaches to wheel rim and covers lug nuts

"What do you mean? All I see is an old house and a yard full of junk!" quipped James.

"Just wait!" replied Dad. "See that old shed out back?"

"Well, yes, I see it, but what's so great about that?" asked James.

Dad exclaimed, "It's not what is so great about that shed. It's what is *inside* that is great! I can hardly wait for you to see it. I couldn't believe my eyes when I first saw it! Last week I came out here to Mr. Crenshaw's place to install a new sink in his kitchen. We went out to the shed because that's where the new sink was stored and that's when I saw it—wow! It took me right back to when I was your age!"

"Okay! Let's see what you're talking about!" James said, a sense of excitement and mystique coming over him.

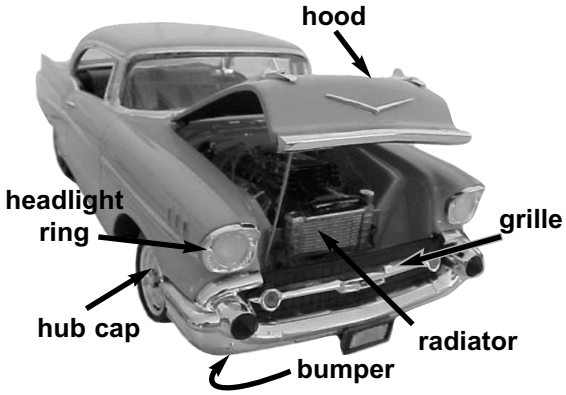
They jumped out of the truck, closed the doors and walked briskly toward the shed. James opened the door and waited for his eyes to adjust to the darkness. As his eyes began to focus, James spied a canvas spread over a large object in the far corner. He hurried over to it and peered under the canvas.

"Wow!" was all he could say. "May I?" he glanced up at Dad for permission to remove the canvas.

"Go ahead, son," said Dad, a twinkle in his eye and a big grin across his face.

James jerked back the canvas and let it fall to the floor. There in that old, dusty shed was THE CAR—the one he had dreamed of owning—a 1957 Chevy Belair two-door hardtop! James found the hood release located under the center of the ***grille*** and raised the hood to reveal the original engine. It was still intact although the ***radiator*** was missing along with the ***battery*** and ***fan belt***. Several exterior parts were also missing—a ***headlight ring*** and ***hubcaps***.

"I know it's not much to look at right now, but it has potential!" said Dad, "All this car needs is a little tender loving care. Well, maybe a little tender loving care and a lot of hard work!"

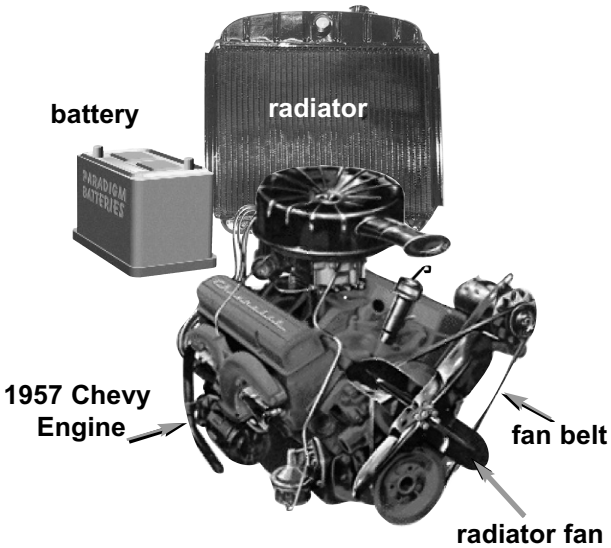


"Yes sir," exclaimed James, "but just think of all the time I have on my hands this summer. I told you this morning how bored I already am. I would love to have a chance to get this car back on the road again and make that faded yellow paint and chrome sparkle! There is only one problem . . ."

"What is that, Son?" asked Dad.

"I know a little bit about cars, but I would definitely need some help, provided Mr. Crenshaw would agree to sell us the car. Do you think this project would be too difficult for me, Dad?"

"Not with my help; after all, that is what dads are for. You couldn't pay me to keep my hands off that '57 Chevy!"





LIFE PRINCIPLE

"Be always ashamed to catch thyself idle."

—Benjamin Franklin



Lesson 2

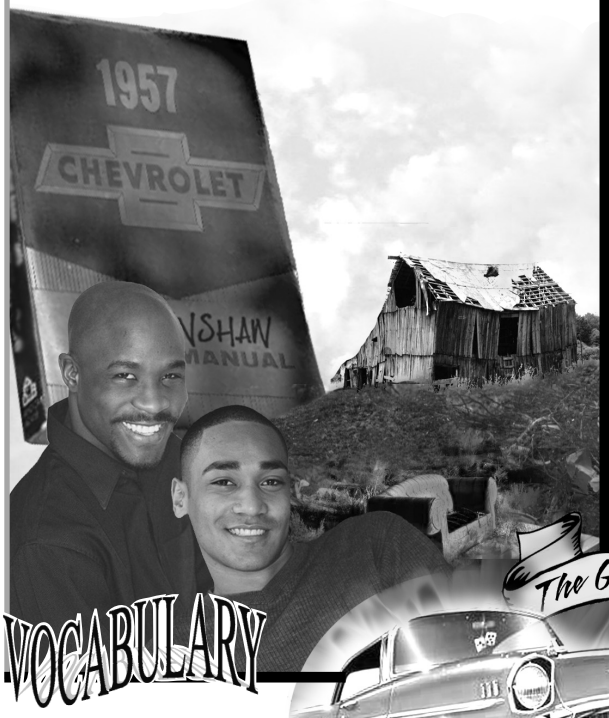
Automotive

Chapter 1

Section 1

Lessons 1-5

COUNTING THE COST



Mr. Crenshaw and James' grandpa had been classmates long ago at Booker T. Washington High School, and the two men had been involved in each other's families for many years; so James hardly noticed when Dad and Mr. Crenshaw went outside to talk, leaving James to "check out" the '57 Chevy. After some time, the two men returned.

"Ready to go home, son?" Dad asked.

"Yes sir," replied James hesitantly, a look of longing on his face as he glanced toward the car.

Dad cleared his throat. "Uh, son, Mr. Crenshaw doesn't think..., uh, well," Dad hesitated.

James' heart sank, but he bravely straightened his shoulders. "That's okay, Dad; I understand. Thank you for letting me look at the car, Mr. Crenshaw," James said.

"Alright!" said Dad loudly, as he slapped his knee, and Mr. Crenshaw let out a loud laugh. "We're just kidding, son! Mr. Crenshaw would be pleased to see his old car restored. He is willing to sell it for $600.00. He and I have worked out an agreement. You may take the car, but you'll have to pay for it by working here for Mr. Crenshaw who needs some cleaning up around his place."

Mr. Crenshaw spoke up. "If you're interested, James, I have a proposal for you. This lot of mine has really become cluttered over the years, and I need someone to clean it up. I would be willing to pay you $7.00 an hour."

James quickly agreed to the deal. He could see that with all the work to be done, he could probably pay for the car by the end of the summer and might even have some money left over to cover the costs of rebuilding and repairing the old car.

"Thank you, Mr. Crenshaw. Thank you so much. I can hardly wait to get started," said James.

Without James suspecting, Dad had come prepared. In the back of the pickup, Dad had brought a ***hydraulic jack***, four ***jack stands***, ***penetrating oil*** and a lug wrench to remove the wheels and tires, which would have to be repaired or replaced.



VOCABULARY

Hydraulic jack: uses liquid under pressure to lift an object

Jack stand: used to support an object after it has been lifted by a jack

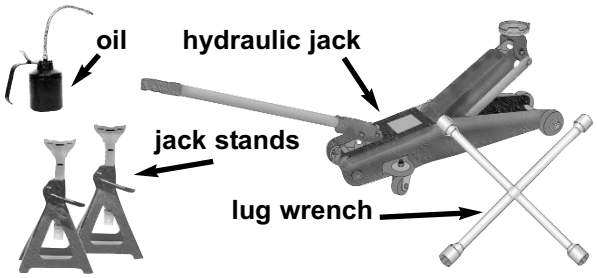
Penetrating oil: oil designed to spread through tread on nuts and bolts

Extension: device used to lengthen a handle for the purpose of gaining more leverage

Suspension: system of springs and other parts that support a vehicle on its frame

Spindle: the part of a car where the front wheels are attached

Balancing: attaching weights to the rim of a wheel to eliminate vibration



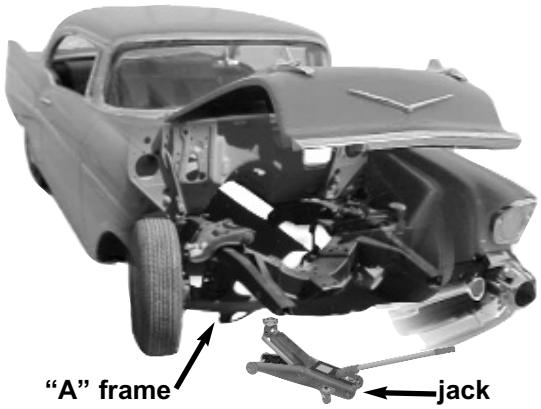
Dad said, "Come on, James, let's get started." Dad used a screwdriver to pry loose the hubcap on each wheel, pointing out that each wheel had several lug nuts that hold the wheel in place. Dad told James to follow behind and spray each lug nut with oil. Next, Dad used the lug wrench to loosen the lug nuts. All but a few loosened easily. On the ones that were really stuck, Dad found he had to use a piece of pipe as an ***extension*** on the lug wrench for more leverage.



LOOSENING LUG NUTS

After loosening all the lug nuts, Dad said, "Now, it's time to get out the jack." James jacked up the right front wheel by placing the jack under the part of the ***suspension*** known as the "A" frame. The "A" frame is the part of the suspension that connects and holds the ***spindle*** to the frame. Dad then placed one of the jack stands under the frame near the right front wheel. He removed the jack and moved to the left front. After putting another jack stand under the frame on the left front side, James removed all the lug nuts and pulled off both front wheels. After the front wheels were removed, Dad said, "Now let's move to the rear of the car."

Dad placed the jack under the right rear axle and proceeded to raise the car. James put in place another jack stand and removed the wheel. They repeated the process on the left rear wheel. Finally, the '57 was sitting on four jack stands. James



inspected the old tires and noted that they were 7.50 x 15 inches in size. He further noted that they were too worn to be safe, and would have to be replaced. As James loaded the wheels into the truck, Dad paid Mr. Crenshaw, who in return, handed over the title to the car. "It is all yours now!" he said to James.

When they got into the car, James said, "Thanks, Dad, for helping me with the money. I'll work hard and pay you back."

"I know you will, son," said Dad. "We're going to have a good time restoring this beauty." On the way home, Dad stopped at Melvin's Tire Shop and picked out some new 195R x 15 inch tires. Each tire was priced at $50.00 with an additional charge of $5.00 per tire for ***balancing***.

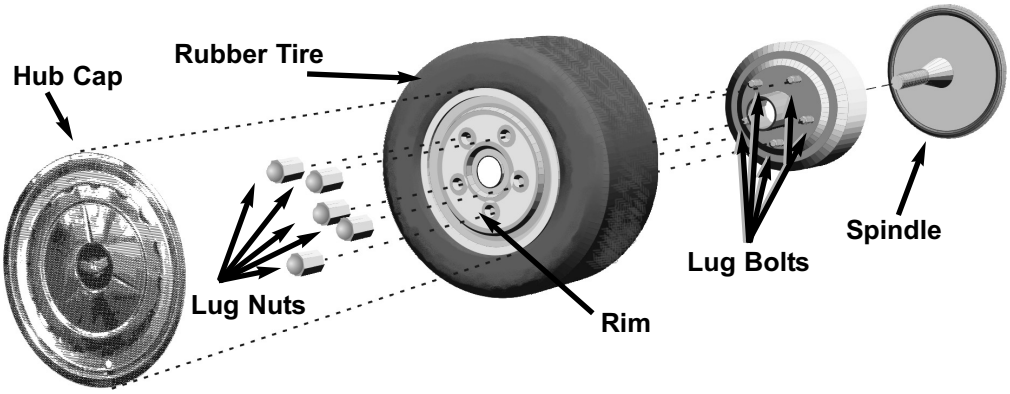
Today had been an eventful day for James. He whispered, "Summer doesn't seem boring any more!"

LIFE PRINCIPLE



"What we hope ever to do with ease, we must learn first to do with diligence."

—Samuel Johnson





Lesson 3

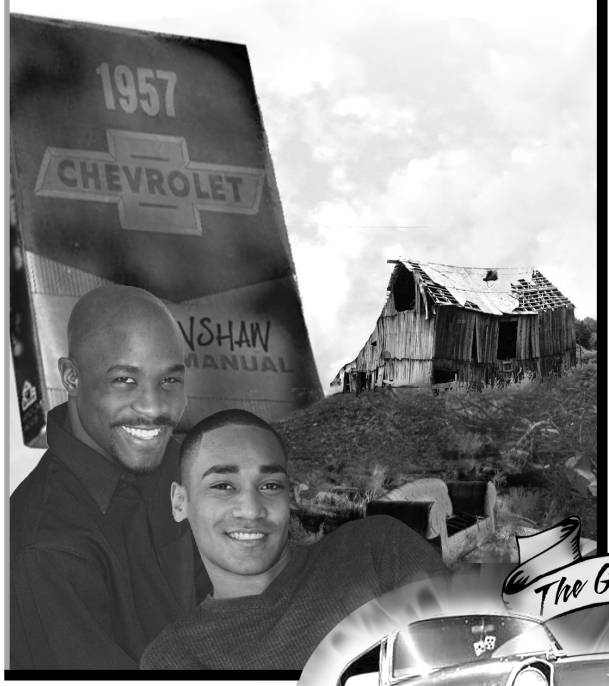
Automotive

Chapter 1

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PREPARING TO MOVE



Late the next afternoon, James waited eagerly for Dad to arrive home. Finally, Dad pulled into the driveway. Attached to his pickup truck was a 16-foot flatbed trailer on which the Chevy would be transported from Mr. Crenshaw's. Dad had rented the trailer from Miller's Trailer and Hauling and had stopped by Melvin's Tire Shop to pick up four brand new 195R x 15 inch tires for the '57 Chevy. James also noticed a ***winch puller*** (also called a ***come-along***) and some nylon tie-down straps in the back of the truck. "Hop in, James. Let's go over to Mr. Crenshaw's to load up your Chevy," Dad said.

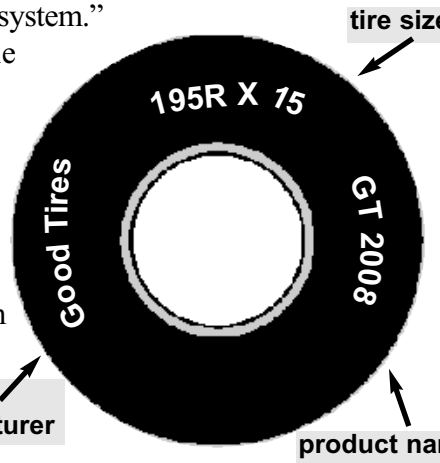
As soon as James was in the truck, his curious mind began to formulate questions. First, he asked, "Why are the numbers on the new tires different from the ones on the old tires?"



Dad replied, "That's a good question, son. The tire manufacturers in the United States now use a universal metric system for tire sizes so the same tire codes may be used by tire dealers worldwide. The old tires we removed from the Chevy were made before manufacturers started using the metric system. Even though the old tire sizes and the new tire sizes are the same, we now refer to that size using the metric system."

James rode silently for a while before asking, "How are we going to get the Chevy onto the trailer?"

Dad chuckled and said, "The trailer has ***ramps*** built onto it. Once we re-install the new wheels on the Chevy, we'll take the car off the jack stands, and you can guide the car with the steering wheel onto the ramps, while I winch it using the come-along."



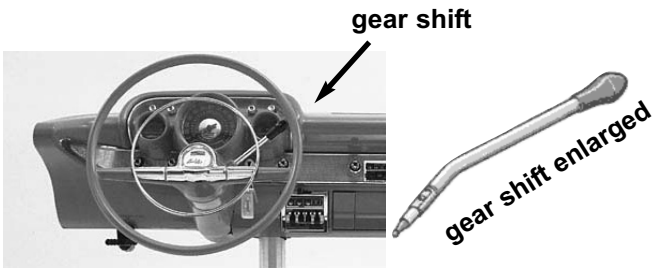
VOCABULARY

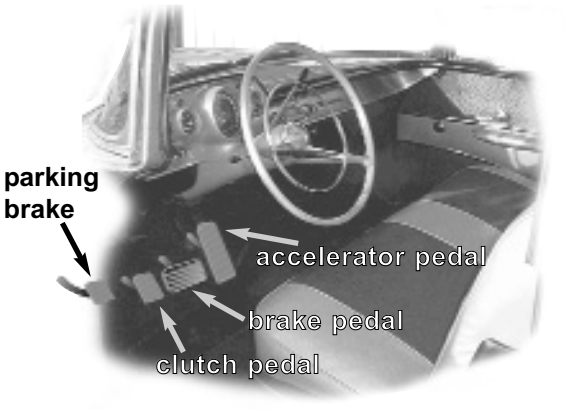
Winch, Come-along: a device that produces leverage by the use of ratchet pulleys and cables

Ramp: an incline used for loading and unloading objects at different levels

Clutch: a device used for putting a vehicle in or out of gear

Neutral: a position of the transmission gears in which power is not transmitted from the engine



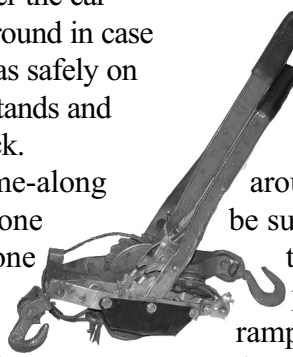


When they arrived at Mr. Crenshaw's place, Dad asked James to get out of the truck and stand behind to help guide the trailer into the shed. This proved to be no easy task. First, James had to remove several pieces of debris from the driveway before the trailer could be backed into the shed. James used right and left hand signals as well as verbal instructions to help his dad place the trailer in front of the car. Finally, the trailer was in position. Dad set the parking brake and turned off the truck. James unloaded the tires and rolled them into position. Dad set each tire on the wheel lug bolts and started one lug nut on each wheel to hold it in place.

James wanted to hurry and get the car home! His impatience must have shown because Dad said, "Just slow down, son! All these tasks have to be done step by step to assure a safe trip home. Now, start the rest of the lug nuts. I will follow behind and use the lug wrench to tighten each nut," Dad instructed.

After that task was completed, Dad used the jack to raise each corner of the car just enough to remove each stand and let the tires support the car. Dad cautioned James not to put his foot or any part of his body under the car while it was being lowered to the ground in case the jack slipped. After the Chevy was safely on the ground, James loaded the jack stands and jack into the back of the pickup truck.

Dad then unloaded the come-along winch from the truck. He hooked one end to the front of the trailer and one end to the frame of the car.


come-along

James thought that finally, the car was ready to be loaded. Dad said, "Get into the driver's seat, James. Release the parking brake, push in the ***clutch*** and put the car into ***neutral***." Putting the car's gear shift into neutral would disengage the engine from the transmission and allow the car to be moved forward or backward by forces other than engine power (such as a winch). James glanced at the parking brake, clutch pedal and gear shift and followed Dad's instructions.

At last the car was ready to be moved. Dad began to work the come-along as James steered the car, lining up the car with the ramps on the trailer. Slowly . . . slowly . . . Dad hoisted the Chevy onto the trailer until it was positioned just right.

"Now set the parking brake and put the transmission into 1st gear," Dad instructed James. Dad explained that first gear was the lowest gear. Setting the car out of neutral and into a gear engaged the clutch plate so the transmission gears could not move.

Dad ran the nylon straps across and around the car and tied them securely to be sure the Chevy did not move during transport. Once the car was securely in place, Dad instructed James to raise the ramps on the trailer. Dad and James both breathed sighs of relief. The car was safely on the trailer, and they were ready to take her home! James could hardly wait!



LIFE PRINCIPLE

"Patience is virtue."

—Anonymous



Lesson 4

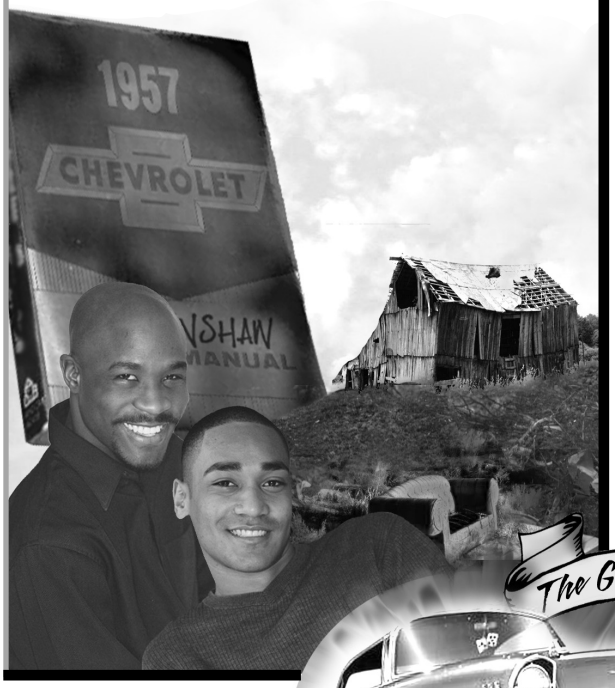
Automotive

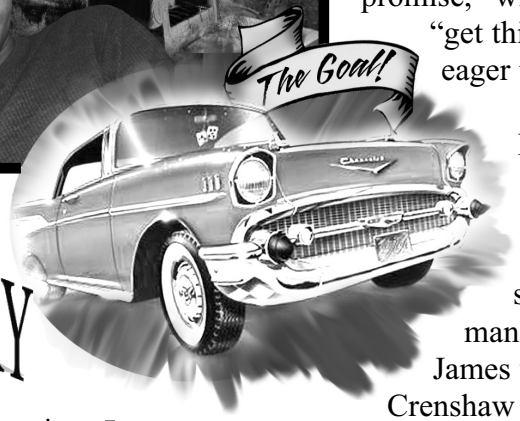
Chapter 1

Section 1

Lessons 1-5

MOVING DAY





Taking a break from his gardening, Mr. Crenshaw walked over to say goodbye to his '57 Chevy. "You know, that car has been around a long time. I expect you to fix it up and take good care of it," he said.

Dad and James thanked Mr. Crenshaw and told him that he would be informed about the progress of the ***restoration*** on the Chevy. James also promised that he would start cleaning Mr. Crenshaw's property next week and that Mr. Crenshaw would be one of the first people to get a ride in the car when it was running again.

"Okay, young man, I'll hold you to your promise," winked Mr. Crenshaw. "Now," he said, "get this beauty on home. I know you're eager to start fixing her up!"

"Yes, sir!" said James. "Thank you, sir. I'll make you proud of her once again!"

As Dad pulled out of Mr. Crenshaw's lot, James looked in the rearview mirror. Mr. Crenshaw was smiling and waving. James knew the man was a truly good and honest person. James was proud that someone like Mr. Crenshaw would take an interest in him and show that he could put his confidence in James.

James looked at the '57 Chevy in the rearview mirror during the slow drive toward home. In fact, James almost got a crick in his neck from looking back at the car so often. Dad and James received lots of stares and waves from people in other cars while traveling home. Dad kept the truck to around 45 mph. all the way home to be sure the car rode safely. "Haste makes waste," Dad cautioned when James complained that they sure were driving slowly.

Even though the ride home was slow, James enjoyed it. It gave him time to look around at things a little more closely. James commented to Dad that it sure was easier to be more observant of one's surroundings when traveling at a slower speed.

VOCABULARY

Restoration: a reconstruction of something back to its original form
Winch: to use a machine designed for lifting or moving that has a drum turned by a crank or motor
Stabilize: to make firm or stationery
Marred: ruined or blemished
Catastrophe: disaster
Audible: able to be heard

"Like, I didn't know that Mrs. Lovis had such a pretty garden," said James as they passed through a nearby neighborhood, and, "Did you know that the Corbins had an American flag flying from their front porch?" James asked. "I wonder if it's in honor of their son serving in Iraq. Wasn't Mr. Corbin a Vietnam Veteran?" asked James.

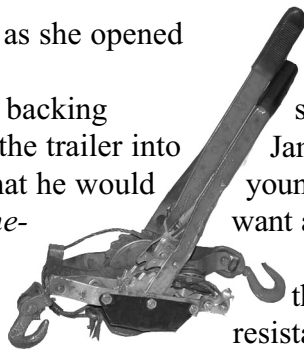
"That's right," said Dad. "He sure was, and I know he's proud of his boy following in his footsteps to serve our country."

Finally, they arrived at their street. In the yard stood Mom and nine year old sister, La Shonda. Both were waving enthusiastically. As the truck and trailer pulled into the driveway, La Shonda exclaimed, "James, I'm here to help! What can I do?"

James laughed at his little sister's eagerness to help. "You sure can, little Sis, we'll think of something you can do to help. You can open the gate to the back yard, and we'll drive the truck and trailer back there so we can unload the car."

"Okay!" said LaShonda as she opened the side gate to the back yard.

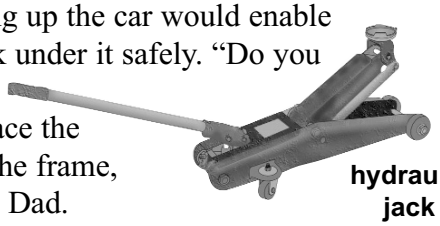
Once again, James gave backing directions as Dad slowly eased the trailer into the back yard. James realized that he would need to attach the winch or *come-along* to something strong and stationary so that the car could be pulled from the trailer. As usual, Dad already had thought ahead and began backing the trailer toward a large oak tree.



come-along

After the trailer was in place, Dad and James tied a chain aroung the tree and hooked one cable of the come-along to the chain. Next, they removed the tie-down straps from the car. James lowered the trailer ramps, and hooked the other cable of the come-along to the rear-end frame of the car so Dad could ***winch*** it off the trailer. James slid into the driver's seat so he could turn the wheels and keep the car on a straight path down the ramps. La Shonda cheered from the passenger seat. Slowly, the car rolled off the trailer and came to a stop at the bottom of the ramps.

Dad instructed James to get the jack and to put the car back up on all four jack stands to ***stabilize*** the car while they worked on it. Jacking up the car would enable Dad to work under it safely. "Do you remember where to place the jack under the frame, son?" asked Dad.



hydraulic jack

"Yes, sir, and also to be careful not to have any body parts under the car while using the jack in case it slips," replied James.

"Good," said Dad. "I think you can handle this assignment without me."

"Thanks, Dad!" James said. He was eager to show off what he had learned. He grinned as he added, "Now, maybe I can prove to La Shonda for once that I *do* know how to do some things!"

"I want to help!" said LaShonda stubbornly.

"Okay, but you must listen carefully to what I say, so no one gets hurt," James cautioned his younger sister. He didn't want a perfect day ***marred*** by a ***catastrophe***.



jack stands

James allowed La Shonda to pump the jack a few times before it met much resistance from the weight of the car. Then, he told her to stand out of the way while he placed each jack stand under each corner of the car. After finishing, he breathed the words, "Mission accomplished!" in a barely ***audible*** voice. He couldn't believe his Chevy was finally home, in his yard, and ready to be restored!

LIFE PRINCIPLE



"We measure ourselves by the responsibility we shoulder successfully."

—Author Unknown



Lesson 5

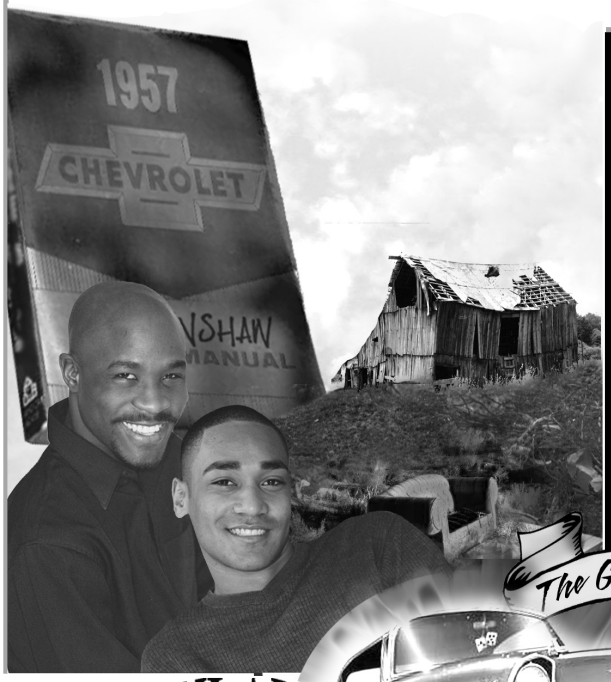
Automotive

Chapter 1

Section 1

Lessons 1-5

TAKING INVENTORY

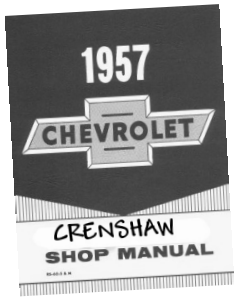




After a good night's sleep spent dreaming of a '57 Chevy Belair, James awoke early, ready to work on his car. He went all through the house looking for Dad. James finally found La Shonda outside playing with the dogs, and she told James that Dad had already left to go to work but that he had left a note for James on the picnic table. James hurried to the table where he discovered dad's note and list:

"James, today we'll check some engine components. Complete this checklist:

1. Check motor oil (will probably need to be drained).
2. Install radiator.
3. Check belts.
4. Check air filter.
5. Check ***carburetor***.
6. Remove old hoses."

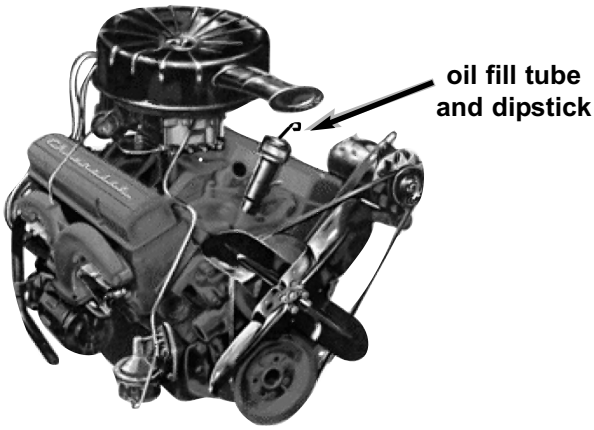


After reading the list, James began to panic. He did not know the location of some of the things that were on the list. Furthermore, he had no clue as to how to check or remove the items listed. Then he noticed a large book on the picnic table. It was an old, oil stained *1957 Chevrolet Shop* ***Manual*** with Mr. Crenshaw's name carefully printed on the front cover. James soon discovered that this book would be the key to success in accomplishing the tasks on Dad's list. James walked to the garage and retrieved Dad's toolbox then selected the necessary tools indicated in the manual and placed the tools on the picnic table.

After carefully reading the instructions, James walked over to the car and lifted the hood. He stared down at the engine and patted the car on the side. "We'll have you up and running in no time, old girl," he said.

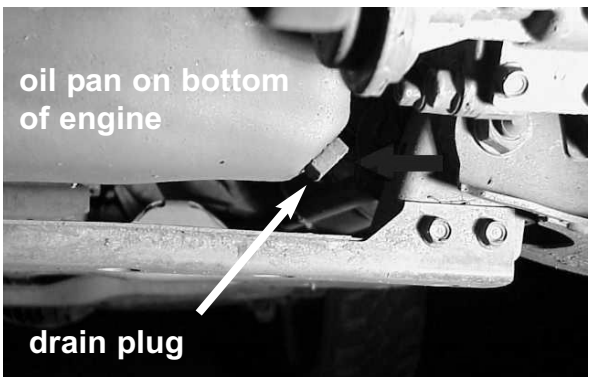
VOCABULARY

Carburetor: an apparatus for supplying an internal combustion engine with an explosive fuel and air mixture
Manual: a book of facts and instructions for use as a guide
Socket: a round cylinder with grooves for fitting around bolts and that attaches to a ratchet handle for use as a wrench
Ratchet: a device designed to hold and release an object both to the right and left
Radiator: a device for cooling an engine using tubes and fans to remove the heat; usually contains water and antifreeze chemicals



engine block

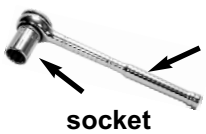
On the engine, James located the oil dipstick. He pulled it out of the oil fill tube and checked the consistency. He noticed that it was thick and gunky and very old. It would have to be drained and replaced with fresh oil. He replaced the dipstick and crawled under the car with the manual (so he could refer to it). He also took a ***socket*** set and a flat pan.



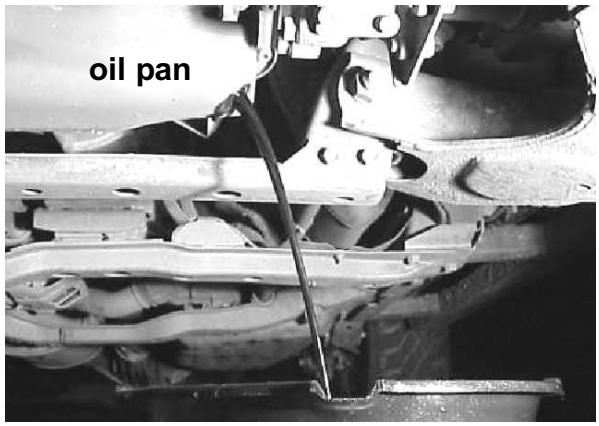
He located the oil pan on the bottom of the engine and the drain plug. He found that a $^{11}/_{16}$ inch socket fit the plug. He placed the socket on the $^{3}/_{8}$ inch ***ratchet*** handle and began removing the plug. Just before the plug came loose, James placed the flat pan under the plug so that it would catch the oil after the plug was removed.



flat pan (to catch the oil as it drains)



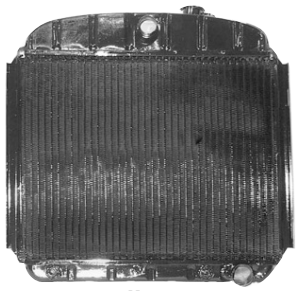
(together, the socket and handle are referred to as a socket wrench)



oil draining from oil pan on bottom of engine into flat pan

While the oil was draining from the oil pan, James looked again at the manual and found that he should replace the oil filter. He decided to wait until Dad purchased a new oil filter before removing the old one. After all the oil had drained out of the engine, James replaced the plug and tightened it. He crawled out from under the car and poured the old engine oil into several plastic containers. Later, it would be taken to an engine oil disposal site. James checked the first item off his list and proceeded to the next.

James read through the manual until he found the section on ***radiator*** repair and installation. The radiator in a car is located just behind the grille and cools the air before entering the engine. At first, James and his dad thought that the radiator to the Chevy was missing, but while inspecting the car, Dad had discovered that the radiator had been rebuilt and never replaced but had been stored in the trunk.



radiator

James retrieved the radiator and inspected it. He noted that it needed to be flushed out and all of its hoses replaced, but that could be done later. It could still be installed in its current condition. James read the instructions and installed the new radiator using a $^{1}/_{2}$ inch socket wrench.



While installing the radiator, James noticed that the battery that should be located on the left side of the engine compartment under the hood was missing. He checked the manual which indicated that the Chevy would need a 12 volt battery of at least 350 amperes cranking power. James made a mental note to mention the missing battery to Dad later that evening.

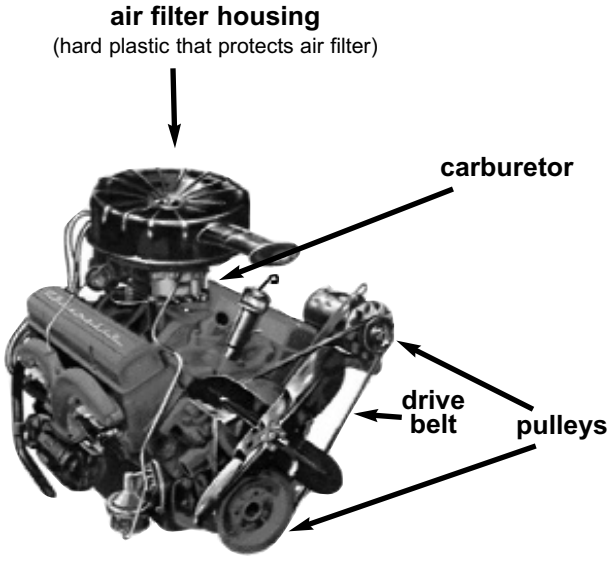
Just then, La Shonda came outside and greeted James with a smile. In her hand she held a glass. "Mama said to bring you this glass of lemonade," she said.

"Thanks, Sis. It sure does hit the spot!"

"How are you coming along with the car?" she asked.

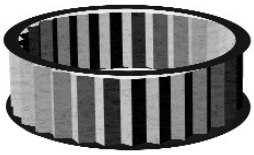
"Pretty well, I guess. I sure am thankful for this manual," James responded.

After La Shonda left, James began examining the drive belt area. The drive belts resembled large rubber bands around a pulley system along the side of the engine block. James knew that the drive belts operated the fan, water pump and generator (or alternator).



The belts were missing and would have to be replaced. How was he going to determine what size of belt to purchase? The manual advised measuring the belt by placing a string around the pulleys where the belt should go. James did this and obtained an accurate belt length. He tied the string together to save the measurement for later when he and Dad would go to the auto parts store.

James checked the belts off his list and moved on to the air filter. Under the air filter housing, James found the remains of the air filter after a rat had used it as part of its nest. James took care to remove the debris so that it would not fall into the carburetor. He added "air filter" to his list of things to buy.



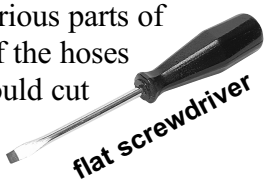
air filter
(fits inside filter housing)

Next, he checked the carburetor which was located under the air filter. James knew that the function of the carburetor was to combine vaporized fuel and air in order to produce a combustible or explosive mixture for the engine to run. James happily discovered that all the parts were intact but needed some oil. He carefully lubricated the carburetor and returned it to its correct location.



carburetor

Next, James turned his attention to the hoses protruding from various parts of the engine. Because all of the hoses were damaged, James would cut them off and replace them. Using a flat screwdriver and pliers, he removed the clamps from the top and bottom radiator hoses and the two heater hoses and cut them off.



flat screwdriver



hose clamp



pliers

At last, James stood back and surveyed his work for the day. He realized that he should temporarily plug all the radiator and carburetor openings with paper towels to keep out dirt, water, and "critters". After he completed this task, he picked up the tools, closed the hood and returned the toolbox to its place in the garage. James was dirty and sweaty, but felt very satisfied with the day's accomplishments.

LIFE PRINCIPLE



"There is only one way to improve one's work—love it."

—Phillip Brooks



Lesson 6

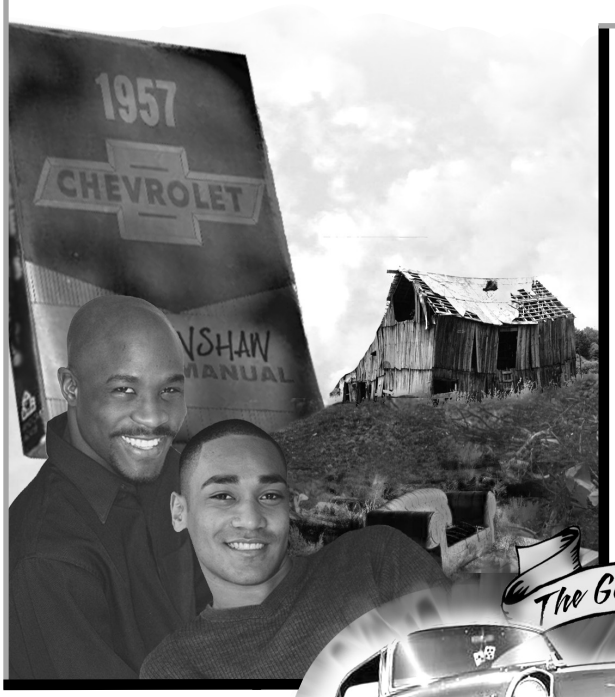
Automotive

Chapter 1

GETTING A CHARGE

Section 2

Lessons 6-10



James cleaned up and settled down with the *1957 Chevrolet Shop Manual* to do some serious reading. He had no sooner sat down when the telephone rang. It was Dad calling from work to check on James' progress.

"How is your progress on the car, son?" he inquired.

"I went through everything on the list, but we are going to need a new battery of 350 or better cranking amps," James reported, "as well as some hoses and belts."

"I suspected as much," replied Dad. "We'll start with the battery first. I'll pick one up on my way home from work. After supper, we'll see about installing it."



When Dad arrived home from work, James went outside to meet him. He unloaded the new battery and set it on the work bench in the garage. Dad proceeded to explain that he had purchased a new battery with 650 cranking ***amperage*** which carried with it a three year warranty.

He explained, "The extra amperage will make the car's engine turn faster and start more efficiently. I thought the extra amperage was worth the additional dollars."

Dad also informed James that the liquid part of the battery contained sulfuric acid, a highly toxic and corrosive material. Because sulfuric acid could burn the skin and eyes, Dad warned James to handle the battery in an upright position and not to put it in a tight, enclosed area. Dad also said that the negative and positive posts of the battery must never receive a direct ***short*** across the posts because the battery might explode.

All those warnings made James a little nervous, but he knew that Dad just wanted to make sure James knew how to handle the battery safely. "Alright," said Dad, "now let's go see what Mom's got cooking. It sure smells good."

VOCABULARY

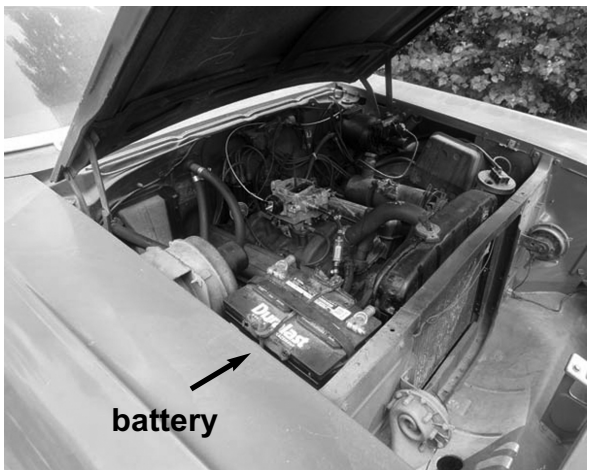
Amperage: measurement of the strength of electrical current
Short: direct contact between the positive and negative points in a circuit
Chassis (chass - ē)***:*** the frame of an automobile
Revolution: one complete 360° rotation of an engine's crankshaft
Spark plug: a device that creates a spark inside the combustion chamber of an engine

Mom and La Shonda had prepared salad, spaghetti and meatballs. After eating and helping clean the dishes, Dad and James walked out to the car and raised the hood.

Dad said, “Here's the battery tray and the hold down straps for the battery.”

James noticed that the spot under the hood where the battery should be was empty, and the thick plastic straps that held the battery in place flopped downward into the empty hole. “Set the battery in the tray, son.”

Even though the battery was heavy, James accomplished this task without difficulty. Once the battery was in place, Dad secured it with the hold down straps.



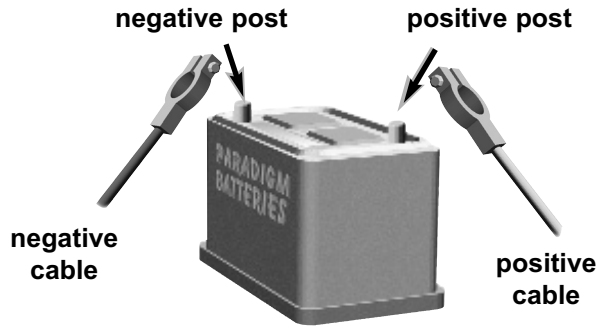
location of battery under hood of 1957 Chevy Bel Air

“Now, we will connect battery cables to the battery. The battery supplies the electricity needed for the car to run. Each battery has two posts—a negative and a positive. These posts must be attached by cables in order for the car to operate. The posts and cables are color coded black, for negative, and red for positive. The negative battery cable is typically the battery cable that is connected from the battery to a part of the car’s ***chassis***. The positive cable connects the positive post on the battery to the starter and other parts of the *primary electrical system*,” Dad explained.

“The negative (black) battery cable is always connected to the negative (-) post, and the positive (red) cable is always connected to the positive (+)post. They should never be mixed up or connected the other way. A battery has what is called *polarity* between its two posts. *Polarity* is the concentration or resistance of electrical fields that affect the flow of power to the car. By connecting the positive and negative posts correctly, you protect the polarity and ensure that the car will operate. If the cables are attached to the battery the wrong way, the polarity would be reversed, and damage would be made to the car’s electrical parts.”

“Wow!” said James. “It sure is important to be paying attention to the right way to install a battery! I sure am glad you know what you’re doing, Dad.”

Dad smiled and said, “Well, I’ve installed a few batteries in my day. Grandpa taught me how to do it properly when I was about your age.”

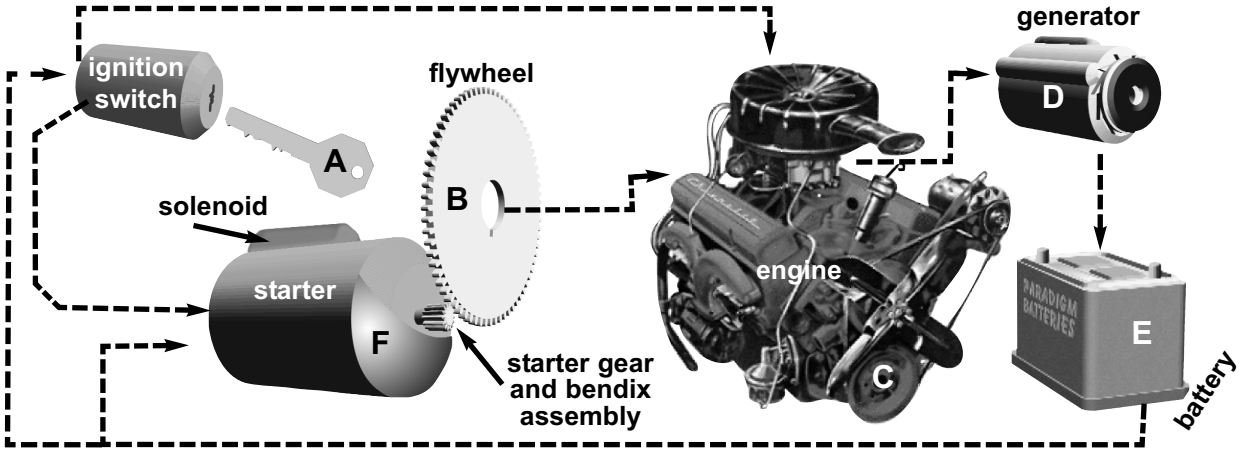


CAR BATTERY



connecting the cables to the posts on the battery

Primary Electrical System



(A) Ignition key turns the ignition switch to allow power to flow from the battery to the starter and electricity to also flow to the spark plugs; (B) the bendix makes contact with the flywheel which turns the engine and the spark plugs ignite the fuel; (C) the ignited fuel allows the engine to run; (D) the engine turns the belt that turns the generator pulley; (E) the generated electricity charges the battery; (F) the battery provides electric power for the starter and ignition system.

Dad then flipped open the shop manual and showed James a diagram of the *primary electrical system* (the solenoid, starter, ignition switch, and generator). The diagram showed how the parts of the engine worked together to make the car run. The solenoid was located on top of the starter and meshed the starter gear into the flywheel gear. The flywheel then turned the crankshaft. The crankshaft ran through the bottom of the engine and connected all of the working parts. James noticed the ignition switch that activated the 12 volt battery. He mistakenly thought that all was in place for the car to run now. He excitedly asked, "Dad, are we ready to start the engine yet?"

Dad grinned and replied, "I'm afraid that we won't be hearing the engine run tonight, but maybe we can 'bump' the engine to see if it will make a complete ***revolution*** of the crankshaft."

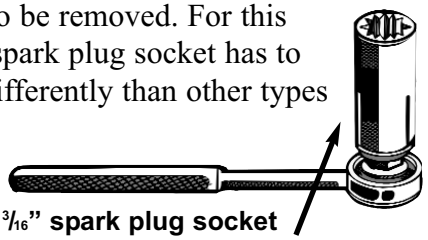
"I don't guess I know what 'bumping' the engine means," said James with a perplexed frown on his face.

"Well," said Dad, "we don't want to start the engine because it still needs quite a bit of work, but we can turn the ignition key on and off quickly to see if the primary electrical system fires up." That sounded complicated to James, but he trusted Dad's knowledge and skills and tried to keep his mind open to learning new things.

"Before we test the system," Dad said, "we'll remove the ***spark plugs***." Dad said that the removal of the spark plugs should help to make the engine turn without much resistance because the air would not be compressed, and no combustion would take place.



Dad told James to select a $^{13}/_{16}$ spark plug socket and the $^{3}/_{8}$ inch ratchet from the tool box. James noticed that the spark plug socket was longer than the sockets he had used to remove the oil pan plug earlier. He mentioned this to his dad, who said, "You're right. A spark plug socket is longer and is called a *deep reach* socket. If you'll look at the socket, you'll understand why. A spark plug is shaped so that the nut sets up above the shank. The socket has to reach over the nut to attach to the shank in order for the spark plug to be removed. For this reason, the spark plug socket has to be shaped differently than other types of sockets."

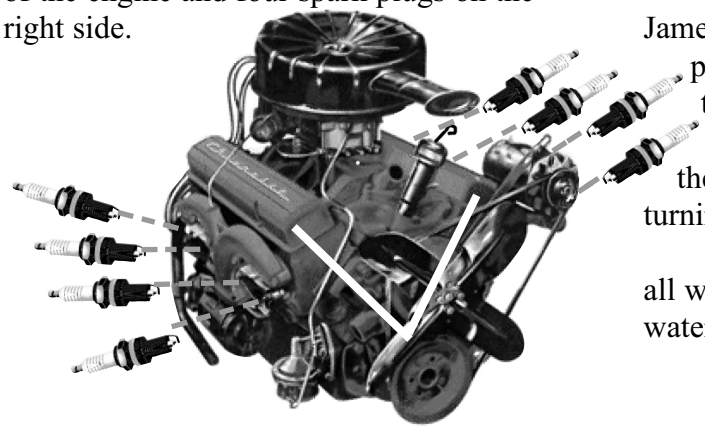


$^{13}/_{16}$" spark plug socket

"Do you know how many spark plugs your Chevy engine has?" Dad asked James.

"No sir," said James.

Dad pointed out that the Chevy's engine was a V-8. The "V" refers to the V-shape of the engine (a right side and a left side connected at an angle). The "8" refers to the number of cylinders (four on each side of the engine). Because the engine was a V-8, it would have four spark plugs on the left side of the engine and four spark plugs on the right side.



notice the "V" shape of the engine block

Dad removed one spark plug. "These will have to be replaced with new ones. I'll pick some up tomorrow before I come home." He asked James to remove the remaining seven spark plugs. Dad sprayed a little oil into each hole created by the removal of the spark plugs. "Now," he said, "the holes where the spark plugs go will allow the air to escape from the engine. This way, the air will not compress when the ignition switch is turned."

"Are you ready to 'bump' the engine?" Dad looked at James.

"You bet!" said James excitedly. "What do I do first?"

"Just get in the car," Dad instructed, "and turn the ignition switch just enough to hear a slight 'er' sound. Then turn off the switch."

James followed Dad's instructions exactly. When he barely 'bumped' the switch, he heard the sweet sound of engine movement. "Listen, Dad!" he exclaimed.

"Great! That means the primary electrical system is working," Dad said with satisfaction. "I knew you wouldn't disappoint me," he smiled and patted the car.

"I heard that," said Mom's voice. "It looks like you're enjoying this every bit as much as James is. I came out to tell you that I just pulled an apple cobbler from the oven."

With a big smile on his face, Dad told James to plug the spark plug holes with torn pieces from a rag to protect them. When this was completed, James closed the hood on the '57. They were through for the night, but what an exciting sound the turning of that engine had been!

Dad put his arm around Mom as they all walked back into the house, mouths watering for that sweet apple pie!

Life Principle



"Minds are like parachutes—
they function only when open."

—Anonymous



Lesson 7

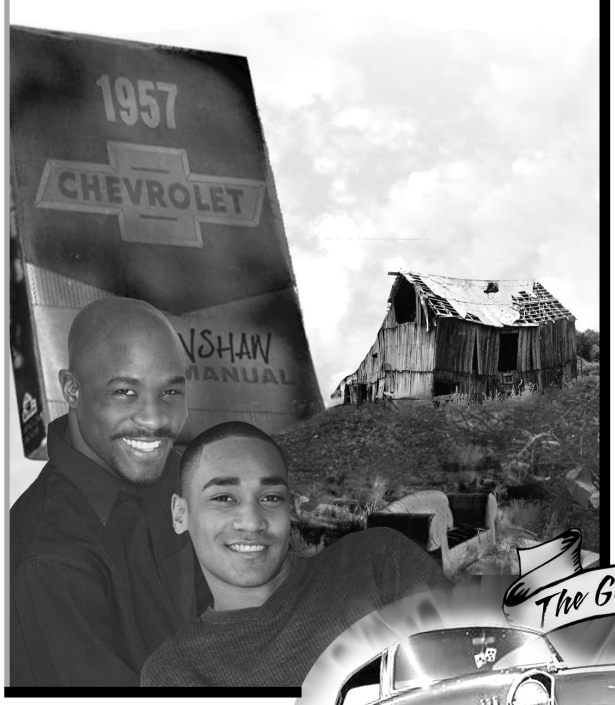
Automotive

Chapter 1

Section 2

Lessons 6-10

PROMISES AND HARD WORK





Early the next morning, Dad woke up James and said, "I think you should start cleaning up Mr. Crenshaw's lot today; you have a promise to keep."

After a big breakfast of eggs, orange juice, and wheat toast, James packed his lunch.

"Hey, James," said La Shonda. "I filled a cooler with water for you to take to your job site."

"Thank you for thinking of me, Sis," James said. "I'm sure I'll need a lot to drink. I plan to work pretty hard today."

Dad had hitched the rented trailer to the truck so that James could load junk to be hauled from the lot. When they reached Mr. Crenshaw's place, James unhooked the trailer. Before Dad left for work, he told James to be careful and to be ready to go home at about 4:30 P.M.



James spent the day removing debris, such as scrap metal, wood, glass, and paper, from the tall weeds, cutting brush with a saw and hatchet provided by Mr. Crenshaw, and cleaning out the shed where the '57 Chevy had been stored.

While James was working in the shed, he was surprised to see his grandpa pull into the driveway. James shouted, "Hi, Grandpa! How are you today?"

"Oh, hello, James. Your dad told me you'd be here today. I came by to see if I could beat my old friend at dominoes."

Grandpa knocked at the back door of the house and was promptly admitted by Mr. Crenshaw, who appeared pleased to see his old buddy. James continued with his work, finding many old tools and objects of interest in the shed. Grandpa and Mr. Crenshaw left after a short time to visit the Senior Citizens' Center for lunch and games of dominoes.

VOCABULARY

Compression tester: device used to determine the amount of pounds per square inch of pressure in a cylinder

Oil Filter: removes impurities from oil

Air gap: the distance between the electrode and the metal on a spark plug

Piston: a device that travels up and down inside a cylinder

Cylinder: holds the piston in place and creates compression

After several hours of hard work, James looked at his watch and realized that Dad would be arriving soon. James began gathering his tools to put away when Dad arrived.

"Well, I see you made progress!" said Dad as he looked proudly at his son.

"Look, Dad," said James, "I've made separate piles of different materials to go to recycling plants. All the plastics are here; all the papers are in this bin; the metals I piled over there, and the glass is in this crate." James motioned with his hands to indicate each pile. "I've designated all of the wood, rubber, and other miscellaneous materials to go to the city dump."

"Excellent!" Dad said. "You have a good plan. Not only will you get paid by Mr. Crenshaw to clean his lot, but you will also receive a small amount of payment at the recycling plants for each load. We'll have to wait on the recycling piles because those places are closed for the night, but we can take the dump pile to the city landfill tonight." They loaded it all onto the trailer and started on their way.

After leaving the landfill, they stopped at the auto parts store and purchased eight spark plugs, a spark plug gauge, an oil filter, and six quarts of 30-weight oil. Dad also rented a cylinder ***compression tester*** (gauge).

When they arrived home, James took a shower to remove the grass and grime that had accumulated while working on the lot. As they ate supper, James told Mom and La Shonda about the day's work and about seeing Grandpa. When supper was over, Dad and James went out to the '57, raised the hood and removed the rags from the spark plug holes.

From his tool box, Dad selected an oil filter wrench and a $^{11}/_{16}$ socket and ratchet from the tool box. Because the oil filter is toward the bottom of the engine, James and Dad had to get under the car. After James was situated directly below the engine, Dad gave instructions on how to check the oil drain plug for tightness and how to remove and replace the oil filter. "Slide the oil filter wrench around the oil filter and try to unscrew it from its recepticle under the engine."



oil filter

"It's pretty tight, Dad," said James as he grunted with exertion.

"Okay, I thought that might be the case. Now, use your socket wrench and place it around the nut on top of the filter. Use the socket wrench as leverage and turn the oil filter wrench again."

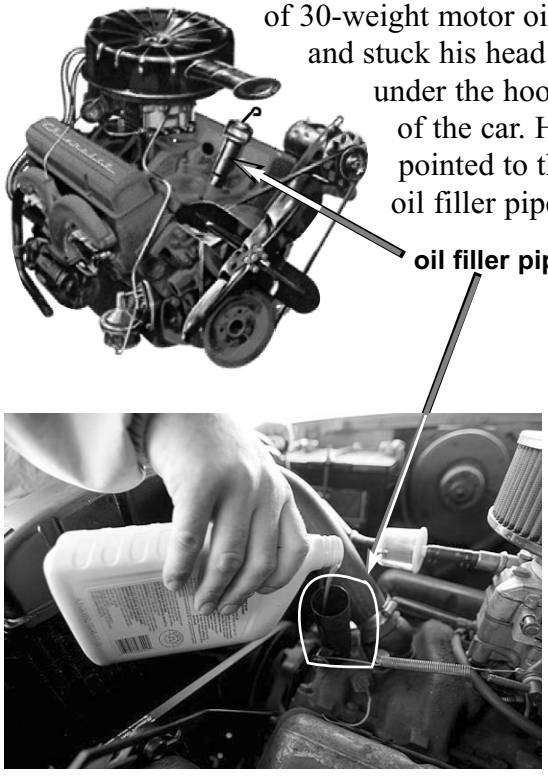

oil filter wrench

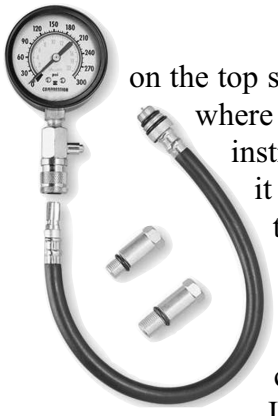
"Got it!" said James as he carefully unscrewed the filter. Dad handed him the new filter to put into place.


tightening the new oil filter into place

"Before you tighten the new one, dip your finger in some oil and lightly grease the seal of the recepticle, then tighten the new filter into place," said Dad. James did this, and he and Dad crawled out from under the car.

Dad opened the bottles of 30-weight motor oil and stuck his head under the hood of the car. He pointed to the oil filler pipe



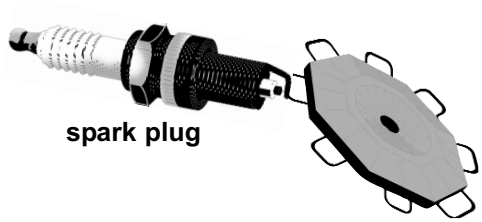


compression gauge

on the top side of the engine. "This is where the new oil goes in," he instructed James. He poured it into the engine through the oil filler pipe.

Dad then screwed the compression gauge into one of the spark plug cylinders. He looked at James and said, "Bump the engine like I showed you before, son." While James was performing this assignment, Dad wrote down the amount of pressure or compression registered on the cylinder. They repeated this process for each of the eight spark plug cylinders. Dad compared his notes for each cylinder, and found that they were all close to the same readings, and that the pressure in each cylinder was within operational limits according to the manual.

Next, Dad opened the box of new spark plugs. He consulted the manual and discovered that the ***air gap*** on the spark plugs was supposed to be set at .035. Dad set each spark plug gap using a set of spark plug gap gauges.



spark plug

spark plug gap gauge

VOCABULARY

Connecting rod: connects the piston to the crankshaft

Crankshaft: a shaft through the engine that connects the piston and piston rod from each cylinder to the common source, and turns downward power into rotational power

During this time, Dad explained to James how a spark plug worked in relation to a ***piston***. Each ***cylinder*** had both a spark plug and a piston. The spark plug was in one end of the cylinder, and the piston in the other end. The piston fits tightly into the cylinder and is forced to move up and down by an explosion. The explosion in the cylinder is produced by two things: 1) burning gases (from the fuel) and 2) the sparks from the spark plug.

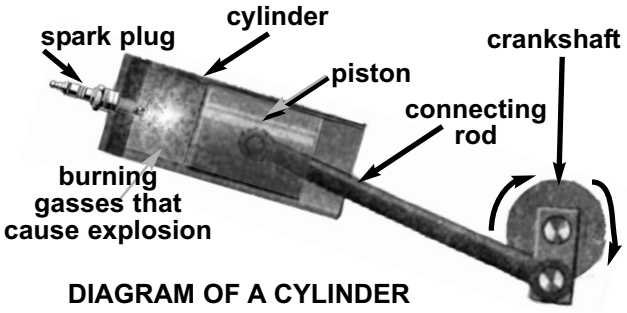


DIAGRAM OF A CYLINDER WITH SPARK PLUG AND PISTON IN ACTION

Each piston is connected to the ***crankshaft*** by a ***connecting rod***. The purpose of the crankshaft is to convert the explosive energy that thrusts the piston downward in the cylinder into a useful, rotating power source.

Dad showed James how to use the $^{13}/_{16}$ spark plug socket and ratchet to install all eight spark plugs. Dad then connected the spark plug wires to each of the eight spark plugs according to the firing order stated for this engine in the manual.

"Well, I think that'll do for tonight, son", Dad said. "Let's go in and enjoy some time with Mom and LaShonda before bed time." As they cleaned up the work area, James thanked Dad for his instructions. The two men headed to the house for some much needed rest.

Life Principle



"You may delay, but time will not."

—Benjamin Franklin



Lesson 8

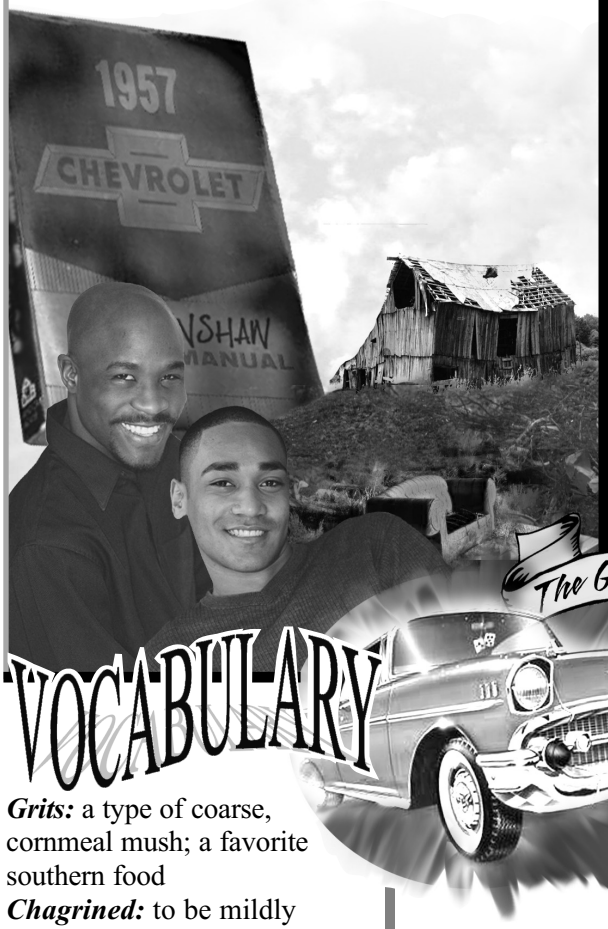
Automotive

Chapter 1

Section 2

Lessons 6-10

GETTING FIRED UP



James awoke the next morning when Dad walked into the room and flipped on the light. "It's time to get up, son. Remember, today you are scheduled to mow Mr. Crenshaw's lot."

"How could I forget?" yawned James, as he threw his legs over the side of the bed. He dressed for the day, then splashed some cold water onto his face at the bathroom sink, brushed his teeth, smoothed his hair, put on deodorant, and found his way to the kitchen. There, he packed a lunch and filled his cooler with water while his mother prepared ***grits***, eggs and sausage for breakfast.

After they ate, Dad and James loaded the lawn mower, gasoline can, and oil into the truck. On the way to Mr. Crenshaw's, they talked some more about how engines work. Dad reminded James that an engine requires four things in order to run: *fuel* (in the form of gasoline, propane, or diesel); *air* (brought in through the carburetor by a vacuum); *compression* (of fuel and air); and *spark* (provided by the spark plug). Dad continued, "If any one of these four factors is missing, or if they are not properly timed together, the engine will not function."

Dad helped James unload the lawn equipment and cautioned James to be careful, then left for work. James planned to start the lawn mower immediately so he could cut the high weeds on Mr. Crenshaw's lot. He pulled several times on the starter rope, but could not manage to get the mower to start. As he stood there impatiently, he had a flashback to his earlier conversation with Dad. He checked the ignition spark by removing the spark plug and turning over the engine. He saw a spark at the bottom of the plug. Next he tried the compression and found that it was good. He looked into the gas tank and was ***chagrined*** to find no gasoline. He was grateful that his dad had thought to bring the gas can! After filling the gas tank, the mower started with a hum, and James began to get rid of the unsightly weeds that had taken over Mr. Crenshaw's place.

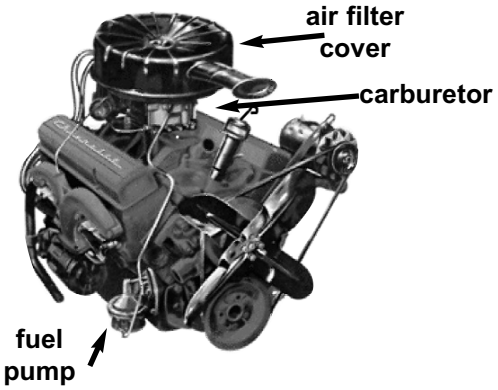
VOCABULARY

Grits: a type of coarse, cornmeal mush; a favorite southern food
Chagrined: to be mildly embarrased or humiliated
Filter: a device for straining a fluid through a porous substance to remove solid particles
Pump: a device that moves fluid from one place to another
Prime: to put a small amount of combustible material directly into a carburetor in order to start an engine
Idle: to operate without transmitting any significant power, as when a car engine is running but the vehicle is stopped

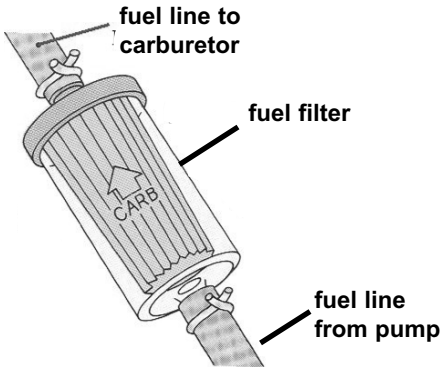
Dad picked up James after 5:30 p.m. and explained plans to work on the Chevy after supper. When they had eaten, Dad said, "James, if you will go to the garage and get the tools ready that we'll need to change the fuel filter and air filter, I'll help Mom with dishes, then we will tackle the next step in getting that Chevy running!"

"Okay, Dad! Meet me out there in a few minutes!" James exclaimed. Then he added, "Thank you, Mom. Supper was really good."

As they surveyed the car, Dad said, "First, we'll replace the fuel ***filter***. Each car model is different, so sometimes the fuel filter is difficult to find, but it is somewhere between the fuel pump and the carburetor."



Dad continued educating James on the fuel filter. "All of the fuel flowing through the fuel line goes through this filter to ensure that the carburetor receives only clean fuel, free of dust particles and debris."



Dad found a diagram in the manual to illustrate his point. "The filter is housed or cased in some kind of holder. Older model cars often had glass housing around the fuel filter, but modern cars have plastic or metal."



modern plastic fuel filter housing (casing)



open end wrench

James located the fuel-filter and saw that the nut on top of the casing was attached to the fuel line. He had to find a $\frac{7}{8}$" open end wrench to loosen and remove the fuel line. Located inside the large, hollow casing was the fuel filter. Dad handed James the new fuel filter. James placed it inside the casing and reattached the fuel line.

Dad said, "We're getting close, son. We should get her up and running tonight! Pour some gasoline into the fuel tank." Dad then loosened pressure lines on the fuel ***pump*** and told James to 'bump' the ignition switch. When he did, gasoline was pumped through the loose connection on the fuel line. This indicated that the fuel pump was functioning properly.

After tightening the line, Dad said, "Now, we're almost ready!" He took off the air filter cover and sprayed some Ignition Start (a lubricant) into the throat of the carburetor to ***prime*** the engine. He explained that this was necessary because no gasoline had been pumped into the carburetor yet. Then, Dad said, "Okay, James, see if the car will start."

After the engine turned several times, James heard a noise that sounded like a bellow. Blue smoke curled out of the tailpipe. In a few minutes, the ***idle*** rate slowed to normal, and the smoke disappeared. After letting the engine run for awhile, Dad said, "Shut it down, now, so it won't get hot."

Life Principle

"When you are committed to something, you accept no excuses, only results."

—Kenneth Blanchard





Lesson 9

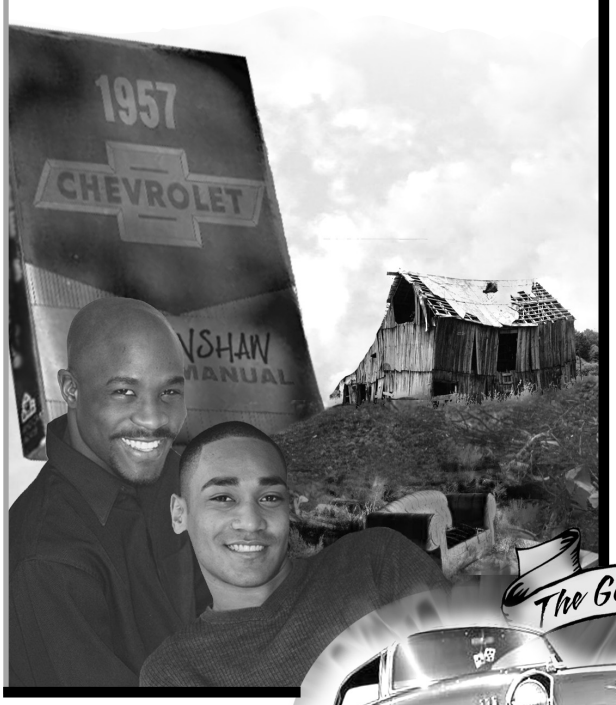
Automotive

Chapter 1

BELTS AND CONFIDENCE

Section 2

Lessons 6-10



James awakened to the smell of breakfast sausage cooking. As he dressed for the day and threaded his belt through his pants' loops, he recalled that today, he and Dad planned to install some ***belts*** on the '57 Chevy engine. James hurried downstairs and found Dad at the table. "Hey! Dad, today we're going to work on the drive belt, right?"

Dad laughed at his son's enthusiasm and said, "Well, I think that's a good idea. Let's go buy a belt before I leave for work this morning."

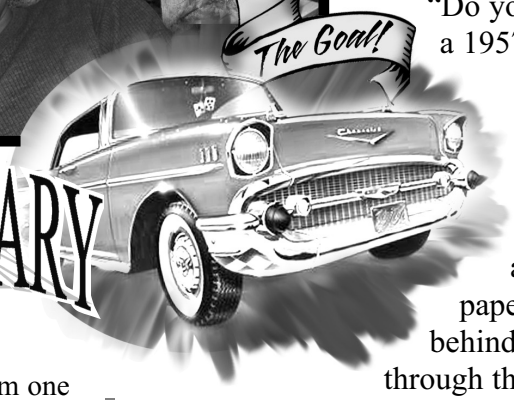
After breakfast they drove to the auto parts store where Mr. Jones, the manager, was just opening up. Dad greeted him and then inquired, "Do you happen to have any drive belts for a 1957 Chevy Belair V-8?"

With a strange look on his face, Mr. Jones replied, "I just threw away a whole box of old, out-dated belts!"

He quickly looked up the number for a 1957 Chevy V-8 belt and wrote it down on a piece of paper. He went out to the trash cans behind the store and proceeded to dig through them until he found a belt with the correct number on it. "You're just in time. Another 30 minutes, and these would have been gone forever! I don't imagine '57 Chevy belts are too abundant in this town!"

Dad asked Mr. Jones for the price of the belt. He said, "You don't owe me anything. I had already thrown away the belt. I hope it works for what you need." Just as he made that comment, the garbage truck arrived.

Thanking Mr. Jones, Dad and James returned to the truck and drove home. At the house, Dad told James to follow the manual's instructions for installing the belt and not to attempt starting the engine. "The reason we didn't let the car run very long last night was because without the water pump and belts working



VOCABULARY

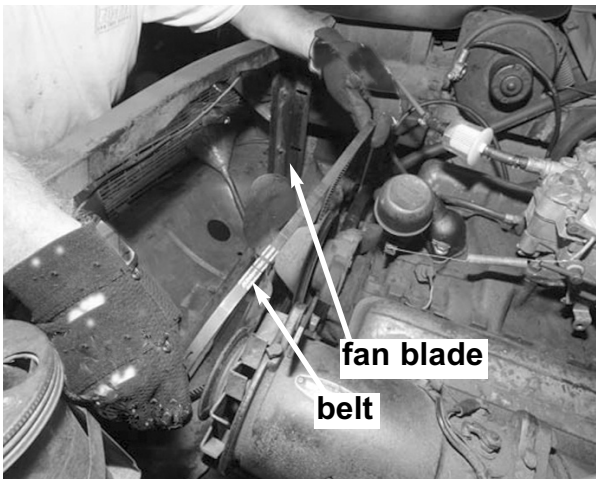
Belt: a thick band for transferring motion from one pulley to another
Reference: a connection; a place or information to which one can refer
Resistance: opposition to some force
Crankshaft pulley: drives the belt that moves the water pump and generator
Bracket: a supporting piece
Tension: to regulate the tautness of a belt

correctly, you could let the engine get too hot and could cause a lot of damage. I want you to wait until I get home before you try to start the engine."

James promised that he would wait. He was a little nervous about to installing the belt on his own. However, he had learned from past experience that he could succeed if he stayed calm and followed instructions. Working on the Chevy had really helped to build self-confidence in his ability to get things done properly.

Dad left for work, and James went into the house to get the manual. He carefully read the part about installing the drive belt, then went out to the garage, picked up the toolbox and carried it to the picnic table. Next, he laid out all the tools needed for installing the belt. He kept the manual handy for reference purposes.

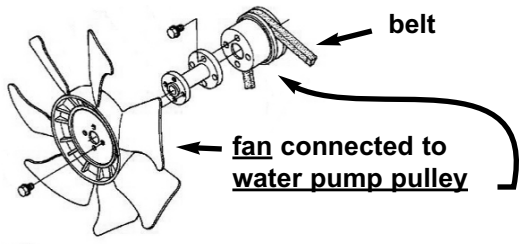
He raised the hood and found the drive belt and engine fan right in front just behind the radiator, as the manual indicated.



location of fan and belt under hood

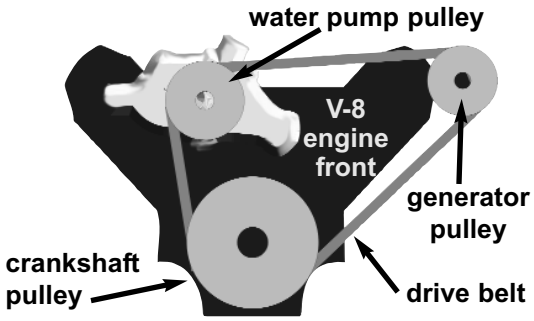
He tried the fan with his hand and discovered that it turned without ***resistance***. James used the fan as a point of ***reference*** for the pulley system because the fan was connected to the water pump.

Earlier, dad had explained that the radiator and the fan, along with the water pump, worked to keep the engine from overheating. While a car is in motion, air and



water flow through the radiator and cool before flowing to the engine. However, when a car is stopped, like in traffic, or is idling, the fan is activated to cool the air before it enters the engine area.

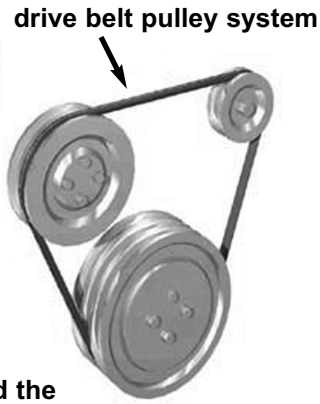
James knew that the belt needed to be stretched over the fan, and around the three main pulleys of the drive belt system—the water pump pulley, the generator pulley, and the ***crankshaft pulley***.



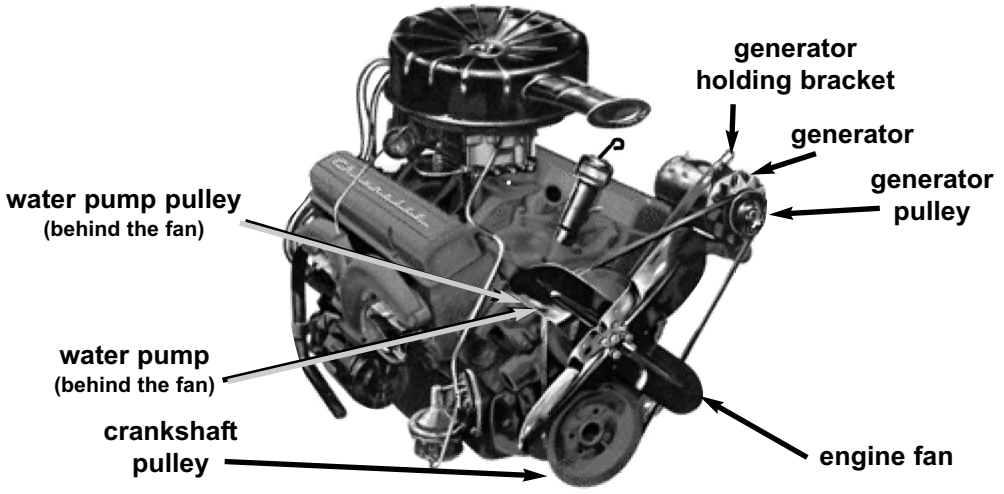
James removed the belt from its packaging and gently slid it over the fan, making sure that it cleared all of the blades, and placed the belt in the grooves of the pulleys.



the fan is connected to the water pump



the belt rotates around the three pulleys (water pump, crankshaft, generator)



James found that placing the belt around the pulley system was difficult. The crankshaft pulley was located toward the bottom of the engine and was difficult to reach. James placed the belt around the pulley on the water pump and tried to make the belt go around the generator pulley.

He discovered that the belt was too short. He checked the number on the belt against the number in the manual and found that they matched. He evidently had the right belt, but did not understand why it would not fit. Upon closer inspection, James discovered that the manual showed a ***bracket*** on the generator pulley that could be adjusted.

James used a 9/16" socket wrench to loosen the bracket. He found that the generator would slide forward just enough to place the belt around the pulley. James then used a long handled screwdriver placed between the bracket and generator to pull the belt tight. He held it in place and tightened the 9/16" inch bolt, thus securing the belt ***tension***. Another job was completed!

James was surprised at how much time had passed when he checked his watch. He had worked right through lunch! Before long Dad would be home from work. James put away the tools and then went into the house to wash up and eat lunch.

LIFE PRINCIPLE



"Determine that the thing can and shall be done, and then we shall find the way."

—Abraham Lincoln



Lesson 10

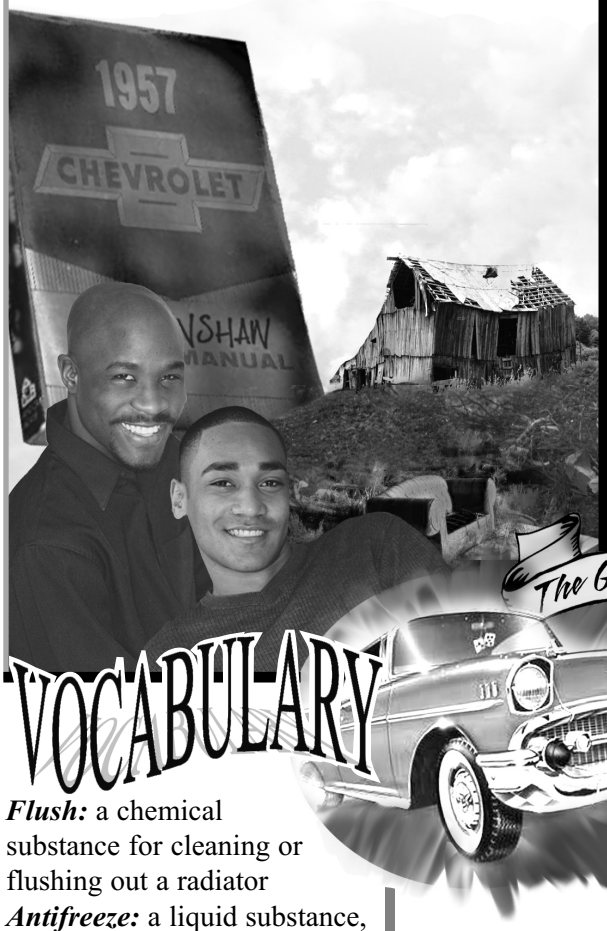
Automotive

Chapter 1

Section 2

Lessons 6-10

IN HOT WATER



VOCABULARY

Flush: a chemical substance for cleaning or flushing out a radiator

Antifreeze: a liquid substance, such as ethylene glycol or alcohol, mixed with water to prevent freezing of water in the engine

Reconditioned: to make fit for work or use again

Lubricated: made slippery or smooth

Fahrenheit: temperature scale that registers the freezing point of water at 32 degrees and the boiling point at 212 degrees

The next evening, Dad and James were watching a documentary on historic automobiles. When it was over, Dad turned off the television and said, "Let's make a list of parts we are going to need for our next work session on the Chevy. We will be dealing mostly with the cooling system, and that means that we will need quite a few replacement parts."

"This is so exciting, Dad!" said James. "I can hardly wait until tomorrow to start working on it again."

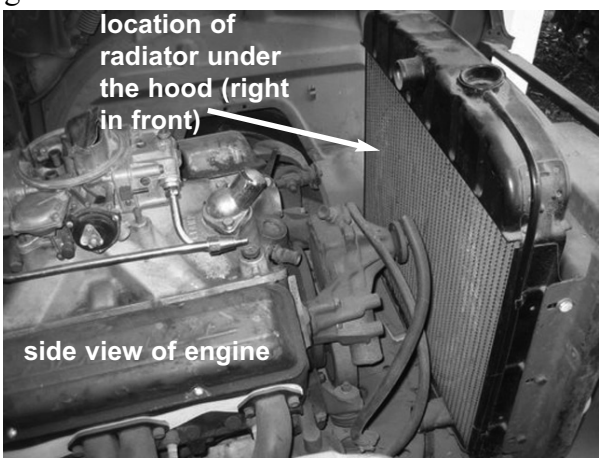
"This week is going to be very busy with LaShonda's ball games and piano recital, son," Dad cautioned, "so we'll wait until Friday to start work again on the Chevy. However, we can go ahead and make our list and plan our next step."

James was disappointed, but he understood that he couldn't take all of Dad's time. His little sister needed special attention, too. James picked up a note pad and began to write down each item as Dad called them out. When he was through, James read back the list. "Let's see, we have: top radiator hose, bottom radiator hose, four $1\frac{1}{2}$ inch worm drive clamps, two heater hoses that are 6 inches long, four $\frac{3}{4}$ inch worm drive clamps, radiator cleaner or ***flush***, ***antifreeze***, radiator cap, carburetor cleaner, and air filter. Is that all?"

"That sounds about right," said Dad. "All of those parts are probably going to cost in the neighborhood of $50.00."

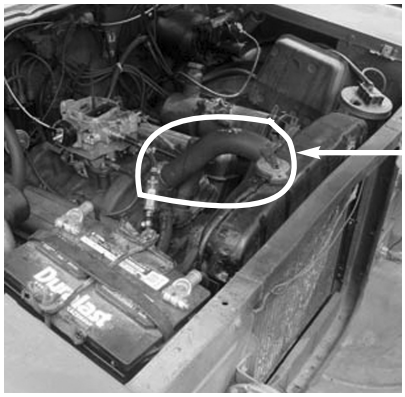
As James worked for Mr. Crenshaw that week, it seemed as though Friday would never arrive, but time passed quickly, and before he knew it, Dad came home Friday afternoon with a sack full of items he had purchased at the auto parts store. James could hardly wait to get started, so he carried the bag of parts out to the Chevy, with Dad following close behind.

Dad began by saying, "Even though the radiator has been ***reconditioned***, we still need to install all of the hoses and then flush the system with the chemicals that I bought." Dad told James to open the hood and locate the radiator right in front, just behind the grille of the car.



above engine pictured without radiator hose or radiator cap

Dad pointed out the parts of the radiator system, such as the radiator cap on the top of the radiator and the valve on the backside where a hose would be installed to connect the radiator to the water pump on the engine block. Another hose connected from the bottom of the radiator so water could travel back out of the radiator and back into the engine.



top radiator hose—connects radiator to water pump on engine block



radiator hose

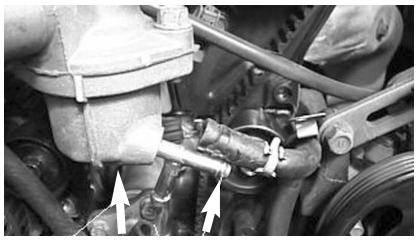
James located the connections on the radiator and the water pump. He began by cleaning each connection. Then he ***lubricated*** them with soapy water. After that, Dad slipped a hose over the bottom radiator outlet and the return flow outlet on the water pump. Following Dad's instructions, James slipped the clamps into position and tightened them with a flat headed screwdriver. James repeated the same process for the top radiator hose.



clamp



flat head screwdriver



water pump and hose

The next step was to measure and cut the two hoses running from the water pump to the heater. Dad cleaned, lubricated, and installed the heater hoses. This task required use of two, $^{3}/_{4}$ inch clamps, one on each end of each heater hose. After installing the hoses, Dad tightened the clamps, making the cooling system water tight.



heater hoses

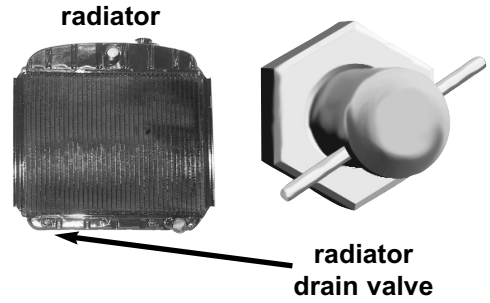
Dad poured the flushing agent into the radiator (through the opening under the radiator cap) and topped it off with water. Finally, he put on the radiator cap. When he had completed these tasks, Dad smiled and said, "Now crank the engine so we can check for leaks."

radiator cap



radiator cap screws into top of radiator

They did not discover any leaks, so Dad let the engine run for about twenty-five minutes. This allowed the flushing agent to clean the radiator and the inside of the engine. "Now, we need to drain the flushing agents," Dad said. He pointed out the radiator drain plug (located at the bottom of the radiator) and showed James how to drain the system completely.

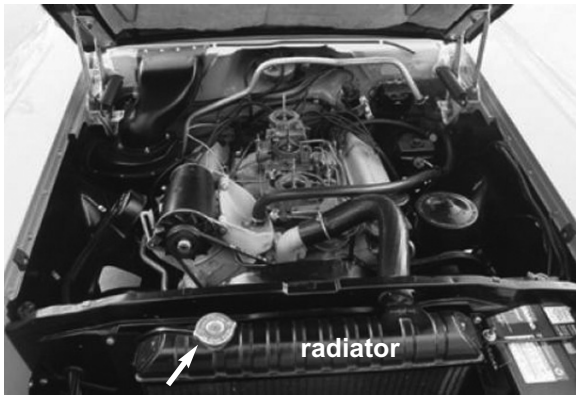




radiator flush draining from radiator

After retightening the radiator drain, James went to the garage to get the antifreeze. Dad read in the Chevy manual that 1 gallon of antifreeze would give protection against freezing, up to negative (-) 20 degrees ***Fahrenheit***. This would provide adequate protection for the engine and keep it from freezing as the water circulated through the system.

Dad said, "Frozen water in the system would mean a cracked engine, which would have to be replaced and be very costly." He also warned that a lack of water in the radiator would cause the engine to overheat, which could also crack the engine.

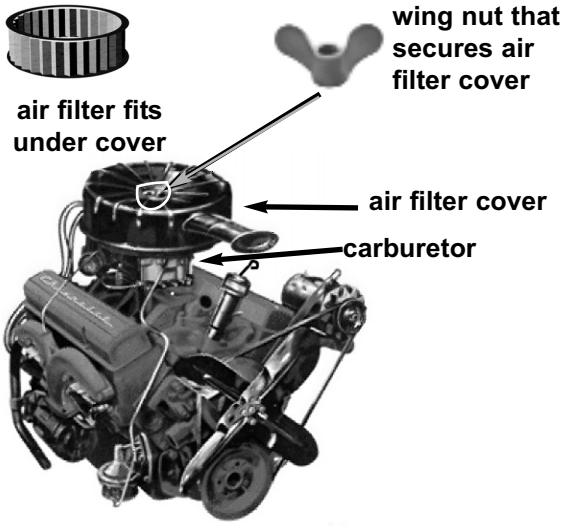


radiator cap

After adding the antifreeze, James finished filling the radiator with water. Next, he restarted the engine and let it run until the radiator was warm, but not hot. James turned off the ignition and waited for further instructions from Dad.

Dad removed the wing nut securing the air filter cover. He sprayed the carburetor liberally with cleaner and let it dry. After removing the old air filter, he asked James to install the new air filter. After screwing the wing nut back on the top of the air filter cover, James once again started the engine. To his delight, the engine ran smoothly—like the sound of a purring kitten. Clean air really made a difference!

Turning to Dad with a big smile, James exclaimed, "We're getting closer and closer to our first test drive! I can hardly wait, Dad."



Life Principle



"We do not work for each other; we work with each other." —Stanley Gault



Lesson 11

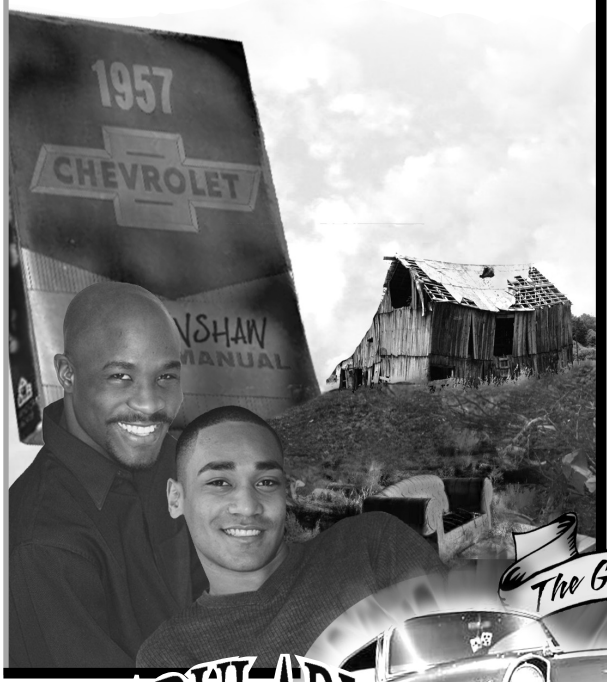
Automotive

Chapter 1

Section 3

Lessons 11-15

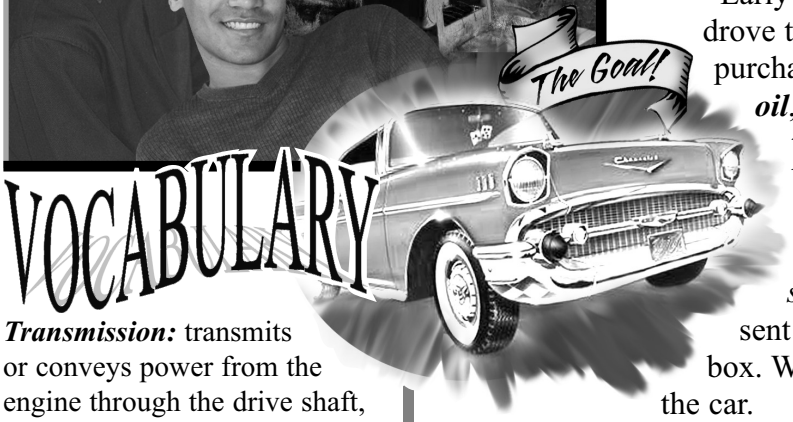
SLICKING THINGS UP



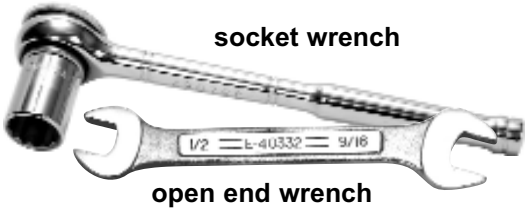
The more times James started the Chevy, the more he dreamed of driving it down the road. Part of the reason for this came from his sense of accomplishment and knowing that he had made good progress toward restoring the car. As Dad and James sat on the couch in their living room, Dad began to explain the things that still needed to be done to make the '57 Chevy street-ready.

Dad explained that the next item on the list was the *drive train*, which consisted of the clutch, ***transmission***, ***drive shaft*** and ***differential***. Then, they would check to be sure that the ***brakes*** were in good working order.

Early Saturday morning, Dad and James drove to the auto parts store where Dad purchased two gallons of 90-weight ***gear oil***, two gallons of 120-weight oil, and two tubes of axle grease. On the way back from the auto parts store, they stopped at Mr. Crenshaw's place to borrow his *grease gun* and *oil syringe pump*. Back at the house, Dad sent James to the garage to get the tool box. When James returned, Dad was under the car.



From under the car, he called, "Hand me the $^{9}/_{16}$ inch open end wrench and the $^{1}/_{2}$ inch socket wrench. Now, slide the flat pan and the 90-weight gear oil under the car."



socket wrench

open end wrench

James gathered the items, then crawled under the car to see what was going on. He found Dad busy loosening and unscrewing the plug from the bottom of what James thought was the transmission. "This is where the old transmission oil comes out," Dad explained. "Watch out. It's no fun to get on you." As soon as

VOCABULARY

Transmission: transmits or conveys power from the engine through the drive shaft, differential and axles to turn the wheels

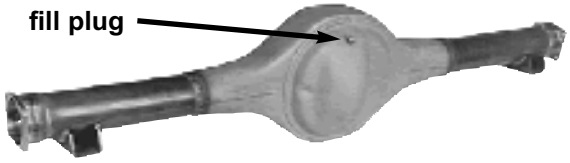
Drive shaft: a metal shaft through which mechanical power from the engine is transmitted to the differential and the wheels

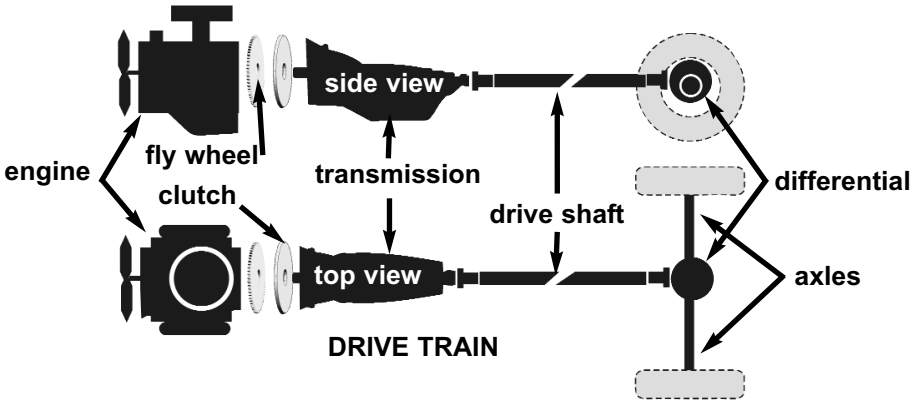
Differential: an arrangement of gears connecting two shafts or axles and a drive shaft (in the same metal casing)

Brake: to slow or stop a car by controlled friction

the plug was out, the old, black, gummy, thick gear oil began to ooze out of the opening. It took several minutes for the oil to drain.

In the meantime, Dad loosened and unscrewed the *filler plug* on the side of the transmission. "This is where the new oil goes in," Dad said. When the old oil had stopped draining from the transmission, Dad replaced the bottom plug. He then drew some new, 90-



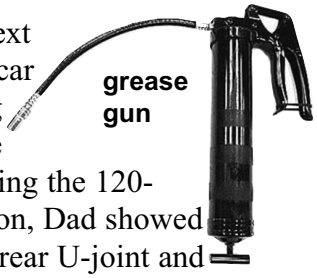


weight gear oil from the gallon can into the syringe pump and shot oil into the transmission through the filler plug, then replaced the filler plug.



While under the front part of the car, Dad greased the front ***U-joint*** of the drive shaft, using the grease gun he had loaded with axle grease.

Dad and James next moved to the rear of the car and repeated the draining and filling process on the differential (rear end), using the 120-weight gear oil. In addition, Dad showed James how to grease the rear U-joint and collect the old gear oil for disposal in a proper container.



They finished servicing the drive train, then crawled out from under the car. The process had been a long and dirty one!

VOCABULARY

Gear oil: oil that is heavier than engine oil but more liquid than grease
U-joint: a universal joint; a device used for connecting the drive shaft to the transmission and the differential

Life Principle



"Wise are they who have learned these truths—trouble is temporary, time is a tonic, tribulation is a test tube."
—William Ward



Lesson 12

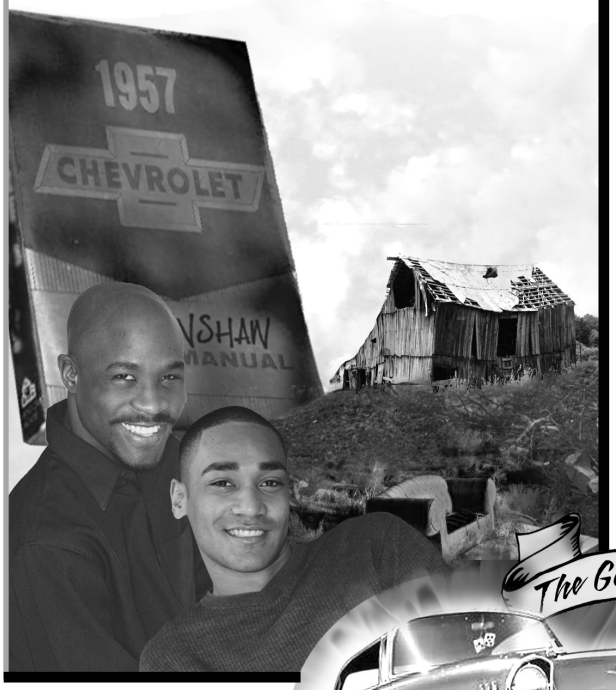
Automotive

Chapter 1

Section 3

Lessons 11-15

PUTTING ON THE BRAKES

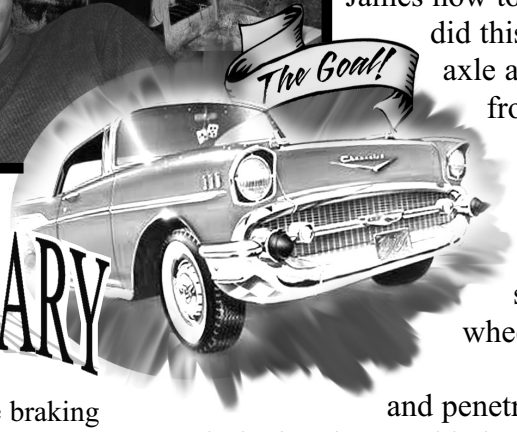


After James and Dad had eaten lunch, Dad asked, "Are you ready to do some more work on the car today?"

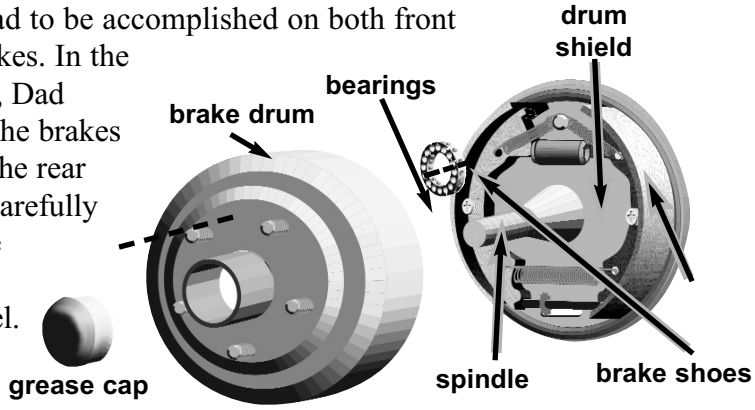
Even though James was tired, he knew that the day of road testing the Chevy would not come if he did not take full advantage of available time, so he answered, "You bet, Dad!"

"Then we will work on the brakes next. That will require another trip to the parts store, but first we need to check out a few things." They went out to the car, where Dad instructed James to jack up the car and remove all four wheels.

When this was accomplished, Dad showed James how to remove the front brake ***drums***. He did this by popping the grease cap off the axle and removing the large nut from the front ***spindle***. Next, they loosened the *brake shoes* through an opening in the back of the front drum shield. When the brake shoes were loosened, the brake drum and hub slid right off along with the front wheel bearings.



Next, Dad mixed some kerosene and penetrating oil and instructed James to wash the bearings and hub until all the grease was gone. This process had to be accomplished on both front wheel brakes. In the meantime, Dad loosened the brakes shoes on the rear axle and carefully tapped the drums off each wheel. This left all of the



VOCABULARY

Drum: the part of the braking system that the brake shoes engage; absorbs pressure from the brake shoes

Spindle: mechanical part that revolves or serves as an axis for larger revolving parts

Wheel bearing grease: special grease that holds to the bearing under hot conditions

Bleed: to draw off a substance from a container, such as to eliminate air from brake lines

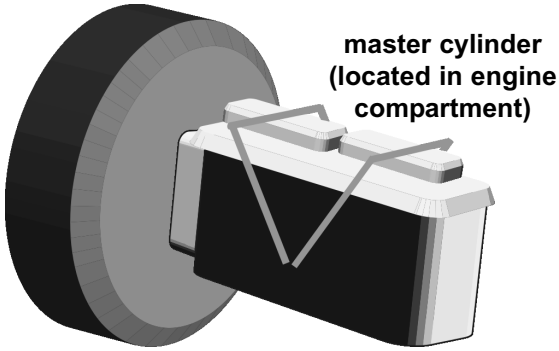
brake shoes exposed. James noticed they were worn thin from using the brakes.

After inspecting all the brake shoes and the front wheel bearings, Dad announced, "It's time to go back to the auto parts store." When they arrived, Dad bought front brake shoes, rear brake shoes, brake fluid, and ***wheel bearing grease***.

Back at home, Dad proceeded to remove the brake shoes by releasing the hold down springs and clips. He then installed the new brake shoes one at a time until all were properly in place. While Dad was installing the brake shoes, James followed his dad's instructions to pack the wheel bearings with wheel bearing grease. James made sure that each bearing roller was covered with plenty of grease.

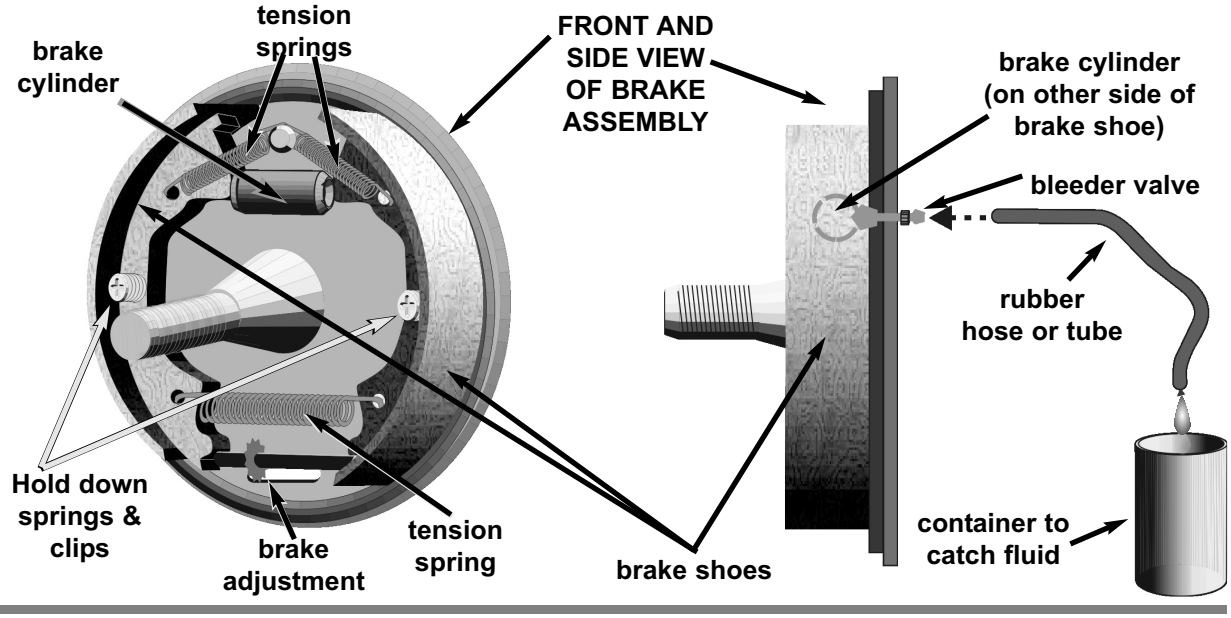
The next project was to install the brake drums. Dad loosened the adjustments so the drums would slide over the new shoes.

Dad remarked, "Now we need to ***'bleed'*** the brakes. You will need to get inside the car and pump the brake pedal until I tell you to hold it down. As I open the bleeder valve and let some air off the brake cylinder, you will feel the pressure release on the pedal. Continue to hold down the pedal until I tell you to pump it again. We will repeat this procedure on each wheel brake assembly until the pedal feels solid when you step on it and it stays well off the floorboard when you apply pressure on the pedal. Each time I open the bleeder valve, brake fluid will also bleed out with the air, so we will have to be sure that the brake *master cylinder* reservoir stays full of brake fluid. To do that, we will check the fluid level after bleeding each wheel cylinder."



At Dad's signal, James began to pump the brake pedal. It felt soft and spongy as he applied pressure; he could push the pedal almost to the floorboard. Dad opened the bleeder valve and released the air pressure in the brakes. Then, he closed the valve and told James to pump the brakes again to build up pressure, then to hold the pedal down with steady pressure. This time, the pedal still went too far to the floorboard.

Dad said, "We'll have to repeat the



process of bleeding the brakes again because we still have air in the lines."

After repeating the process, the brake pedal became firm, and James was not able to push it more than halfway to the floorboard. Dad looked at the position of the brake pedal as James was applying pressure and decided that the air finally had been bled from the brake system and the brakes would now work properly.

James and Dad then replaced the wheels and tested how the brakes affected each wheel: James pressed the brake pedal down while Dad tried to rotate each tire by hand. Each wheel responded well to the brakes. Dad grinned and said, "Another job well done, James. You are getting to be quite the mechanic!"

"Thanks, Dad! It's been awesome!" James said. "Should we lower the car to the ground or leave it up on blocks?" he asked.

"We can leave it up tonight, son," Dad answered. It was getting dark outside, and Dad was not anxious to start anything else that evening. James happily put away the tools. Later that night, he went to bed with a great feeling of appreciation for his dad and Mr. Crenshaw.

LIFE PRINCIPLE



"Many hands make light work."

—Latin Proverb



Lesson 13

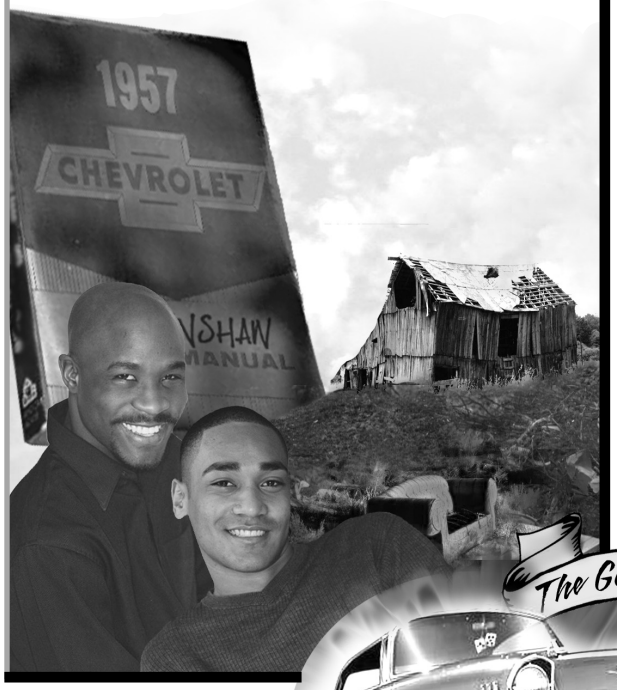
Automotive

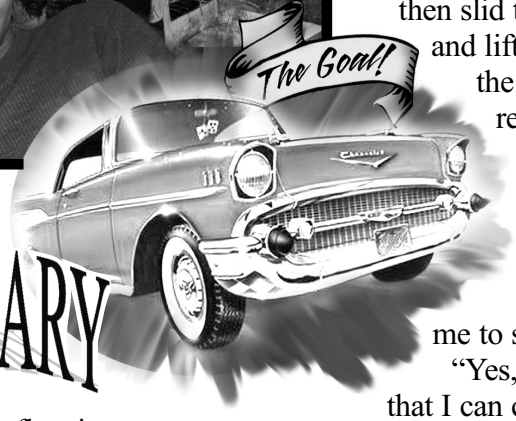
Chapter 1

Section 3

Lessons 11-15

CHECKING IT OUT





The time was drawing near! After attending church services on Sunday, eating a wonderful home-cooked meal and changing clothes, James coaxed Dad into going out to the car. After standing silently for a few minutes, admiring their handiwork, Dad said, "Raise the hood, and I'll show you how to check the oil."

"Ho! I'm a step ahead!" said James triumphantly. "I already read the manual and checked and drained the oil a few days ago."

"Excellent," said Dad. "Demonstrate to me that you remember."



James lifted the dipstick from the oil reservoir and carefully wiped it with a rag. He then slid the dipstick back into the reservoir and lifted it a second time to read where the oil came to on the measurement reading. "When the oil level gets below the 'add' mark, that means that it's time to add a quart of 30-weight oil," James said.

"Very good," Dad said approvingly.

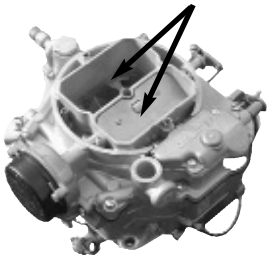
James inquired, "Is it okay for me to start the engine now, Dad?"

"Yes, that will be fine, but let the car idle so that I can check the ***choke*** movement," he said.

Dad removed the air filter housing, exposing the carburetor. James watched as Dad inspected a piece of flat metal on top of a round cylinder. A hissing noise escaped the cylinder. Slowly the flat piece of metal began to move, opening the cylinder more and more. James was amazed. He could not see any reason for the movement.

Dad explained, "As the engine warms, a coiled spring heats up and expands, moving this flat piece of metal. It looks like a butterfly, thus the name, 'butterfly' choke."

After the butterfly was completely open, Dad replaced the air filter housing.



carburetor

VOCABULARY

Choke: restricts the air flow in a carburetor

Turn signals: inform other drivers of your intent to turn off from one road onto another

Vacuum: air pulled through the intake side of an engine by the piston moving downward in the cylinder

Stick shift: a lever on the steering column or floor for engaging a standard or manual transmission

VOCABULARY

Clutch Pedal: a pedal on the floorboard for operating standard or manual transmissions

Automatic transmission: a transmission that engages forward gears automatically as the vehicle accelerates

"I guess the next information you need to know is what will be checked when we take the car in for an official state inspection. We want to make sure the car will pass inspection before we take it to the station," Dad said. "First, we'll check the headlights."

James got into the Chevy and turned on the headlights. "Now, dim the lights," Dad said. James searched in vain for the switch. Laughingly, Dad told him to tap the large metal button on the upper left side of the floorboard near the clutch pedal. James found and pressed the metal button, and the lights dimmed.

Dad then remarked, "Now we need to check the ***turn signals*** to determine whether they are working properly."

Dad asked James to turn the right and then left signals while Dad stood in front of the car facing the headlights. Then he moved to the rear to check the taillights and asked James to activate the turn signals. While Dad was at the rear of the car, he checked the license plate light as well.

"Stop!" Dad suddenly yelled loudly.

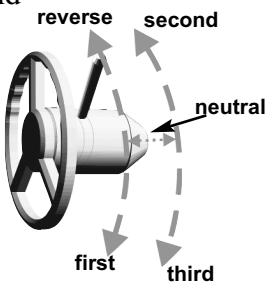
James automatically stomped the brake pedal with his foot, and Dad again laughed and remarked that James had good reflexes. He also assured James that the brake lights worked properly, because they flashed bright red when the brakes were applied.

James checked the windshield wipers and found they needed to be replaced. He also discovered that when he raced the motor slightly, the wipers seemed to run at a different speed. Dad said that was because the wind-shield wipers operated on a ***vacuum*** system directly linked to the engine. Modern cars have windshield wipers that are driven by electric motors.

Climbing into the passenger seat, Dad said, "Have you ever seen a stick shift on a steering column?"

"No sir," James said. Shifting gears of a standard transmission with a ***stick shift*** and ***clutch pedal*** was new to James; the truck and family car both had ***automatic transmissions***. The only stick shift he had ever seen was on his Uncle Don's pick-up truck with the gear shift column on the floor. "Does it work similar to a floor stick shift?"

"Well, somewhat," Dad said. He showed James how to manuever the gears in the correct shift pattern. Dad said that the shift pattern was like a letter H with first gear in the lower left corner, neutral on the bar part, second gear in the upper right corner, third gear in the lower right position, and reverse in the upper left corner of the H.



Once James became familiar with the shift pattern, he discovered that he could move through the gears with ease. He practiced for thirty minutes until his arm finally got tired.

"Turn off the ignition switch, and come out here," Dad instructed.

He raised the hood and pointed far down on the left hand side of the engine to find the VIN (Vehicle Identification Number). Dad pointed out, "Modern cars have the VIN attached to the left side of the dash so the number is visible through the windshield. We will need this number in order to register the Chevy and to enable us to get license plates."

LIFE PRINCIPLE



"Promise little and do much."

—Hebrew Proverb



Lesson 14

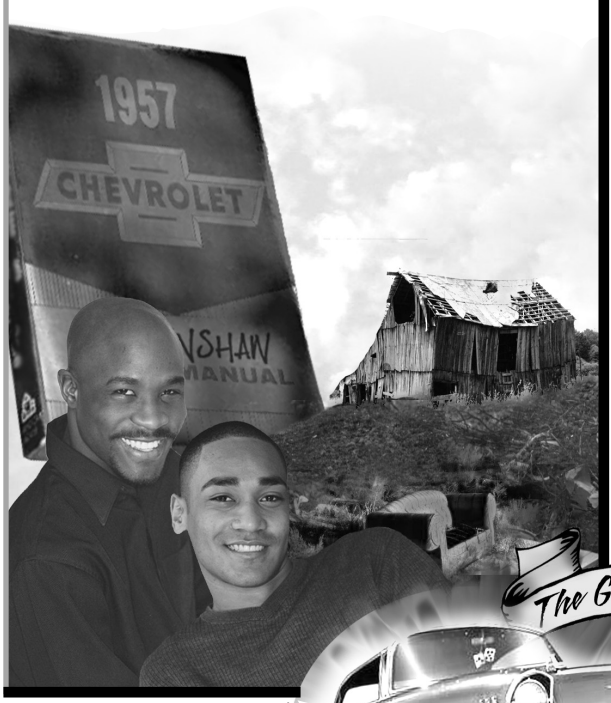
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COOPERATION ON THE JOB



James awoke in response to Dad's voice. "Wake up, Mr. Mechanic, so you can ride with me over to Mr. Crenshaw's place."

After eating one of Mom's hearty breakfasts, Dad and James pulled away from the house. James looked over his shoulder longingly at the Chevy.

"Don't worry, Son. We'll ***polish*** her up this afternoon," Dad assured James. Dad dropped off James at Mr. Crenshaw's house. The remainder of the day was spent mowing, replacing boards on the shed, and painting the shed. When Dad came to pick James up about 4:30 P.M., Mr. Crenshaw came outside with a box full of items he had collected for James. James thanked him, said goodbye, and got into the truck.

As they drove away, James began to inspect the box he had been given. To his delight, he found that it contained four hubcaps and a headlight ring for the '57 Chevy. This was surely a ***bonus*** for his hard work at Mr. Crenshaw's!

As Dad turned the corner near the house, James spotted John and Manuel, two of his best friends, standing around the '57 Chevy. They were soon joined by La Shonda and Mom, who had come out from the house. When Dad pulled up beside the Chevy, they were all waiting with big grins. After James and Dad slid out of the pickup, Dad reached into the truck bed and pulled out a can of car wash solution, a can of ***chrome*** polish, a can of ***rubbing compound***, a can of ***wax***, a box marked 'hog rings', a plier-like device with rounded ends, and a plastic bucket containing sponges and wash mitts.

Dad turned to Mom, "Honey, is your surprise ready?"

"It sure is," she said, as she went over to the picnic table and brought back some velvet-like material. "While you were away hard at work, I have been hard at work too, James. These are new seat covers for your Chevy."



VOCABULARY

Polish: to make smooth or shiny by rubbing or chemical action

Bonus: something given or paid in addition to what is usual or expected

Chrome: a plating of the element chromium that adds a bright silver shine to steel

Rubbing compound: a material containing abrasives (usually pumice), used to remove old paint and to smooth existing paint

Wax: a material designed to add hardness, protection, and luster to a surface

James could hardly believe she had spent all of that time making seat covers for the Chevy! He gave her a big hug and told her how much he appreciated her gift.

Dad then announced, "I'm glad to see everyone here because all of us are needed to put the final touches on the '57."

James grabbed the water hose, and the job was under way. James, Manuel, and La Shonda began washing the car. Mom, Dad, and John removed the seats from the car and started changing the seat covers using the hog rings and the hog ring pliers. Rapid progress was made. Mom and Dad continued to work on the seat covers while John climbed inside the car with the vacuum cleaner and glass cleaner. He started the process of removing years of dirt and grime. La Shonda, James, and Manuel put rubbing compound over the entire car exterior. This process removed all of the old, dull paint residue and brought out the original yellow color of the vehicle. They repeated this process to be sure that all of the old paint residue had been removed. Next, they applied a coat of wax all over the car and polished the surface until the '57 displayed a shiny luster.

In the meantime, Mom and Dad had finished installing the new seat covers. Then John helped Dad replace the seats in the car. John cleaned the outside of the windows with glass cleaner while James began to apply chrome polish to all of the chrome parts on the car.

He paused for a moment and turned to his family and friends. "I can never thank you enough for all of your hard work. This would have taken me forever, but it's going fast, thanks to you."

Dad installed the headlight ring and hubcaps while Mom ordered pizza and prepared a cool fruit beverage for all of the workers.

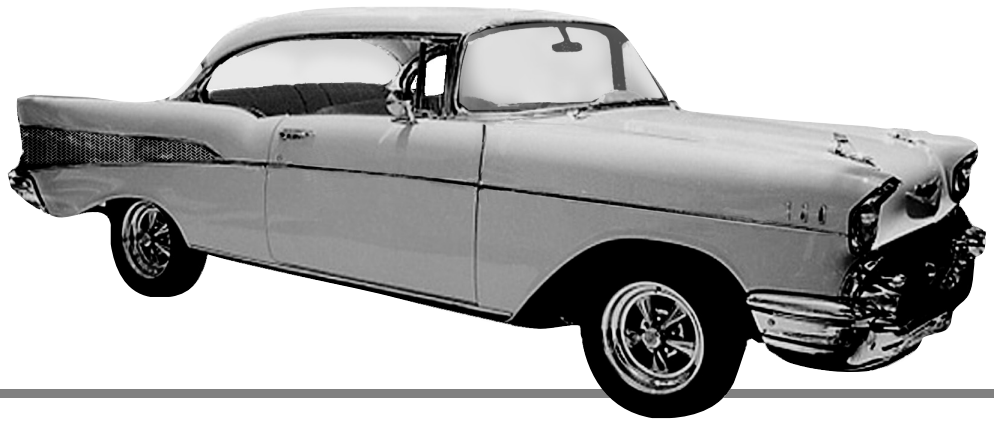
By the time the pizza arrived, everyone had completed their jobs, cleaned their hands, and were gathered around to admire the results of all of their hard labor: a bright yellow '57 Chevy Belair Hardtop, shining in the afternoon sun!

Life Principle

"He that is thy friend indeed, He will help thee in thy need."

—William Shakespeare





1957 CHEVY BELAIR HARDTOP



Lesson 15

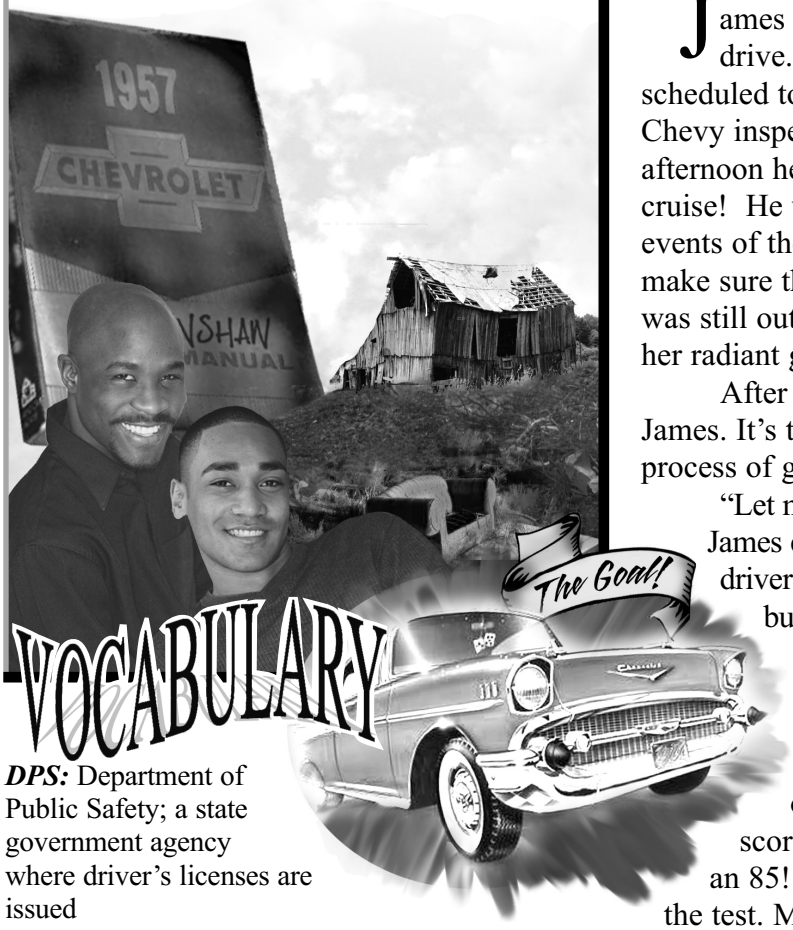
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TEST DRIVE



James arose early on the day of his test drive. This was also the day he was scheduled to take his driver's test and get the Chevy inspected. If all went as planned, by late afternoon he would be ready to take his '57 for a cruise! He was thrilled with anticipation of the events of the day. He looked out the window to make sure that the newly washed and waxed car was still outside on blocks. There she was, in all her radiant glory!

After breakfast, Mom said, "Get ready, James. It's time to go over to the ***DPS*** to start the process of getting your ***driver's license***."

"Let me get my cap, and I'll be ready," James exclaimed. He had studied hard for his driver's test during the past several weeks, but he was still nervous and could feel his stomach churning from excitement.

When he arrived at the license department, the first thing James had to do was to take the written portion of the driving test. When it was scored, he found that he had passed with an 85! Then he faced the driving portion of the test. Mom had to provide proof that the car had ***liability insurance*** before James could begin. He was taking the test in the family car because he was more familiar with it. The driving instructor checked out all of the systems on the vehicle. Finally, they were ready to begin the actual driving portion of the test. As James drove around town, the officer marked James' performance. He gained confidence after a few minutes and was not nervous by the end of the test.

"Okay, Son, I think that will about do it. Head back to headquarters," the officer instructed.

After James pulled into the parking lot, the instructor shook James' hand and said, "I'm happy to inform you that you have passed with flying colors!"

VOCABULARY

DPS: Department of Public Safety; a state government agency where driver's licenses are issued

Driver's license: proof of permission to drive on public roads

Liability insurance: financial protection for the driver of a vehicle in the event he/she causes an accident

Windshield: the front window of a car used to close in the cab and protect against wind

Chauffeur: (shō-fuŕ) a person whose work is to drive an automobile for someone else

James had to complete a little more paper work and take a photo. Then he was issued a temporary license. He was now eligible to drive!

"Hooray!" James yelled as he and Mom got back into the car to go home.

When they arrived, James immediately began taking the Chevy off the blocks. Dad arrived home about 5:30 P.M. with the new license plates, a means by which the car could be identified. Dad also said that he had stopped by the insurance company and had added the '57 to the family policy. James promptly installed the license plates, and then Dad got into the driver's seat and stated that the car needed to be officially inspected to ensure that it met all safety standards. James climbed into the passenger seat, wondering when he would be allowed to drive.

At the Auto Service Center, the mechanic gave the Chevy a good going over and then applied a new inspection sticker to a corner of the front ***windshield***. Dad paid for the inspection and headed back to the car. He handed James the keys and said, "She's all yours now, James! Let's see if you can handle her. Mom said that you passed your driving test this morning, but you still have to pass Dad's test." Dad smiled as he emphasized DAD'S TEST.

That made James a little nervous. Other than a little difficulty with the standard gear shift and clutch pedal, James made the trip home just fine. How excited he was finally to be behind the wheel of his own '57! When they pulled into the home driveway, James saw Mr. Crenshaw standing near the family barbecue pit. John, Manuel, and La Shonda were busy cleaning up the area where the Chevy had been parked, and Mom was putting a checkered plastic tablecloth on the picnic table. Soon, John's mom and dad and Manuel's parents pulled up into the driveway. James realized that a celebration was about to take place. Everyone was smiling and waving and motioning to James.

"Dad, would it be alright if I took everyone for rides in the '57 while the ribs are cooking?" James asked.

To his son's delight, Dad replied, "I think that is a dandy idea, James. Remember that mom's are always first. Then, you have a promise to keep to Mr. Crenshaw."

"That's right," James said. "I did tell him that he would be one of the first to get a ride after we got the Chevy back to going. I'm sure he'll understand though if I take mom first."

"I'm sure he will," Dad smiled.

Dad opened the car door for mom then leaned down and gave her a kiss on the cheek. He patted the car and said, "Remember your seat belts."

Mr. Crenshaw was the next one to ride. James went around to the passenger side and opened the door for him like a real ***chauffeur***. Mr. Crenshaw climbed in. As they drove along, Mr. Crenshaw told James about all the places he had been and all the sights he had seen in that Chevy.

As they pulled into the driveway once more, James said, "Thanks for letting me be the next owner of the Chevy. I know that many wonderful experiences lie ahead for me, too!"

John, Manuel, and La Shonda all wanted rides of course. After a few spins around the block, they were satisfied and ready to eat. "That's one sweet car," John exclaimed as he climbed out.

Life Principle



"First-rate work requires first-rate sincerity and first-rate work ethic."

—Sarah Barbee