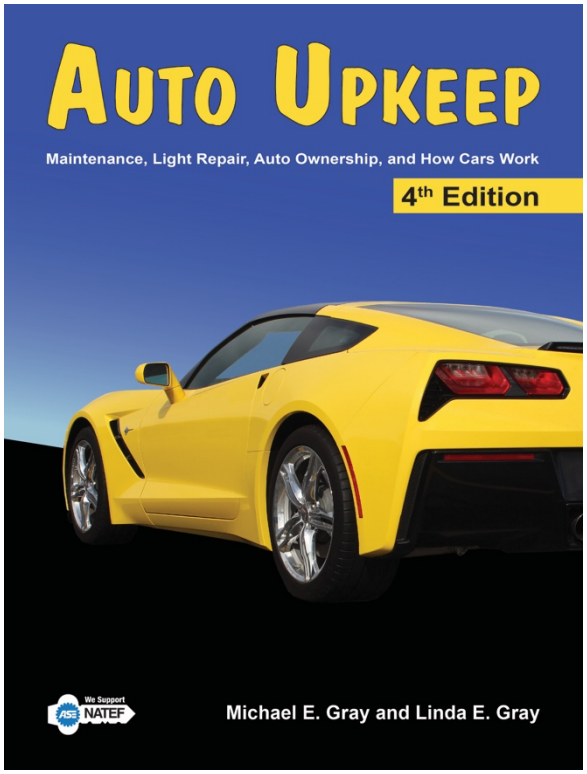
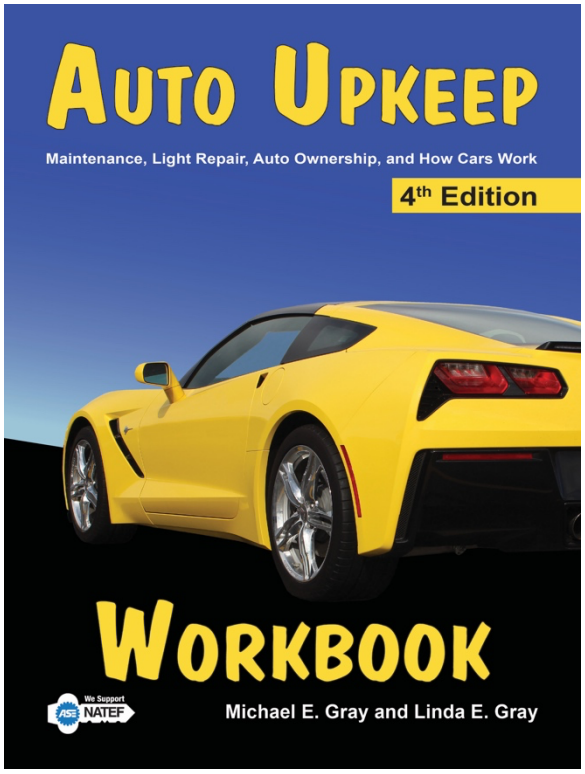
Auto Upkeep



Textbook



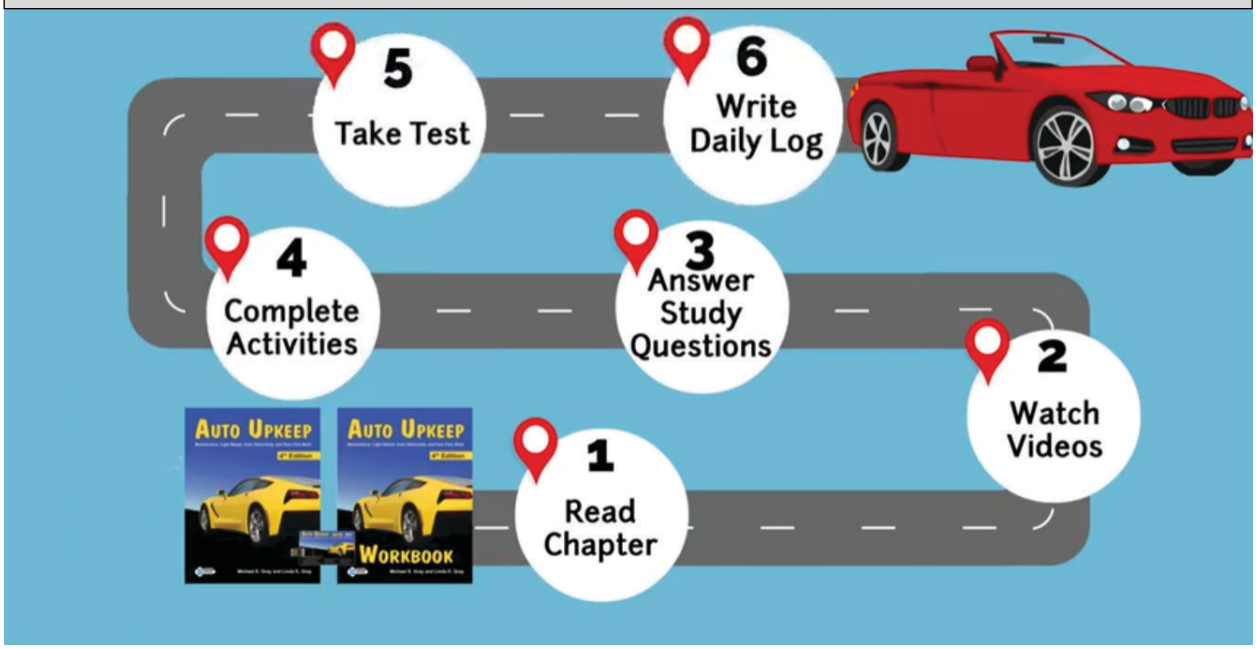
Workbook

Resource USB

Sample Unit

Chapter 1 – Introduction and How Cars Work

How to Teach Auto Upkeep



Sample Course Syllabus
Auto Upkeep

Course Description:
This course is intended to provide you with the knowledge to make economical decisions and take preventative measures to enhance the overall satisfaction of being an automotive consumer. The class discussions and lab activities provide the fundamental knowledge and experience in owning and maintaining an automobile.

Course Goal:
This course is designed to provide you with the necessary environment and interactions to advance your knowledge and understanding in owning, maintaining, and repairing the automobile.

Intended Competencies/Skills:
Please see the Excel spreadsheet titled *Auto Upkeep Competency Profile.*

Credits:
Auto Upkeep can be either a 1/2 credit or 1 credit course elective. The course covers 135 hours of instruction (18 weeks x 1.5 hours a day x 5 days a week). If you would like to run this as a 1/2 credit course, shorten the number of hours by reducing or eliminating the number of activities completed. Activities are both hands-on and internet-based. Most hands-on activities can be completed with a limited number of tools. Some activities can also be completed more than once to extend hours of instruction, enhancing the student's skill set. The curriculum is flexible for you to adjust it to fit your needs. The great thing with the Auto Upkeep curriculum is that you can pick and choose from 40 activities on what you would like to cover.

Course Evaluation:
You will be evaluated on the achievement of the tasks/skills as listed on the competency profile, study questions, lab activity participation, daily reflection logs, and exams.

Grade Distribution/Weight
20% Competency Profile
20% Study Questions
20% Lab Activities
20% Daily Reflection Logs
20% Exams (Written and Practical)

Chapter Resources:
Online Chapter Resources can be accessed at www.AutoUpkeep.com/resources.

Safety:
It is essential that each student follows all safety guidelines, rules, and procedures as discussed in class and demonstrated in the lab/shop. Safety glasses are required for all hands-on lab activities.

Assignments Explained:
In the Course Schedule you will see the following under Assignment/Lab/Log/Test column.

Complete Daily Reflection Log – The Daily Reflection Log is located on page 171 Appendix D of the *Auto Upkeep Workbook*. You can also create a written log using a computer word processing program. At the end of each day, write a short 3 to 5 sentence reflection on what you learned.

View a Video - Links to videos that support each chapter can be accessed at www.Video.AutoUpkeep.com. Choose one video to view.

Complete Video Review – After viewing a video from the chapter, complete the Article, Website, or Video Review form located on page 172 Appendix E of the Auto Upkeep Workbook. You can also create a similar form using a computer word processing program.

Explore a Web Link – Explore a web link listed in the assigned reading.

Complete Website Review – After exploring the web links listed in the chapter, complete the Article, Website, or Video Review form located on page 172 Appendix E of the Auto Upkeep Workbook. You can also create a similar form using a computer word processing program. If you don't have a good Internet connection, reading an article from an automotive magazine is also acceptable.

Research Apps – Apps that support each chapter can be accessed at www.AutoUpkeep.com/apps.

Answer Study Questions - Study Questions for each chapter are located in the *Auto Upkeep Workbook*.

Complete Activity – Activities for each chapter are located in the *Auto Upkeep Workbook*.

Complete Career Exploration - The Career Exploration form is located on page 173 Appendix F of the Auto Upkeep Workbook. You can also create a similar form using a computer word processing program.

Take Test/Exam – Chapter Tests and Exams are located on the Instructor USB.

Course Schedule:
18 weeks (90 minute class periods) = 135 total hours = 1 credit course

Week	*Day*	*Topic*	*Read/ Discuss*	*Assignment/Lab/Log/Test*
1	1	Introduction to the Class Course Syllabus Tour of Area		Complete Daily Reflection Log
1	2	Chapter 1 Introduction and How Cars Work	Pages 10-15	Explore a Chapter 1 Web Link Complete Website Review View a Chapter 1 Video Complete Video Review Complete Daily Reflection Log
1	3	Chapter 1 Introduction and How Cars Work	Pages 16-21	Explore a Chapter 1 Web Link Complete Website Review Answer Chapter 1 Study Questions Complete Daily Reflection Log
1	4	Chapter 1 Introduction and How Cars Work		Complete Car Identification Activity Complete Owner's Manual Activity Complete Daily Reflection Log
1	5	Chapter 1 Introduction and How Cars Work		Review for Chapter 1 Test Take Chapter 1 Test Complete Daily Reflection Log
2	6	Chapter 2 Buying an Automobile	Pages 22-27	View a Chapter 2 Video Complete Video Review Complete Daily Reflection Log
2	7	Chapter 2 Buying an Automobile	Pages 28-33	Explore a Chapter 2 Web Link Complete Website Review Research Chapter 2 Apps Answer Chapter 2 Study Questions Complete Daily Reflection Log
2	8	Chapter 2 Buying an Automobile		Complete Buying a New Automobile Activity Complete Buying a Used Automobile Activity Complete Daily Reflection Log
2	9	Chapter 2 Buying an Automobile		Review for Chapter 2 Test Take Chapter 2 Test Complete Daily Reflection Log
2	10	Chapter 3 Automotive Expenses	Pages 34-37	View a Chapter 3 Video Complete Video Review Explore a Chapter 3 Web Link Complete Website Review Complete Daily Reflection Log
3	11	Chapter 3 Automotive Expenses	Pages 38-41	Explore a Chapter 3 Web Link Complete Website Review Research Chapter 3 Apps Answer Chapter 3 Study Questions Complete Daily Reflection Log
3	12	Chapter 3 Automotive Expenses		Complete Automotive Expenses Activity Complete Daily Reflection Log
3	13	Chapter 3 Automotive Expenses		Review for Chapter 3 Test Take Chapter 3 Test Complete Daily Reflection Log

3	14	Chapter 4 Repair Facilities	Pages 42-45	Explore a Chapter 4 Web Link Complete Website Review View a Chapter 4 Video Complete Video Review Complete Daily Reflection Log
3	15	Chapter 4 Repair Facilities	Pages 46-49	View a Chapter 4 Video Complete Video Review Explore a Chapter 4 Web Link Complete Website Review Answer Chapter 4 Study Questions Complete Daily Reflection Log
4	16	Chapter 4 Repair Facilities		Complete Repair Facilities Activity Complete Daily Reflection Log
4	17	Chapter 4 Repair Facilities		Review for Chapter 4 Test Take Chapter 4 Test Complete Daily Reflection Log
4	18	Chapter 5 Safety Around the Automobile	Pages 50-55	Explore a Chapter 5 Web Link Complete Website Review Research Chapter 5 Apps Complete Daily Reflection Log
4	19	Chapter 5 Safety Around the Automobile	Pages 56-63	View a Chapter 5 Video Complete Video Review Explore a Chapter 5 Web Link Complete Website Review Answer Chapter 5 Study Questions Complete Daily Reflection Log
4	20	Chapter 5 Safety Around the Automobile		Complete Automotive Safety Activity Complete Safety Data Sheet (SDS) Activity Complete PPE and Fire Safety Activity Complete Daily Reflection Log
5	21	Chapter 5 Safety Around the Automobile		Review for Chapter 5 Test Take Chapter 5 Test Complete Daily Reflection Log
5	22	Chapter 6 Tools and Equipment	Pages 64-73	View a Chapter 6 Video Complete Video Review Explore a Chapter 6 Web Link Complete Website Review Complete Daily Reflection Log
5	23	Chapter 6 Tools and Equipment	Pages 74-81	Research Chapter 6 Apps Explore a Chapter 6 Web Link Complete Website Review Answer Chapter 6 Study Questions Complete Daily Reflection Log
5	24	Chapter 6 Tools and Equipment		Complete Tools and Equipment ID Activity Complete Service Manual Activity Complete Daily Reflection Log
5	25	Chapter 6 Tools and Equipment		Review for Chapter 6 Test Take Chapter 6 Test Complete Daily Reflection Log
6	26	Chapter 7 Auto Care and Cleaning	Pages 82-86	View a Chapter 7 Video Complete Video Review Research Chapter 7 Apps Complete Daily Reflection Log

6	27	Chapter 7 Auto Care and Cleaning	Pages 87-91	Explore a Chapter 7 Web Link Complete Website Review View a Chapter 7 Video Complete Video Review Answer Chapter 7 Study Questions Complete Daily Reflection Log
6	28	Chapter 7 Auto Care and Cleaning		Complete Interior Cleaning Activity Complete Exterior Cleaning Activity Complete Daily Reflection Log
6	29	Chapter 7 Auto Care and Cleaning		Complete Waxing Activity Complete Daily Reflection Log
6	30	Chapter 7 Auto Care and Cleaning		Review for Chapter 7 Test Take Chapter 7 Test Complete Daily Reflection Log
7	31	Chapter 8 Fluid Level Check	Pages 92-97	Complete Daily Reflection Log
7	32	Chapter 8 Fluid Level Check	Pages 98-101	View a Chapter 8 Video Complete Video Review Research Chapter 8 Apps Answer Chapter 8 Study Questions Complete Daily Reflection Log
7	33	Chapter 8 Fluid Level Check		Complete Fluid Level Check Activity Complete Daily Reflection Log
7	34	Chapter 8 Fluid Level Check		Review for Chapter 8 Test Take Chapter 8 Test Complete Daily Reflection Log
7	35	Chapter 9 Electrical System	Pages 102-111	View a Chapter 9 Video Complete Video Review Explore a Chapter 9 Web Link Complete Website Review Complete Daily Reflection Log
8	36	Chapter 9 Electrical System	Pages 112-119	Explore a Chapter 9 Web Link Complete Website Review View a Chapter 9 Video Complete Video Review Research Chapter 9 Apps Answer Chapter 9 Study Questions Complete Daily Reflection Log
8	37	Chapter 9 Electrical System		Complete Ohm's Law Activity Complete Wiring Diagram Activity Complete Daily Reflection Log
8	38	Chapter 9 Electrical System		Complete Battery Activity Complete Charging Activity Complete Starting Activity Complete Daily Reflection Log
8	39	Chapter 9 Electrical System		Review for Chapter 9 Test Take Chapter 9 Test Complete Daily Reflection Log
8	40	Chapter 10 Lubrication System	Pages 120-123	Explore a Chapter 9 Web Link Complete Website Review Complete Daily Reflection Log

9	41	Chapter 10 Lubrication System	Pages 124-127	Explore a Chapter 10 Web Link Complete Website Review View a Chapter 10 Video Complete Video Review Answer Chapter 10 Study Questions Complete Daily Reflection Log
9	42	Chapter 10 Lubrication System		Complete Oil and Filter Change Activity Complete Daily Reflection Log
9	43	Chapter 10 Lubrication System		Review for Chapter 10 Test Take Chapter 10 Test Complete Daily Reflection Log
9	44	Careers Paths Chapters 1-10 Review Chapters 1-10 for Mid-Term Exam		Complete Career Exploration Review for Mid-Term Exam Complete Daily Reflection Log
9	45	Mid-Term Exam		Take Mid-Term Exam Complete Daily Reflection Log
10	46	Chapter 11 Fuel System	Pages 128-133	View a Chapter 11 Video Complete Video Review Complete Daily Reflection Log
10	47	Chapter 11 Fuel System	Pages 134-139	Explore a Chapter 11 Web Link Complete Website Review View a Chapter 11 Video Complete a Video Review Answer Chapter 11 Study Questions Complete Daily Reflection Log
10	48	Chapter 11 Fuel System		Complete Fuel System Part ID Activity Complete Fuel System Maintenance Activity Complete Daily Reflection Log
10	49	Chapter 11 Fuel System		Review for Chapter 11 Test Take Chapter 11 Test Complete Daily Reflection Log
10	50	Chapter 12 Cooling System and Climate Control	Pages 140-147	View a Chapter 12 Video Complete Video Review Research Chapter 12 Apps Complete Daily Reflection Log
11	51	Chapter 12 Cooling System and Climate Control	Pages 148-153	Explore a Chapter 12 Web Link Complete Website Review View a Chapter 12 Video Complete Video Review Answer Chapter 12 Study Questions Complete Daily Reflection Log
11	52	Chapter 12 Cooling System and Climate Control		Complete Air Conditioning Activity Complete Cabin Air Filter Activity Complete Daily Reflection Log
11	53	Chapter 12 Cooling System and Climate Control		Complete Cooling System Activity Complete Daily Reflection Log
11	54	Chapter 12 Cooling System and Climate Control		Review for Chapter 12 Test Take Chapter 12 Test Complete Daily Reflection Log

11	55	Chapter 13 Ignition System	Pages 154-157	Explore a Chapter 13 Web Link Complete Website Review View a Chapter 13 Video Complete Video Review Complete Daily Reflection Log
12	56	Chapter 13 Ignition System	Pages 158-161	Research Chapter 13 Apps View a Chapter 13 Video Complete Video Review Explore a Chapter 13 Web Link Complete Website Review Answer Chapter 13 Study Questions Complete Daily Reflection Log
12	57	Chapter 13 Ignition System		Complete Ignition System Activity Complete Daily Reflection Log
12	58	Chapter 13 Ignition System		Review for Chapter 13 Test Take Chapter 13 Test Complete Daily Reflection Log
12	59	Chapter 14 Suspension, Steering, and Tires	Pages 162-169	View a Chapter 14 Video Complete Video Review Complete Daily Reflection Log
12	60	Chapter 14 Suspension, Steering, and Tires	Pages 170-179	Research Chapter 14 Apps Explore a Chapter 14 Web Link Complete Website Review View a Chapter 14 Video Complete Video Review Answer Chapter 14 Study Questions Complete Daily Reflection Log
13	61	Chapter 14 Suspension, Steering, and Tires		Complete Suspension and Steering Activity Complete Daily Reflection Log
13	62	Chapter 14 Suspension, Steering, and Tires		Complete Tire Inspection and Rotation Act. Complete Daily Reflection Log
13	63	Chapter 14 Suspension, Steering, and Tires		Review for Chapter 14 Test Take Chapter 14 Test Complete Daily Reflection Log
13	64	Chapter 15 Braking System	Pages 180-184	Explore a Chapter 15 Web Link Complete Website Review View a Chapter 15 Video Complete Video Review Complete Daily Reflection Log
13	65	Chapter 15 Braking System	Pages 185-189	View a Chapter 15 Video Complete Video Review Explore a Chapter 15 Web Link Complete Website Review Answer Chapter 15 Study Questions Complete Daily Reflection Log
14	66	Chapter 15 Braking System		Complete Brake Inspection Activity Complete Daily Reflection Log
14	67	Chapter 15 Braking System		Review for Chapter 15 Test Take Chapter 15 Test Complete Daily Reflection Log

14	68	Chapter 16 Drivetrain	Pages 190-194	View a Chapter 16 Video Complete Video Review Explore a Chapter 16 Web Link Complete Website Review Complete Daily Reflection Log
14	69	Chapter 16 Drivetrain	Pages 195-199	View a Chapter 16 Video Complete a Video Review Answer Chapter 16 Study Questions Complete Daily Reflection Log
14	70	Chapter 16 Drivetrain		Complete Drivetrain Activity Complete Daily Reflection Log
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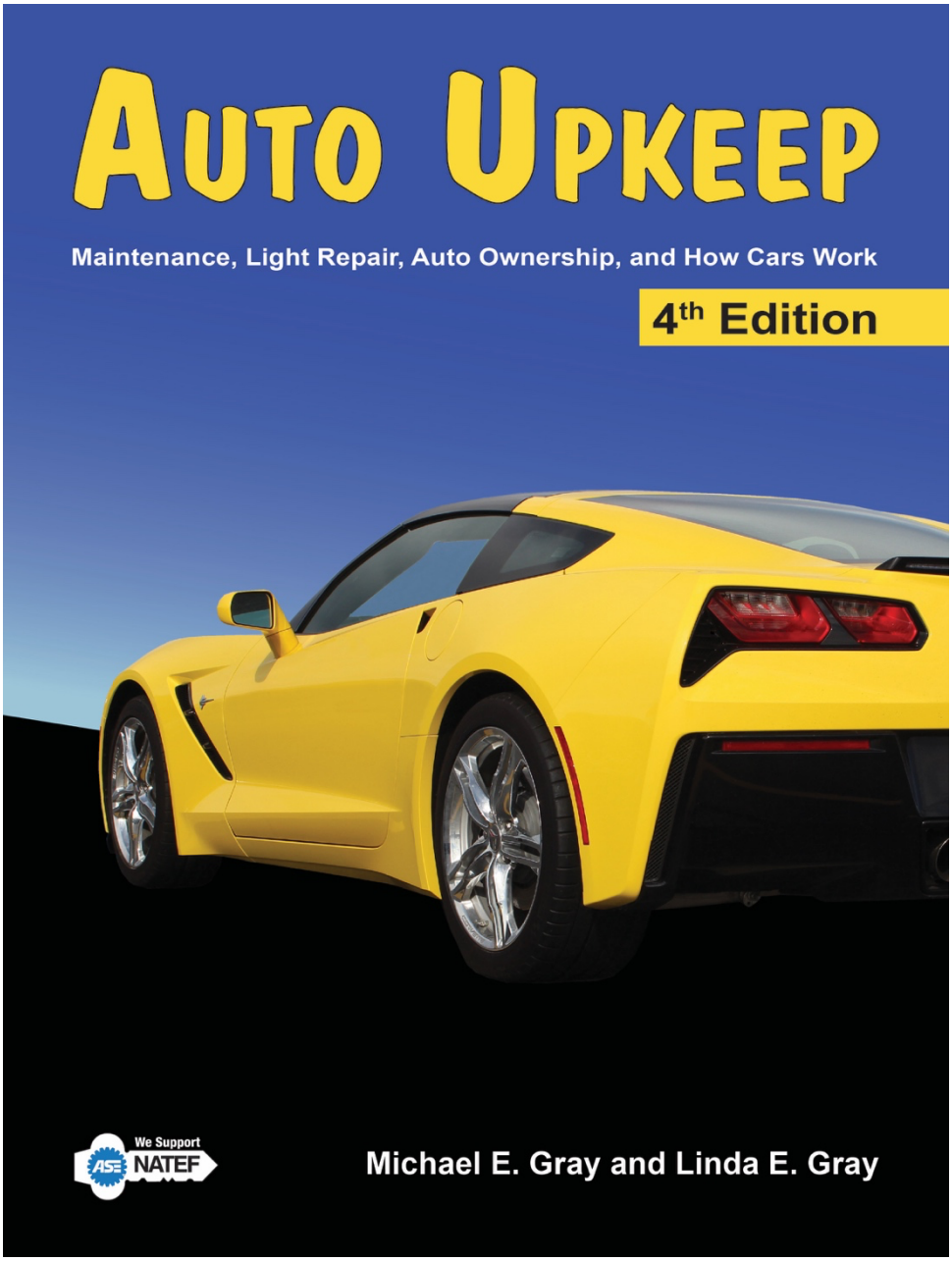
15	72	Chapter 17 Exhaust and Emission System	Pages 200-205	Explore a Chapter 17 Web Link Complete Website Review Complete Daily Reflection Log
15	73	Chapter 17 Exhaust and Emission System	Pages 206-211	View a Chapter 17 Video Complete Video Review Answer Chapter 17 Study Questions Complete Daily Reflection Log
15	74	Chapter 17 Exhaust and Emission System		Complete Exhaust and Emission Activity Complete Daily Reflection Log
15	75	Chapter 17 Exhaust and Emission System		Review for Chapter 17 Test Take Chapter 17 Test Complete Daily Reflection Log
16	76	Chapter 18 Alternative Fuels and Designs	Pages 212-220	Explore a Chapter 18 Web Link Complete Website Review View a Chapter 18 Video Complete Video Review Complete Daily Reflection Log
16	77	Chapter 18 Alternative Fuels and Designs	Pages 221-231	View a Chapter 18 Video Complete Video Review Explore a Chapter 18 Web Link Complete Website Review Answer Chapter 18 Study Questions Complete Daily Reflection Log
16	78	Chapter 18 Alternative Fuels and Designs		Complete Payback Period Activity Complete Future Transportation Activity Complete Daily Reflection Log
16	79	Chapter 18 Alternative Fuels and Designs		Review for Chapter 18 Test Take Chapter 18 Test Complete Daily Reflection Log
16	80	Chapter 19 Automotive Accessories	Pages 232-239	Explore a Chapter 19 Web Link Complete Website Review View a Chapter 19 Video Complete Video Review Complete Daily Reflection Log
17	81	Chapter 19 Automotive Accessories	Pages 240-247	Explore a Chapter 19 Web Link Complete Website Review Answer Chapter 19 Study Questions Complete Daily Reflection Log

17	82	Chapter 19 Automotive Accessories		Complete Automotive Accessories Activity Complete Daily Reflection Log
17	83	Chapter 19 Automotive Accessories		Review for Chapter 19 Test Take Chapter 19 Test Complete Daily Reflection Log
17	84	Chapter 20 Common Problems and Roadside Emergencies	Pages 248-259	Research Chapter 20 Apps Explore a Chapter 20 Web Link Complete Website Review Complete Daily Reflection Log
17	85	Chapter 20 Common Problems and Roadside Emergencies	Pages 260-267	View a Chapter 20 Video Complete Video Review Explore a Chapter 20 Web Link Complete Website Review Answer Chapter 20 Study Questions Complete Daily Reflection Log
18	86	Chapter 20 Common Problems and Roadside Emergencies		Complete Changing a Flat Tire Activity Complete Replacing Wipers Activity Complete Daily Reflection Log
18	87	Chapter 20 Common Problems and Roadside Emergencies		Complete Jump-Starting Activity Complete Lighting Activity Complete Daily Reflection Log
18	88	Chapter 20 Common Problems and Roadside Emergencies		Review for Chapter 20 Test Take Chapter 20 Test Complete Daily Reflection Log
18	89	Careers Paths Chapters 11-20 Review for Final Exam		Complete Career Exploration Review for Final Exam Complete Daily Reflection Log
18	90	Final Exam		Take Final Exam Complete Daily Reflection Log



Sample Textbook Pages

Chapter 1 – Introduction and How Cars Work

Features of the Text

QR (Quick Response) Codes - Scan to easily access additional chapter resources online.

Introduction - Brief overview of the content that will be covered in the chapter.

Q & A - Practical questions and answers from real problems.

Price Guides - Tools, parts, and labor price estimates.

Warnings - Potential hazard alerts requiring safety precautions to avoid personal injury.

Web Links - Expand learning through the Internet.

Trouble Guides - Quick troubleshooting reference.

Tech Tips - Insightful, useful, and practical information, supplementing the content.

Video - Links to videos that support content learned in the *Auto Upkeep* curriculum can be accessed at www.Video.AutoUpkeep.com.

Fuel for Thought - Essential questions to stimulate thinking related to information in the chapter.

Objectives - What you should know and be able to do upon completion of the chapter and activities.

Illustrations - To clarify concepts and develop further understanding.

Procedures - Step-by-step hands-on learning experiences.

Calculations - Integrating practical math problems.

Servicing - General guides to maintenance schedules.

Summary - Reviews the chapter content, reinforcing the learning objectives.

Activities and Study Questions - Located in the *Auto Upkeep Workbook* to extend learning.

Career Paths - A brief introduction to automotive related fields to help you discover potential careers.

Apps - Helpful apps to extend learning can be accessed at www.AutoUpkeep.com/apps.

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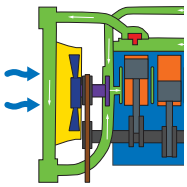
CHAPTER 8
Fluid Level Check

CHAPTER 9
Electrical System

CHAPTER 10
Lubrication System

CHAPTER 11
Fuel System

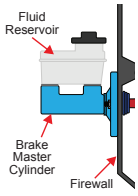
CHAPTER 12
Cooling System and Climate Control



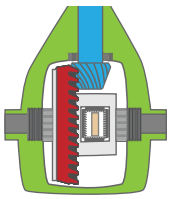
CHAPTER 13
Ignition System

CHAPTER 14
Suspension, Steering, and Tires

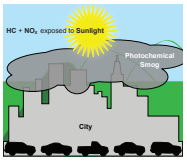
CHAPTER 15
Braking System



CHAPTER 16
Drivetrain



Chapter 17
Exhaust and Emission System



Chapter 18
Alternative Fuels and Designs

Chapter 19
Automotive Accessories

Chapter 20
Common Problems and Roadside Emergencies

Appendix A

Appendix B

Appendix C

Introduction and How Cars Work

CHAPTER 1

Fuel for Thought

- How do cars work?
- How are vehicles classified?
- Why is it good to know the size of your vehicle's engine?

Introduction

For hundreds of years people have been compelled to find a better way to travel. It would be impossible to credit just one person for the development of the automobile. The word "automobile" literally means self-moving. People wanted a vehicle that could take them to new places. For many years people worked and lived within miles of where they were born and where they eventually died. Before the automobile, most people traveled on land from one place to another by foot, train, bicycle, or horse and carriage. Within a few years of the turn of the 20th century, the automobile would change society forever. Today, there are millions of vehicles on the roadways.

Objectives

Upon completion of this chapter and activities, you will be able to:

- Identify early automotive contributors.
- Differentiate between vehicle manufacturers, makes, models, and types.
- Describe how cars work.
- Locate and use an online owner's manual.

Automotive Timeline

Numerous milestones and significant automotive events (***Figure 1.1***) have made vehicles more efficient, comfortable, and reliable. This section focuses on:

- Early Years
- Henry Ford
- Growth Over 100 Years

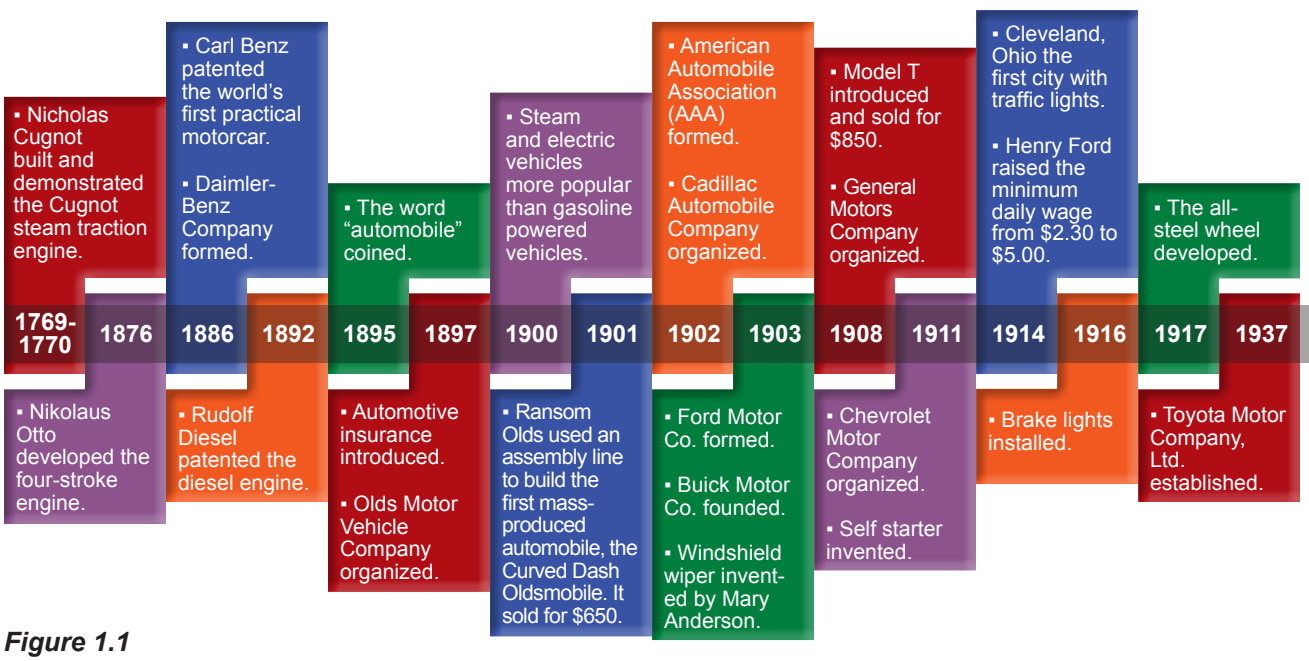


Figure 1.1

Early Years

One of the earliest recorded major milestones in the development of the automobile was the Cugnot steam traction engine in 1769-1770. Even though this self-powered road vehicle was rather impractical, it was a starting point for the automobile. The development of the internal combustion engine in 1860 made road vehicles more promising. Then in 1886 Carl Benz was credited with building the world's first practical motorcar. At the turn of the century, blacksmith shops around the country were hand-building cars.

Web Links

Automotive Museum Sites

Antique Automobile Club of America Museum
www.aacamuseum.org

Gilmore Car Museum
www.gilmorecarmuseum.org

Henry Ford Museum
www.thehenryford.org

Manitoba Antique Auto Museum
www.mbautomuseum.com

National Automobile Museum
www.automuseum.org

Petersen Automotive Museum
www.petersen.org

Henry Ford

Henry Ford, who introduced the Model T in 1908, put an end to many of the small hand-building automotive shops. By 1914, Ford was able to significantly decrease production time using a conveyor (moving) assembly line (***Figure 1.2***). Workers could put together a Model T in just 93 minutes. Originally introduced at $850 in 1908, the Model T eventually sold for as little as $260. By the 1920s, half the cars in the world were Model T Fords. In 1923 alone, Ford produced over 1.8 million Model Ts. The last Ford Model T rolled off of the assembly line in 1927. Ford produced over 15 million Model Ts.

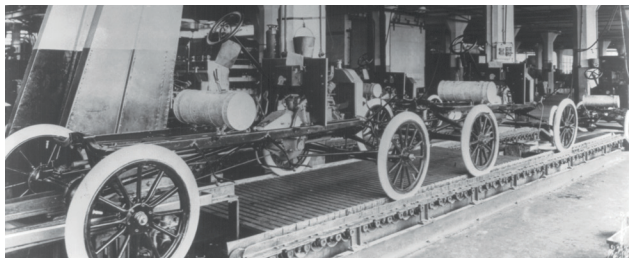
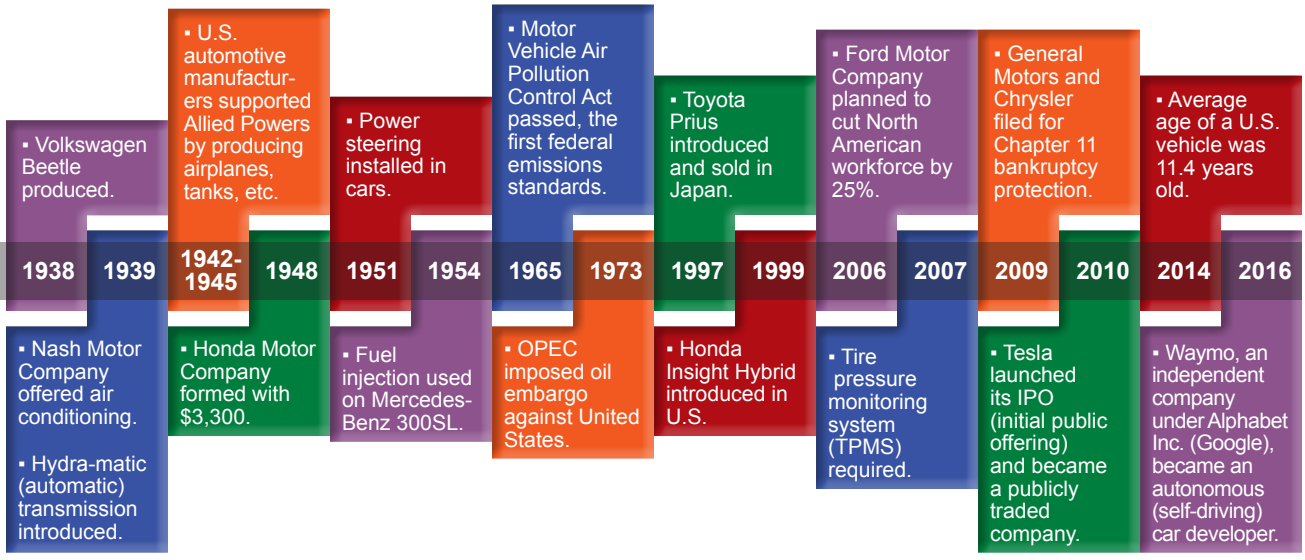


Figure 1.2 ***Model T Ford Assembly Line***
Source: Library of Congress

Growth Over 100 Years

Over the last hundred years, automobile production has grown substantially. In 1900 about 9500 motor vehicles were produced in the world. That number grew to over 50 million per year just a century later.



Significant Automotive Events

How Cars Work

Currently the most common propulsion system in an automobile is the internal combustion engine (ICE). ICEs burn fuel in a combustion chamber inside the engine. This section focuses on:

- Conservation of Energy
- Force, Work, Power, and Energy
- Measuring Engine Output
- Engine Components
- Four-Stoke Engines
- Power Transfer

Conservation of Energy

Vehicles need energy to move. The energy used is commonly gasoline, diesel, or electricity. A key concept to understand is that energy cannot be created or destroyed in the vehicle, it is just converted from one form to another. This is called the law of conservation of energy in physics (specifically in a closed system). Gasoline vehicles are not very efficient at moving down the road. They don't destroy energy, but they lose energy. These losses occur in the engine, drivetrain, braking, overcoming the wind (aerodynamic drag), rolling resistance (tires contacting the road), and running accessories (parasitic losses). The energy into the system is going to equal the energy out of the system, even if some of it is unwanted and not usable (***Figure 1.3***).

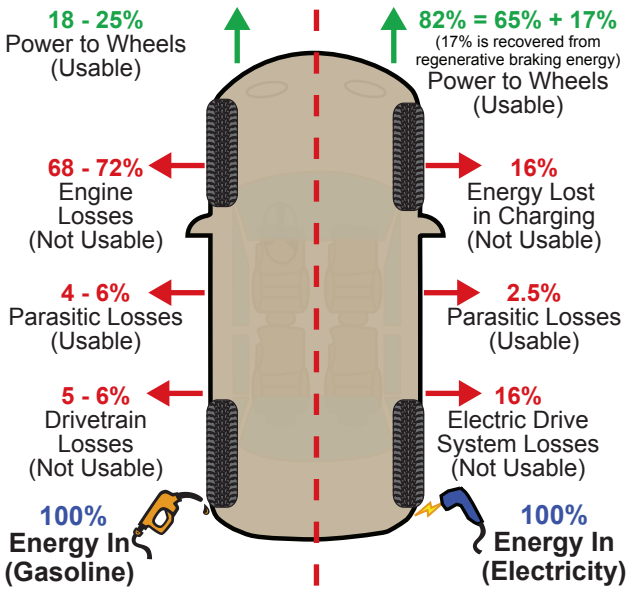


Figure 1.3 ***Gasoline vs. Electric Energy Usage***

Source: U.S. Department of Energy EERE - www.fueleconomy.gov

Force, Work, Power, and Energy

To learn how power is transferred in a vehicle, key terms (force, work, power, and energy) and the relationship between them need to be studied.

Force. Simply defined, force is a push or pull interaction between objects (***Figure 1.4***). This interaction can occur when objects are in physical contact with one another or when there is an action at a distance caused by magnetic forces, gravitational forces, and electric forces.

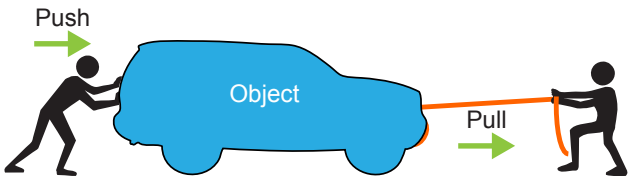


Figure 1.4 ***Force***

Work. When an object has moved from a force, the position of the object has changed and work has occurred. If no motion has occurred, no work has been done. Work is the transfer of energy from one object to another (***Figure 1.5***).

Work = Force x Distance

Figure 1.5 ***Work = Force x Distance***

Calculations

Calculating Work

Using the example from (***Figure 1.5***), calculate work.

Force	10 lb
x Distance	x 25 ft
Work	= **250 ft-lb**

Note: To use this formula, the force must be parallel to the movement.

Power. Power is the rate at which work is done (the amount of work done, energy delivered, in a given amount of time).

Power = Work/Time

Energy. Objects have the ability to do work when they have energy. Different forms of energy are classified into two categories: potential and kinetic. Potential energy is stored energy or energy of position. Kinetic energy is the energy of an object from its movement. Energy is required to do work. Gasoline, diesel, electricity, or some other source of energy is needed for a vehicle to do work. Energy and power are linked, but are not the same thing. This is helpful to know when looking at battery ratings on hybrid and electric vehicles. These batteries are usually rated in kilowatt hours (kWh).

Energy = Power x Time

1 kWh = 1 kilowatt x 1 hour

For example, an electric vehicle might have a battery capacity of 60 kWh. Think of energy as the amount of "fuel" stored or used to perform work.

Measuring Engine Output

Two numbers are commonly used in advertising a vehicle's output: torque and horsepower.

Torque. When force is in a twisting motion it is called torque. Tightening a bolt with a wrench is an example of torque (***Figure 1.6***). A special wrench, a torque wrench, is used to tighten bolts to an exact specification.

Torque = Force x Lever Length

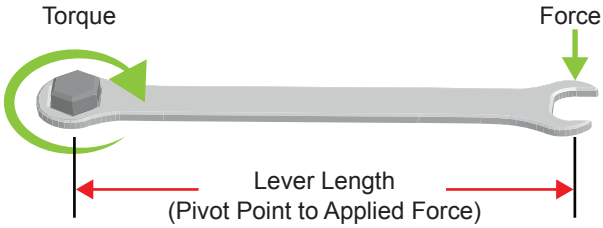


Figure 1.6 ***Torque = Force x Lever Length***

Crankshaft Torque. Torque is also used to describe the output rating of an engine, the crankshaft's turning force (***Figure 1.7***).

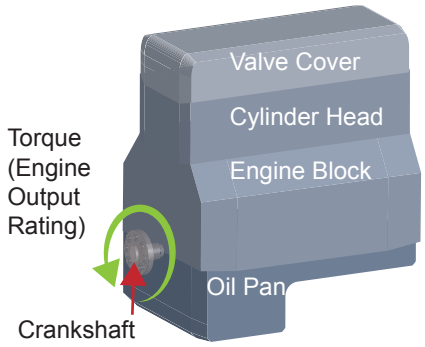
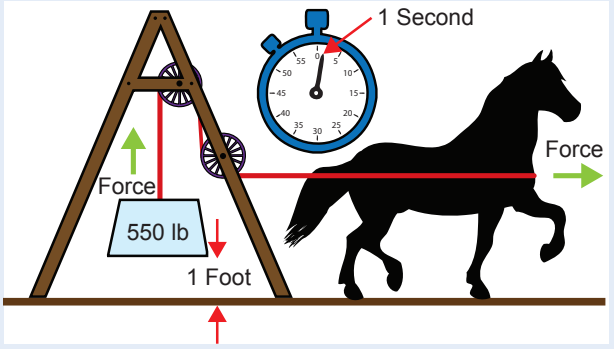


Figure 1.7 ***Crankshaft Torque***

Horsepower. A unit of power that is common in the automotive field is horsepower (hp). One horsepower is the work needed to lift 550 pounds a distance of 1 foot in 1 second (***Figure 1.8***).

Horsepower (English System)

1 Horsepower = 550 foot-pounds/second
1 Horsepower = 33,000 foot-pounds/minute



Watt (Metric System)

1 Horsepower = 746 watts = 0.746 kilowatts

Figure 1.8 ***One Horsepower***

Revolutions Per Minute (RPM). Torque and horsepower change as engine speed (revolutions per minute or rpm) changes, so these ratings are given at a specific rpm (***Figure 1.9***).

Vehicle	Engine	HP	Torque
1920 Ford Model T	2.9 L Gasoline	20 hp @ 1600 rpm	83 lb-ft @ 900 rpm
2017 Ford Super Duty	6.7 L Turbo Diesel	440 hp @ 2800 rpm	925 lb-ft @ 1800 rpm

Figure 1.9 ***Horsepower Comparison***

Engine Components

The basic parts in a four-stroke engine include intake valves, exhaust valves, pistons, connecting rods, engine block, cylinder head(s), crankshaft, camshaft(s), and oil pan (***Figure 1.10***).

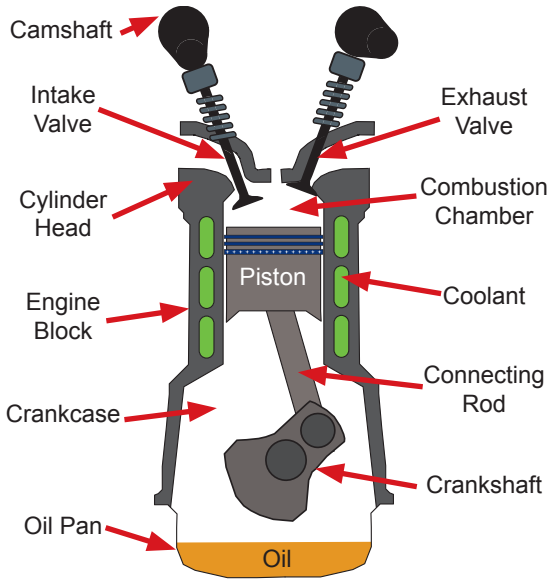
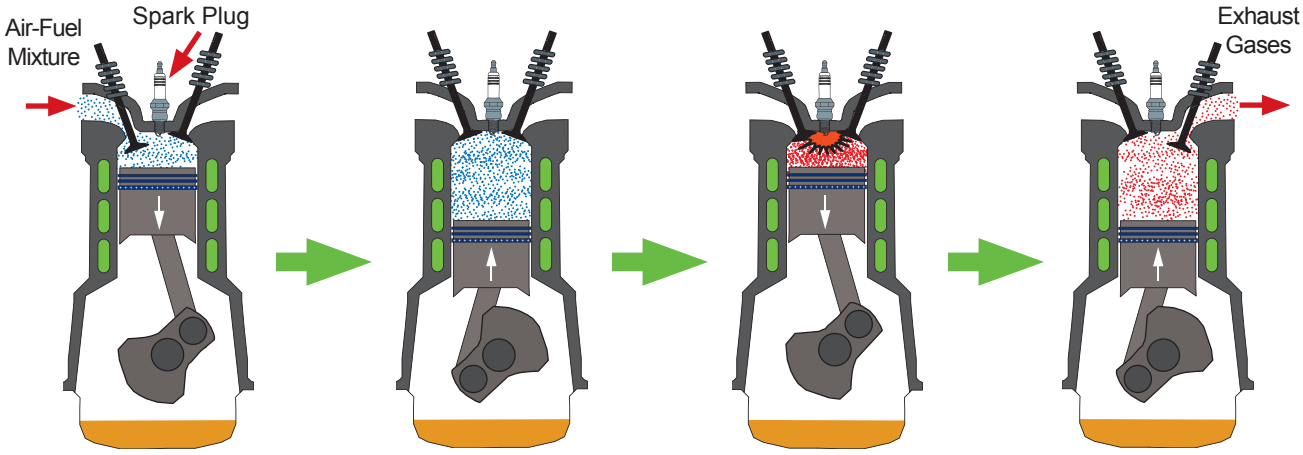


Figure 1.10 Dual Overhead Camshaft (DOHC) Engine

Four-Stroke Engines

The four-stroke internal combustion engine (also known as the Otto cycle, named after Nikolaus Otto) is the most common type used in automobiles. In a four-stroke engine the piston makes reciprocating (back and forth or up and down) movements to convert the chemical energy of fuel into mechanical energy of motion (kinetic energy).

Spark Ignition. Spark ignition (SI) engines are fueled by gasoline, propane, natural gas, or a gasoline/alcohol blend. A spark plug ignites the air-fuel mixture. The four-strokes of the spark ignition engine (***Figure 1.11***) are intake, compression, power (combustion), and exhaust. To complete the four strokes, the crankshaft makes two revolutions. Gasoline direct injection (GDI) engines, now becoming popular, will be explained in Chapter 11.



Intake Stroke
Intake valve is open. Exhaust valve is closed. Piston moves down. Air-fuel mixture enters the combustion chamber.

Compression Stroke
Intake and exhaust valves are closed. Piston moves up. Air-fuel mixture is compressed.

Power (Combustion) Stroke
Intake and exhaust valves are closed. A spark plug ignites the air-fuel mixture. Piston is forced down by combustion. This is the stroke that provides the power.

Exhaust Stroke
Exhaust valve opens. Intake valve is closed. Piston moves up, pushing exhaust gases out of the engine.

Figure 1.11 Four-Stroke Spark Ignition Engine Compression Ratio Commonly 8:1 to 12:1

Compression Ignition. Compression ignition (CI) engines are fueled by diesel. The four-strokes of the compression ignition engine (***Figure 1.12***) are similar to the spark ignition engine, except fuel is not mixed with air in the intake system. Instead diesel is injected directly into the combustion chamber or indirectly into a swirl (precombustion) chamber. Once in the combustion chamber, the diesel combusts spontaneously from the high pressure and heat. CI engines do not use spark plugs.

Videos

How Engines Work

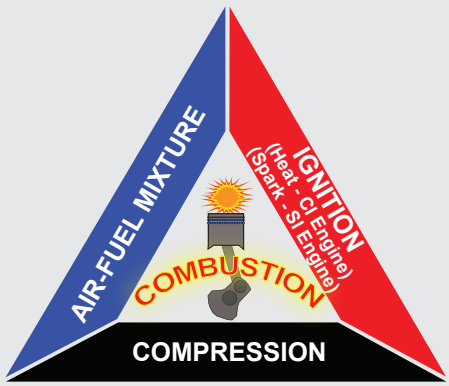
www.Video.AutoUpkeep.com

Click on Chapter 1

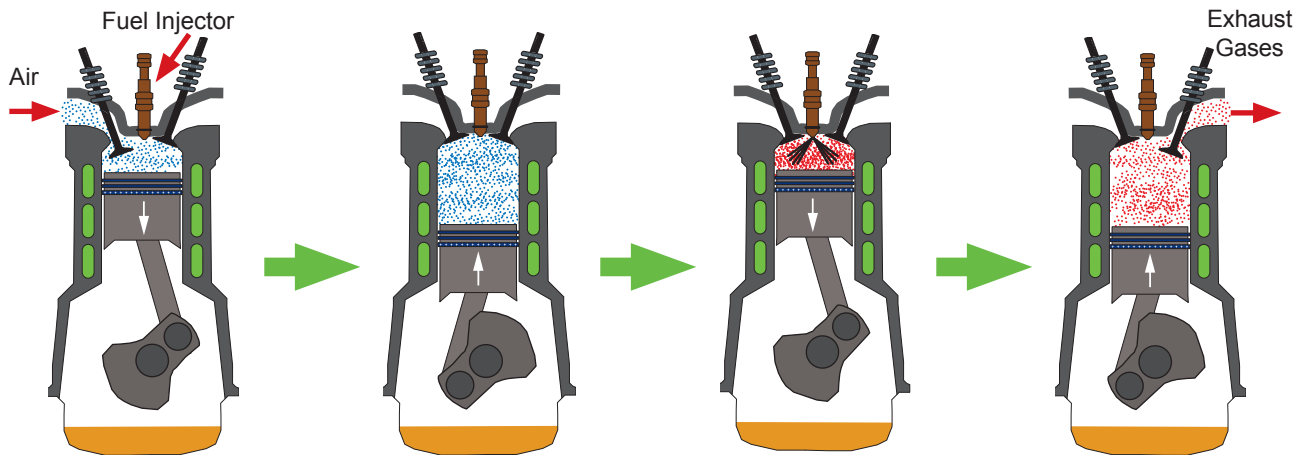
Tech Tip

ICE Requirements

For efficient combustion to occur in an internal combustion engine (ICE), there needs to be the correct air-fuel mixture, sufficient compression, and an ignition source (heat or spark). These three things must function properly to achieve engine efficiency and minimize emissions.



ICE Requirements Triangle



Intake Stroke
Intake valve is open. Exhaust valve is closed. Piston moves down. Air enters the combustion chamber.

Compression Stroke
Intake and exhaust valves are closed. Piston moves up. Air is compressed.

Power (Combustion) Stroke
Intake and exhaust valves are closed. Fuel is injected into the combustion chamber. The high pressure and heat ignite the fuel. Fuel combusts spontaneously. Piston is forced down by combustion. This is the stroke that provides the power.

Exhaust Stroke
Exhaust valve opens. Intake valve is closed. Piston moves up, pushing exhaust gases out of the engine.

Four-Stroke Cycle Repeats

Figure 1.12 *Four-Stroke Compression Ignition Engine (Direct Injection Diesel)*
Compression Ratio Commonly 16:1 to 20:1

Power Transfer

Several processes have to happen in order for a vehicle to move. The following (***Figure 1.13***) explains how power is transferred in a common gasoline powered (non-hybrid) automobile.

Power Transfer Process	
1	Fuel is stored as chemical energy in the gas tank.
2	Fuel is transported to the engine by a fuel pump.
3	Air-fuel mixture enters the engine.
4	Electrical energy is used to create a spark at the spark plug.
5	Combustion occurs, converting the chemical energy to kinetic energy. The piston moves linearly, reciprocating up and down or back and forth.
6	The reciprocating motion of the pistons is converted to rotary (circular) motion of the crankshaft.
7	The crankshaft's rotary motion turns the transmission.
8	On front-wheel drive (FWD) vehicles, rotary motion is transferred through a transaxle (transmission and differential combined). From the transaxle, rotary power is moved through constant velocity (CV) shafts. On rear-wheel drive (RWD) vehicles, rotary motion is transferred from the transmission through the drive shaft then to a differential and final drive assembly. In this situation, the differential changes the power flow 90° and allows the drive wheels to turn at different speeds when cornering. Power is transferred from the differential to axle shafts.
9	The axle shafts or CV shafts turn the wheels.
10	The rotary motion of the wheels converts to linear motion on the roadway.

Figure 1.13 ***How Power is Transferred***

Fuels and Designs

Most of the 260 million vehicles registered in the United States today burn either gasoline or diesel in an internal combustion engine. This section focuses on:

- Gasoline Powered Vehicles
- Diesel Powered Vehicles
- Emerging Technologies

Gasoline Powered Vehicles

Passenger cars and light trucks powered solely by burning gasoline in an internal combustion engine are the most popular. Gasoline engines use spark plugs to ignite the air-fuel mixture in the engine. There are several reasons for the popularity of gasoline powered vehicles. They are currently affordable (this depends on the price of gas (***Figure 1.14***)), easy to refuel (gas stations in just about every town), they meet performance expectations (range, acceleration, and speed), and we are most familiar with the technology.

Gasoline Fuel. One of the major disadvantages of gasoline is that once the fuel is burned, it is gone forever. In addition, gasoline engines emit hydrocarbons (HC), nitrogen oxides (NO_X), carbon monoxide (CO), and carbon dioxide (CO_2). Gasoline emissions are discussed in Chapter 17.

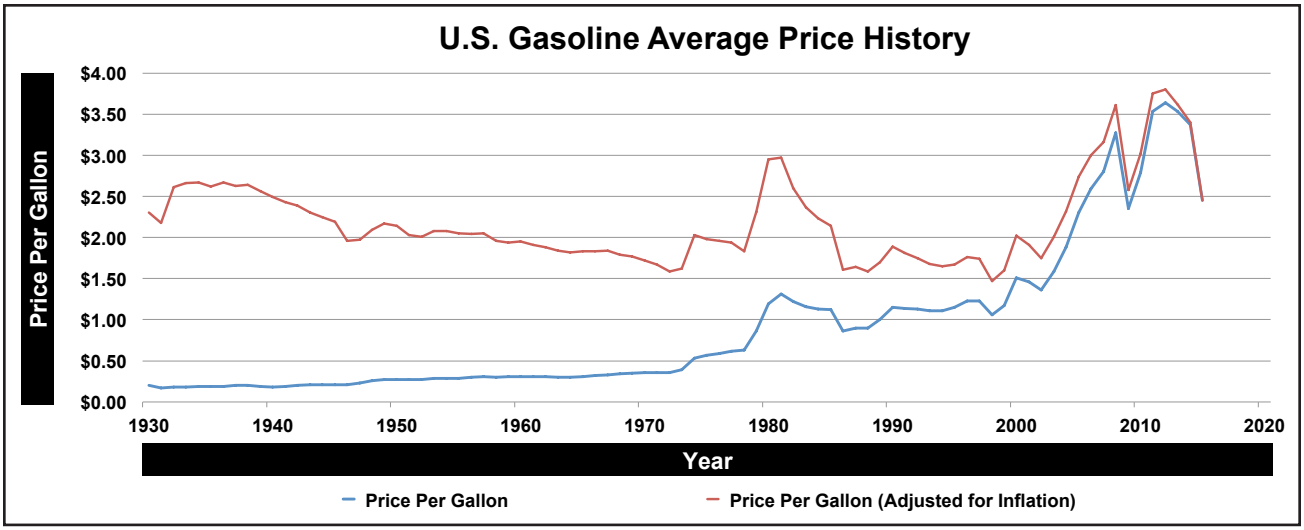


Figure 1.14 ***U.S. Gasoline Price History***

Diesel Powered Vehicles

Diesel engines are compression ignition engines; they do not have spark plugs. When thinking of diesel, a medium (***Figure 1.15***) or heavy-duty truck might come to mind. Diesel powered specialty vehicles (e.g., garbage trucks, school buses, and fire engines) and semi trucks pulling trailers are very common.

Figure 1.15 ***Ford F 650 Medium Duty***
Courtesy of Ford Motor Company

Passenger Vehicles. Diesel engines have also become popular in light trucks. Recently in the United States there has been a resurgence of diesel powered cars. In Europe, diesel powered cars are fairly common, making up about one-half of new cars.

Diesel Fuel. Diesel fuel (***Figure 1.16***) has more energy per gallon as compared to gasoline, making it more efficient for every gallon of fuel burned. Diesels emit NO_X and particulate matter (PM), in addition to greenhouse gas pollutants. Ultra-low sulfur diesel and newer engine and emission systems have greatly decreased emissions. Diesel emissions are discussed in Chapter 17.

Figure 1.16 ***Diesel Fuel Dispenser***

Emerging Technologies

In 2017, the following gas-free, 100% electric vehicles (EVs) were produced by auto manufacturers (***Figure 1.17***). ***Note: Miles per gallon of gasoline equivalent (MPGe) is a measure used to compare energy usage in advanced technology vehicles to the miles per gallon (MPG) rating in conventional vehicles.***

Electric Vehicles	MPGe
Hyundai Ioniq Electric	136 MPGe
BMW i3	124 MPGe
Nissan Leaf	112 MPGe
Mitsubishi i-MiEV	112 MPGe
Tesla Model X	93 MPGe
Mercedes-Benz B250e	84 MPGe

Figure 1.17 ***Electric Vehicles***

EV Charging. EVs use only electricity for propulsion. The disadvantage is that their driving range is limited when the battery is discharged. In a sense, this is similar to your gasoline powered vehicle when your gas tank is empty. The difference is that there are many more gas stations than EV charging stations. Public and company owned charging stations (***Figure 1.18***) are strategically placed to extend the range of electric vehicles when you cannot recharge at home.

Figure 1.18 ***Tesla Supercharger Station***
Photo: Tesla

Web Links

EV Charging Stations

PlugShare
www.plugshare.com

ChargePoint
www.chargepoint.com

Tesla Superchargers
www.tesla.com/supercharger

Engine Identification

A vehicle's engine is classified by its:

- Size/Displacement
- Configuration

Size/Displacement

The size of the engine is the combined volume of the cylinders. Engine size can be found on the vehicle emission control information sticker under the hood. Engine size is commonly listed in liters or cubic inches (***Figure 1.19***).
Note: 1 L = 61.02 cu. in.

International System of Units (Metric System)		U.S. Customary Units (English System)
1.8 L	=	110 cu. in.
2.4 L	=	147 cu. in.
4.6 L	=	281 cu. in.
5.0 L	=	305 cu. in.
5.3 L	=	323 cu. in.
6.8 L	=	415 cu. in.

Figure 1.19 ***Common Engine Sizes***

Configuration

Engine configuration is the design of the engine block. Common engine configurations include inline, opposed, or V (***Figure 1.20***). The configuration describes the way cylinders are arranged in the block. The number of cylinders within the engine block is also used to identify the type of engine design. Engines have 3, 4, 5, 6, 8, 10, or 12 cylinders. The most common engine configurations are inline 4s, V6s, and V8s.

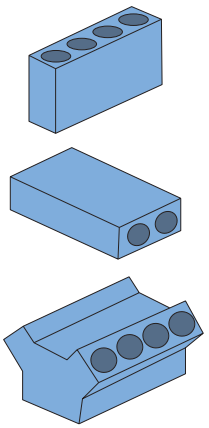


Figure 1.20 ***Engine Configurations***

Vehicle Identification

Vehicles can be identified by the:

- VIN
- Manufacturer
- Make
- Model
- Year
- Type

VIN

The Vehicle Identification Number (VIN) is an important number on a vehicle. This 17-character number can be seen on the left side of the dash from outside the vehicle through the windshield. Left and right sides are determined by sitting inside the vehicle facing forward. The VIN also appears on the vehicle certification label on the inside of the driver's doorjamb. Additionally, it is on the vehicle's title card.

VIN Information. The VIN contains information including codes that identify the engine type, body type, model year (MY), assembly plant, production sequence number, and other information specific to that vehicle. In the following figure, the tenth character "H" identifies the model year as 2017, even though the manufacture date was October 2016 (***Figure 1.21***). Keep the VIN handy, automotive parts stores may need it to find the correct replacement parts.

Figure 1.21 ***Doorjamb VIN***

Manufacturer

An automotive manufacturer (***Figure 1.22***) is a company that produces vehicles. Through the years some manufacturers have taken over others, joined forces, or completely gone out of business.

Figure 1.22 ***Automotive Manufacturer Logos***

Make

Automotive manufacturers (***Figure 1.23***) identify the various vehicles they produce by their "make" (also known as brands or divisions).

Manufacturer	Make/Brand/Division
GM	Buick, Cadillac, Chevrolet, and GMC
Fiat Chrysler Automobiles	Chrysler, Dodge, Jeep, Ram Truck, Alfa Romeo, Fiat, Lancia, Abarth, and Maserati
Daimler	Maybach, Mercedes-Benz, AMG, and smart
Ford	Ford and Lincoln
Toyota	Lexus and Toyota
Volkswagen Group	Volkswagen, Audi, Bentley, Bugatti, Lamborghini, Porsche, SEAT, and SKODA
Honda	Acura and Honda
Hyundai	Hyundai and Kia
Nissan	Infiniti, Nissan, and Datsun
Geely	Geely and Volvo
Tata	Jaguar, Land Rover, and Tata
BMW	BMW, MINI, and Rolls-Royce

Figure 1.23 ***Examples of Makes***

Model

The model (***Figure 1.24***) of a vehicle refers to the specific name of each vehicle within a make. Model names often change over time.

Make	Model
Chevrolet	Bolt EV, Camaro, Colorado, Corvette, Cruze, Equinox, Impala, Malibu, Silverado, Sonic, Spark, Suburban, Trax, Traverse, Tahoe, and Volt

Figure 1.24 ***Examples of Models***

Year

The model year of a vehicle is not necessarily the year in which it was built. A vehicle built in October 2017 most likely would be considered a 2018 model year vehicle. To find the actual model year of the vehicle look at the vehicle emission control information (VECI) sticker under the hood. This sticker indicates the year of pollution standards conformance, which is also the model year (MY). The date of manufacture is listed inside the driver's door on the vehicle certification label. This is the actual month and year that the vehicle rolled off the assembly line.

Type

Automotive manufacturers design many different types (***Figure 1.25***) of vehicles to meet consumer demands.

Type	Model
Microcar	GEM e2, Nano, and smart fortwo
Subcompact Car	Accent, Fiesta, Fit, Spark, Versa, and Yaris
Compact Car	Civic, Corolla, Focus, Golf, and Sentra
Mid-size Car	Accord, Camry, Fusion, and Malibu
Full-size Car	Avalon, Charger, Impala, and Maxima
Sports Car	Challenger, Corvette, Mustang, and Porsche 911
Compact SUV	Escape, RAV4, CR-V, and Wrangler
Mid-size SUV	Durango, Explorer, Grand Cherokee, Highlander, and Pathfinder
Crossover SUV	Edge, Flex, Murano, Outback, and Tiguan
Full-size SUV	Escalade, Expedition, Suburban, and Tahoe
Compact Pickup	Colorado, Frontier, Ridgeline, and Tacoma
Full-size Pickup	F-Series, Ram, Sierra, Silverado, Titan, and Tundra
Minivan	Caravan, Pacifica, Odyssey, Quest, Sedona, Sienna, and Transit Connect
Van	Express, Savana, and Transit

Figure 1.25 ***Examples of Types and Models***

Tech Tip

Identifying Vehicle Parts

To purchase the correct maintenance items (e.g., filters) or replacement parts (e.g., an alternator or a starter), it is important to know a vehicle's VIN, make, model, engine size/configuration, production date, and model year. ***Note: The date of manufacture and the model year of a vehicle may differ. Manufacturers produce millions of vehicles each year by continuous manufacturing. Showroom floors often include vehicles from next year's model lineup six to nine months before that calendar year.***

Parts and Systems

The automobile is made up of:

- Parts
- Systems

Parts

The car's frame and body (sometimes integrated together into one unit called a unibody) are large parts of the automobile (***Figure 1.26***). Smaller parts (also called components) and assemblies (e.g., engine and transmission) work together to make the vehicle move.

Figure 1.26 ***Vehicle Body***
Photo: Tesla

Systems

Parts that work together to perform a specific task make up a system.

Electrical System. The job of the electrical system is to deliver electricity throughout the vehicle to various lights, motors, relays, and switches.

Lubrication System. The lubrication system moves oil throughout the engine to reduce wear.

Fuel System. Using fuel lines, injectors, and a fuel pump, the fuel system supplies the engine with the correct amount of fuel and air.

Cooling System and Climate Control. The cooling system carries away excess heat from the engine. Climate control is used to condition the air in the passenger's cabin.

Ignition System. The ignition system is designed to ignite the air-fuel mixture in a gasoline engine at the correct time.

Suspension, Steering, and Tires. The suspension system helps to control the vehicle's up and down movement. The steering system controls the vehicle's directional movements. The tires connect the vehicle to the road.

Braking System. The braking system slows and stops a vehicle.

Drivetrain. The drivetrain transfers the power from the engine to the wheels.

Exhaust and Emission System. The exhaust and emission system removes exhaust from the engine, quiets engine combustion, and lowers vehicle pollutants.

Web Links

Automotive Manufacturer Sites

BMW of North America, LLC
www.bmwusa.com

Fiat Chrysler Automobiles
www.fiat.com

Fisker Inc.
www.fiskerinc.com

Ford Motor Company
www.ford.com

General Motors
www.gm.com

Honda Motor Company
www.honda.com

Hyundai Motor Company
www.hyundai.com

Mazda
www.mazda.com

Mitsubishi Motors North America, Inc.
www.mitsubishicars.com

Nissan Motor Company
www.nissanusa.com

Tata Motors
www.tatamotors.com

Tesla
www.tesla.com

Toyota Motor Corporation
www.toyota.com

Volkswagen of America
www.vw.com

Careers

Many careers exist in the automotive industry:

- Manufacturing Careers
- Service and Repair Careers
- Support Careers

Manufacturing Careers

Automotive manufacturers hire many different types of engineers that assist in pre-production, software and programming, automation, paint, and assembly. Designers, machinists, logistics personnel, production supervisors, and assembly line workers (***Figure 1.27***) are all needed to build highly complex vehicles.

Figure 1.27 ***Automotive Manufacturing***
Photo: Tesla

Service and Repair Careers

Automotive technicians can work in a variety of repair facilities (***Figure 1.28***) in different capacities to diagnose, service, and repair a vehicle. Service managers oversee the shop operations. Service writers communicate with the customers and convey the concern or scheduled service to the technician through a work order.

Figure 1.28 ***Repair Facility***
Courtesy of Ford Motor Company

Support Careers

Careers that support the automotive industry include automotive teachers, salespeople, parts specialists, auto body technicians, insurance adjusters, auto loan specialists, car rental managers, and installers at specialty shops.

Summary

In a little over one hundred years, automobiles have become extremely popular. The automobile has made personal land transportation easy, allowing people to work great distances from where they live. Cugnot, Benz, and Ford, among others, changed the development of the automobile forever. Today, manufacturers are mass-producing hybrid and 100% electric vehicles to increase efficiency, minimize pollution, and reduce our reliance on nonrenewable energy resources. See Chapter 18 to learn more about alternative fueled vehicles.

Activities

Introduction and How Cars Work

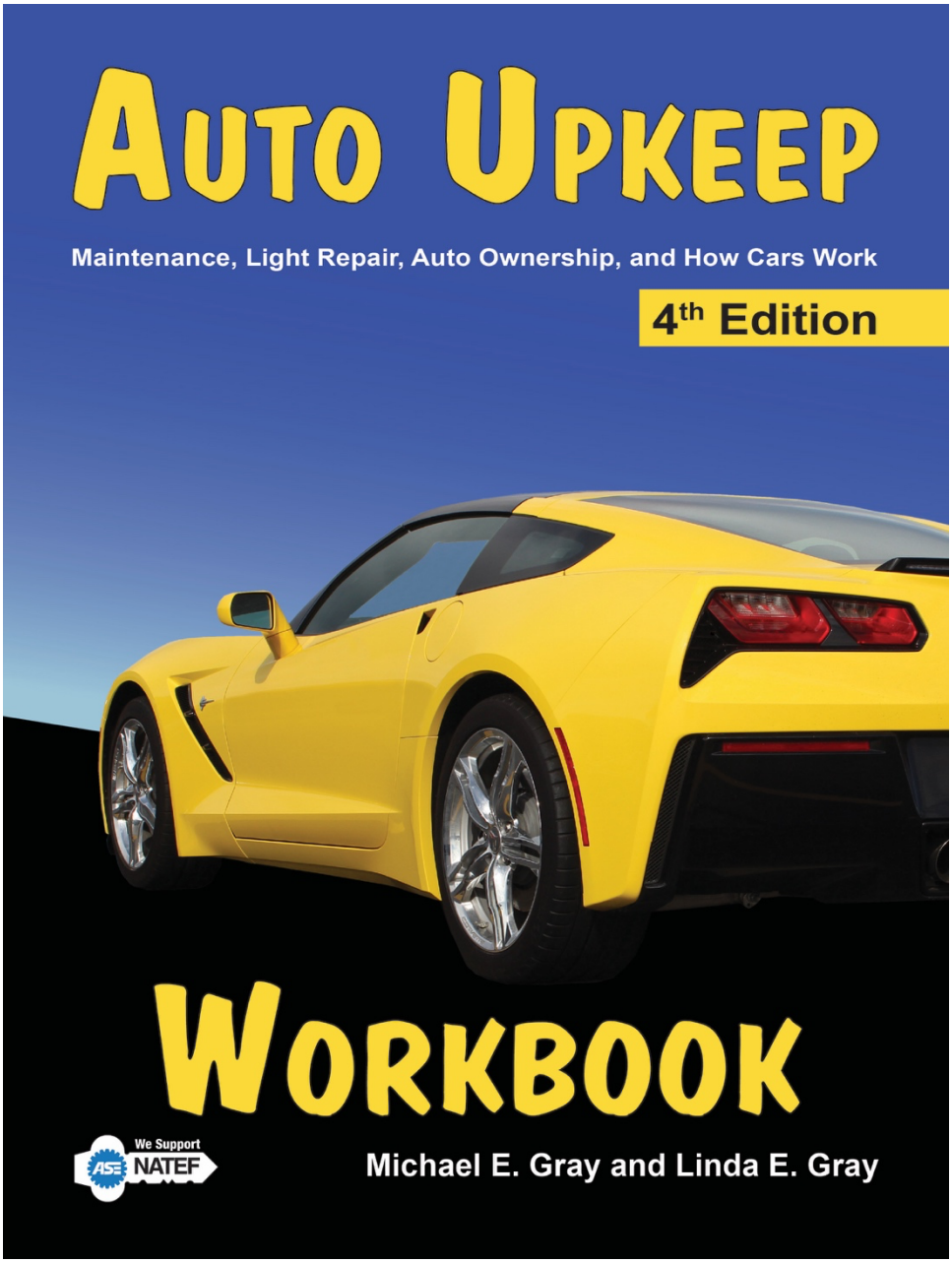
- Car Identification Activity
- Owner's Manual Activity
- Chapter 1 Study Questions

Activities and Study Questions can be completed in the *Auto Upkeep Workbook*.

Career Paths

Automotive Teacher

Education: Bachelor's Degree and/or ASE Cert.
Median Income: $52,800
Abilities: Good communication with students in a technical hands-on environment.
Find your career at www.bls.gov/ooh.



Sample Workbook Pages

Chapter 1 – Introduction and How Cars Work

Features of the Workbook

QR (Quick Response) Codes - Scan to easily access additional chapter resources online.

Objectives - What you should know and be able to do upon completion of the chapter and activities.

Online Resources - Tips to using online resources.

Web Exploring - Expand learning through key terms and internet search words.

Think Safety - Key safety tips related to the procedures in each chapter.

Illustrations - To clarify concepts and develop further understanding.

Procedures - Step-by-step learning experiences.

Calculations - Integrating basic practical math problems.

Activity Journal - Take notes as you complete the procedures.

Study Questions - Developed to extend learning.

Appendix - Additional resources that may be duplicated to enhance learning.

Cautions - Reference to precautions in the activity.

NATEF Correlations - A list of 2017 NATEF MLR entry level tasks that correlate to the chapter.

Warnings - Potential hazard alerts requiring safety precautions to avoid personal injury.

Tools - A list of tools and equipment you will need to complete the activity.

Supplies - A list of supplies you will need to complete the activity.

Directions - Information on how to make a record of the tasks completed in the procedures.

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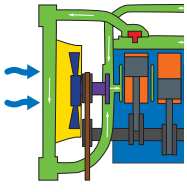
Electrical System

CHAPTER 10
Lubrication System

CHAPTER 11
Fuel System

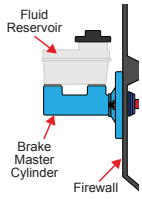
CHAPTER 12
Cooling System and Climate Control



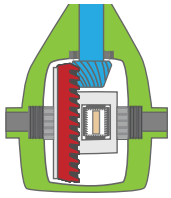
CHAPTER 13
Ignition System

CHAPTER 14
Suspension, Steering, and Tires

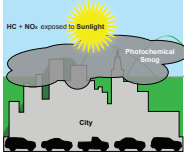
CHAPTER 15
Braking System



CHAPTER 16
Drivetrain



CHAPTER 17
Exhaust and Emission System



CHAPTER 18
Alternative Fuels and Designs

CHAPTER 19
Automotive Accessories

CHAPTER 20
Common Problems and Roadside Emergencies

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ORDER PAGE

Introduction and How Cars Work

Think Safety

Moving and/or hot engine components can be dangerous. Shut off the engine and remove the key before opening the hood.

Objectives

After reading the *Auto Upkeep* text and completing the following activities, you will be able to:

- Identify early automotive contributors.
- Differentiate between vehicle manufacturers, makes, models, and types.
- Describe how cars work.
- Locate and use an online owner's manual.

Online Resources

Chapter Resources

Online resources to support this chapter can be accessed at www.autoupkeep.com/resources or by scanning the QR Code at the top of this page.

Videos

Links to videos that support this chapter are available at www.video.autoupkeep.com.

Internet Addresses

Internet addresses were accurate at the time of printing. If the webmasters of these domains change links or home pages, please look for similar navigational items to complete this activity.

Updates

Please email us at info@autoupkeep.com if you find any broken links. Updates are posted online. Use the chapter resources link above.

Chapter 1 Activities

- Study Questions
- Car Identification Activity
- Owner's Manual Activity

Web Exploring

Key Terms/Internet Search Words

Visit www.google.com to investigate any of the following terms or phrases. Summarize your findings in a research paper.

- Automotive Manufacturers
- Automotive Milestones
- Carl (Karl) Benz
- Cugnot Steam Traction Engine
- Diesel Engines
- Ferdinand Porsche
- Four-Stroke Engine
- Gasoline Engines
- Henry Ford
- How Cars Work
- Internal Combustion Engine
- Leonardo da Vinci Automobile
- Model T
- Nicholas Cugnot
- Nikolaus Otto
- Ransom Olds First Assembly Line
- Vehicle Identification Number
- Volkswagen Beetle
- What is MPGe

Name _____ **Class** _____ **Date** ___/___/___ **Score** _____

Study Questions - Introduction and How Cars Work

1. What was the earliest self-powered road vehicle?

2. Who was credited with the world's first practical motorcar?

3. What is the difference between force, work, power, and energy?

4. What are the strokes in a four-stroke internal combustion engine? What is the difference between a gasoline and diesel engine?

5. What two units of measurement are used to classify engine sizes?

6. What is an engine configuration? List several examples.

7. What does the acronym VIN represent?

8. What is the difference between a manufacturer and make?

9. What are the systems of the automobile?

10. What types of careers exist in the automotive industry?

Name _____ Class _____ Date / / Score _____

Car Identification Activity

Objective

Upon completion of this activity, you will be able to correctly identify an automobile by manufacturer, make, model, year, and type.

NATEF Correlations

Preparing Vehicle for Service

- Vehicle identifying information.

Tools

None

Supplies

None

Cautions

Follow all procedures and safety guidelines specified by your instructor.

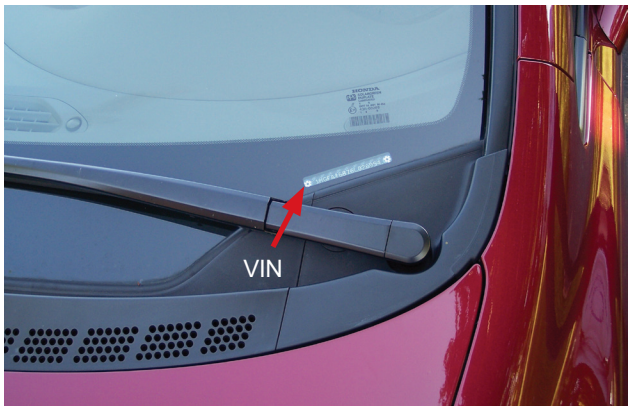
Directions

Check off the boxes ❑ when completed. When you see a hand ✍ next to the task, write the information in the activity journal. If you have any questions during the duration of this activity, stop and ask the instructor for assistance.

Procedure

❑ Open the driver's door and look for the vehicle certification label.

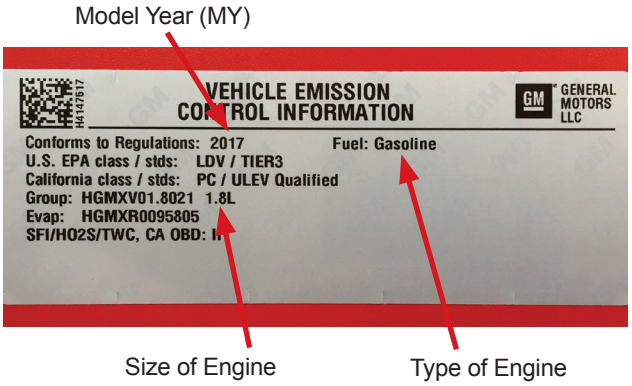
✍ Identify the date of manufacture.
✍ Identify the vehicle manufacturer.
✍ Look in the front windshield and find the VIN. Write down the VIN.



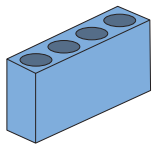
❑ Look on the outside of the vehicle. The make and model are usually identified on the rear, front, or side of the vehicle.
✍ Note the make and model.
✍ Identify the vehicle type (e.g., Microcar, Subcompact Car, Compact Car, Mid-size Car, Full-size Car, Sports Car, Compact SUV, Mid-size SUV, Crossover SUV, Full-size SUV, SUT, Compact Pickup, Full-size Pickup, Minivan, or Van).
❑ Open the hood. If unsure how to open the hood, refer to the owner's manual. A release latch should be under or near the steering column.
❑ Once the hood is popped, there is a safety latch on the outside.

❑ Locate the vehicle emission control information (VECI) sticker under the hood.

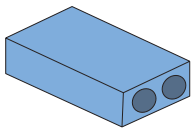
- ✍ Look on the VECI sticker to determine the model year.
- ✍ Look on the VECI sticker to determine the size (e.g., 1.8 L) and type (e.g., gasoline or diesel) of engine in your vehicle.



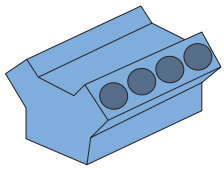
- ✍ Look at the engine design to determine the configuration (e.g., inline, opposed, or V).



4 Cylinder Inline



4 Cylinder Opposed



V8

- ✍ Look at the engine to try to determine the number of cylinders. Identifying the number of spark plugs may help you. ***Note: Most engines have one spark plug per cylinder, but some have two.***
- ❑ Close the hood.

✍ Activity Journal

1. What is the date of manufacture for the vehicle?

_____

2. What company manufactured the vehicle?

_____

3. What is the VIN for the vehicle?

_____

4. What is the make and model of the vehicle?

_____

5. What is the vehicle's type?

_____

6. What is the model year according to VECI sticker?

_____

7. What is the engine size and type?

_____

8. What is the engine configuration?

_____

9. How many cylinders does the engine have?

_____

Name _____ Class _____ Date / / Score _____

Owner's Manual Activity

Objective

Upon completion of this activity, you will be able to locate and use an online owner's manual.

NATEF Correlations

Shop and Personal Safety

- Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS).

Preparing Vehicle for Service

- Vehicle identifying information.

Engine Repair, Automatic Transmission and Transaxle, Manual Drivetrain and Axles, Suspension and Steering, Brakes, Electrical/Electronic Systems, HVAC, Engine Performance

- Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.

Tools

Internet access

Supplies

None

Cautions

Follow all procedures and safety guidelines specified by your instructor.

Directions

Check off the boxes ❑ when completed. When you see a hand ✍ next to the task, write the information in the activity journal. If you have any questions during the duration of this activity, stop and ask the instructor for assistance.

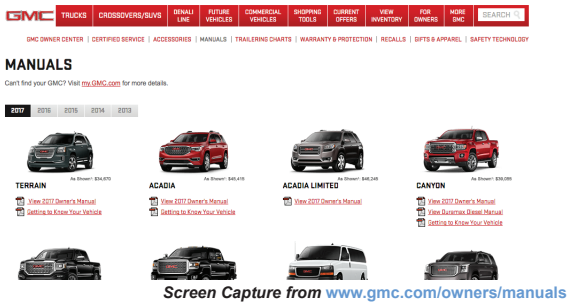
Procedure

✍ Note the manufacturer, make, model, model year, and trim level of your vehicle, a vehicle in your household, or the one given to you by your instructor.

❑ Use a phone, tablet, or computer to access the Internet.

❑ Open a search engine such as www.google.com.

❑ Search for the electronic copy of your owner's manual. For example, search *GMC Owner's Manual*. Look for the manufacturer's website.



Screen Capture from www.gmc.com/owners/manuals

❑ Take a couple of minutes to become familiar with how to navigate the online owner's manual.

✍ Use the manual to find the following vehicle specifications. Note the vehicle specifications.

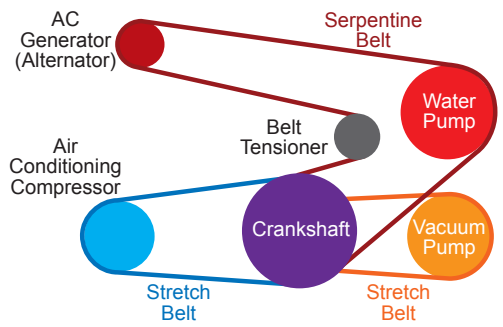
- Recommended Oil
- Oil Capacity
- Fuel Tank Capacity
- Minimum Fuel Rating
- Engine Coolant Type
- Brake Fluid Type
- Transmission Fluid Type
- Maximum Towing Capacity
- Lug Nut Torque

✍ Use the manual to find the maintenance schedules for the following. Note the maintenance schedules.

- Change Engine Oil
- Rotate Tires
- Replace Spark Plugs
- Replace Engine Air Filter
- Replace Cabin Air Filter
- Replace Timing Belt
- Flush Brake Fluid

❑ Use the manual to find out how to reset the engine oil life monitoring system.

✍ Locate the drive belt routing diagram in the manual. Sketch how the drive belt routes on the engine.



❑ Locate the section in the manual that reviews information about the supplemental restraint system (airbags).

✍ Note three warnings associated with the supplemental restraint system.

❑ Locate the section in the manual that reviews the instrument warning lights (also called malfunction indicator lights).

✍ Note three warning lights.

❑ Use the manual to locate the jack point on the vehicle. This is the place where you would jack up the vehicle if you had a flat tire.

❑ Research any applicable recalls or technical service bulletins for your vehicle. Use a search engine with the keywords *safety recalls and technical service bulletins (TSBs)* to find a website with information about your vehicle.

✍ Note any recalls or technical service bulletins.

❑ Log off your device.

✍ Activity Journal

1. What is the manufacturer, make, model, model year, and trim level of the vehicle?

2. List the vehicle specification information below.

3. List the maintenance schedules below.

4. On a separate sheet of paper, sketch a drawing to illustrate how the drive belt routes on the engine.

5. What are three warnings associated with the supplemental restraint system?

6. What are three warning (malfunction indicator) lights on the vehicle?

7. Note any recalls or technical service bulletins.

Safety Rules

Personal Protection

- Safety glasses are not optional. Wear them at all times when working on a vehicle. ***Note: Ordinary prescription glasses are not safety glasses. You can purchase approved prescription safety glasses with side shields.***
- Do not have bare feet or wear open-toed sandals. Wear shoes that protect your feet.
- Loud noises can damage your hearing, so wear ear protection (e.g., earplugs or earmuffs).
- Keep your tools and hands free of grease and oil. Wearing mechanic gloves is smart, but do not wear gloves when moving parts are present. Keep your hands away from moving parts. Never use your hands to stop components that are moving.
- Remove your rings, watch, and other jewelry. If you have long hair, tie it back. It could get caught in moving parts. Do not wear loose or baggy clothing that could get caught in moving parts.
- Use the appropriate respirator when hazardous dust or airborne chemicals are present.
- Do not touch spark plug wires while the engine is running. Tens of thousands of volts are present.
- Never put your hands on or near the cooling fan. Many fans are electric and can start at anytime, even if the ignition is off.
- Do not work on a hot engine. Never open a hot radiator cap.
- Use proper lifting procedures to avoid injury. Use your legs, not your back.

Shop/Lab Procedures

- Know the location and operational procedures of fire extinguishers, first-aid kits, safety data sheets, eyewash stations, and a telephone. Dial 911 for emergencies. Have an evacuation route out of the shop identified.
- Someone must be sitting in the driver's seat whenever a car is started and/or running.
- The exhaust system of a running engine must be connected to a ventilation system if the vehicle is in an enclosed location such as a garage. ***Warning: Carbon monoxide is a colorless, odorless, and poisonous gas. Proper ventilation is required.***
- Always engage the parking brake to prevent the vehicle from moving.
- Put oily rags in an approved can for combustible materials.
- Always clean up spilled oil and grease off the floor. Sawdust, kitty litter, and oil dry work well for this.
- Never pour chemicals, solvents, antifreeze, or oil down the sanitary drain. Put them in their proper containers to be recycled.
- Use an approved safety cabinet for flammable materials. Do not use gasoline to clean parts.
- OSHA states that compressed air shall not be used for cleaning purposes (parts or objects) except where reduced to less than 30 pounds per square inch (psi) and then only with effective chip guarding and appropriate personal protective equipment. Never (at any pressure or under any circumstances) use compressed air to clean off clothes or your body. Never point an airline toward your skin, your body, or another person.

Hand Tools, Power Tools, and Shop Equipment Safety

- Use the proper tool for each job. Make sure tools and equipment have all the proper guards installed. Operate tools and equipment according to the manufacturers' instructions. Do not put sharp or pointed tools in your pocket.
- Avoid tripping hazards. Stand creepers up and place floor jack handles in the up position when not being used.
- Be cautious where sparks are falling when grinding, cutting, or welding.
- If a car is off the ground (except when on an automotive lift) it must be supported by jack stands.
- Do not use chisels or punches with mushroomed heads. When striking the ends with a hammer, the heads might shatter on impact, causing fragments to become airborne.
- Wrenches must not be used when jaws are sprung, malformed, or bent. Slippage can occur.
- Secure work with a vise or clamp. Operate a tool with both hands as recommended by the manufacturer.
- Maintain good footing and keep yourself balanced when operating power tools.
- Do not put tools on top of a vehicle's battery. Accidentally touching both terminals will cause a spark, which could lead to an explosion.
- Inspect electrical cords for fraying before use. Do not use electric tools in damp or wet locations. Electric tools must have a three-wire cord with a ground and be plugged into a properly grounded receptacle or be double-insulated.
- Prior to grinding stand off to the side and allow the grinder to get up to full operating speed. A grinding wheel can explode during start-up.

Note: This list is not all-inclusive. Follow safety guidelines provided by OSHA, EPA, safety data sheets, your instructor, and tool, equipment, and chemical manufacturers.

Name _____ Class _____

Activity Completion Record

	Activity	Date	Points	Grade
CHAPTER 1	Car Identification Activity			
	Owner's Manual Activity			
CHAPTER 2	Buying a New Automobile Activity			
	Buying a Used Automobile Activity			
CHAPTER 3	Automotive Expenses Activity			
CHAPTER 4	Repair Facilities Activity			
CHAPTER 5	Automotive Safety Activity			
	Safety Data Sheet (SDS) Activity			
	Personal Protection Equipment and Fire Safety Activity			
CHAPTER 6	Tools and Equipment Activity			
	Service Manual Activity			
CHAPTER 7	Interior Cleaning Activity			
	Exterior Cleaning Activity			
	Waxing Activity			
CHAPTER 8	Fluid Level Check Activity			
CHAPTER 9	Ohm's Law Activity			
	Wiring Diagram Activity			
	Battery Activity			
	Charging Activity			
	Starting Activity			
CHAPTER 10	Oil and Filter Change Activity			
CHAPTER 11	Fuel System Part Identification Activity			
	Fuel System Maintenance Activity			
CHAPTER 12	Air Conditioning Activity			
	Cabin Air Filter Activity			
	Cooling System Activity			
CHAPTER 13	Ignition System Activity			
CHAPTER 14	Suspension and Steering Activity			
	Tire Inspection and Rotation Activity			
CHAPTER 15	Brake Inspection Activity			
CHAPTER 16	Drivetrain Activity			
CHAPTER 17	Exhaust and Emission Activity			
CHAPTER 18	Payback Period Activity			
	Future Vehicle Activity			
CHAPTER 19	Automotive Accessories Activity			
CHAPTER 20	Changing a Flat Tire Activity			
	Jump-Starting Activity			
	Lighting Activity			
	Replacing Wipers Activity			
	On-Board Diagnostics Activity			
			Total Points	Overall Grade

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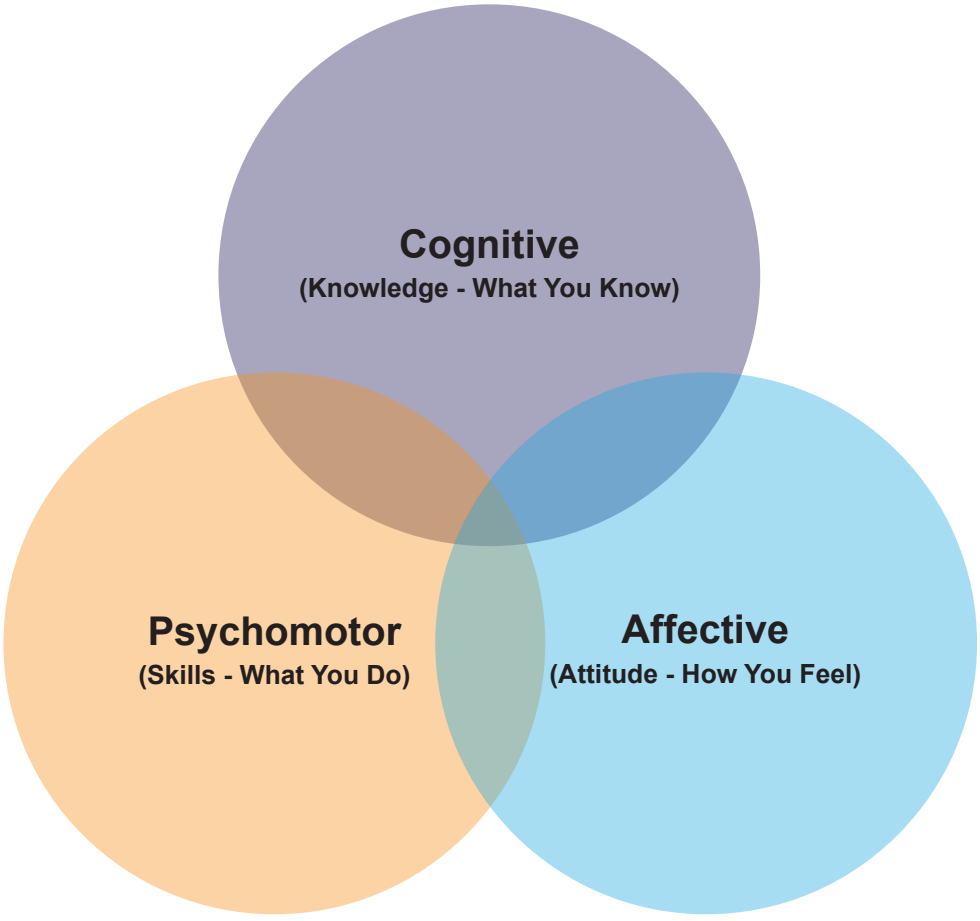
Domains of Learning

The *Auto Upkeep* curriculum focuses on three domains of learning: cognitive, psychomotor, and affective. Think of domains as categories of learning. The tasks/skills listed in the *Auto Upkeep Competency Profile* are categorized into the corresponding domain and the level of learning within that domain. These are the things that students should know and be able to do after completing the learning activities.

Higher Levels

Cognitive (Knowledge - Think)	Psychomotor (Skills - Do)	Affective (Attitudes - Feel)
Evaluation	Naturalization	Characterization
Synthesis	Articulation	Organization
Analysis	Precision	Valuing
Application	Manipulation	Responding
Comprehension	Imitation	Receiving
Knowledge		

More Complex



Name _____ **Class** _____ _____ **pts./** _____ **=** _____ **GPA**

Score/Mastery

A	B	C	D	F
Master	Proficient	Apprentice	Novice	No Attempt
4	3	2	1	0

Grade Scale			
4.0 = A	3.0 = B	2.0 = C	1.0 = D
3.7 = A-	2.7 = B-	1.7 = C-	0.7 = D-
3.3 = B+	2.3 = C+	1.3 = D+	0 = F

Task/Skill	Domain	Level
Chapter 1. Introduction and How Cars Work		
Describe how cars work.	Cognitive	Knowledge
Locate and identify the Vehicle Identification Number (VIN).	Psychomotor	Imitation
Identify the engine size and configuration.	Cognitive	Knowledge
Explain the difference between manufacturer, make, and model.	Cognitive	Comprehension
Classify vehicle types.	Cognitive	Analysis
Distinguish differences between spark and compression ignition engines.	Cognitive	Analysis
Relate pollutants to gasoline and diesel engines.	Cognitive	Synthesis
Propose and discuss possible future vehicle designs.	Affective	Valuing
Practice identifying automobiles by make, model, year, and type.	Psychomotor	Manipulation
Differentiate between force, work, power, and energy.	Cognitive	Analysis
Identify careers in the automotive industry.	Cognitive	Knowledge
Navigate an online owner's manual.	Psychomotor	Manipulation
Chapter 2. Buying an Automobile		
Differentiate between transportation needs and wants.	Cognitive	Analysis
Develop a budget.	Cognitive	Application
Identify the steps in purchasing an automobile.	Cognitive	Knowledge
Compare and contrast different places to purchase an automobile.	Cognitive	Evaluation
Calculate a reasonable offer for a vehicle.	Cognitive	Application
Advocate for safety features in an automobile.	Affective	Characterization
Carry out research on vehicles using available resources.	Psychomotor	Imitation
Evaluate window stickers.	Cognitive	Evaluation
Conduct a vehicle inspection.	Psychomotor	Manipulation
Propose the benefits of selling, trading in, or donating a used vehicle.	Affective	Valuing
Chapter 3. Automotive Expenses		
Explain how car payments are calculated.	Cognitive	Synthesis
Describe insurance coverage levels.	Cognitive	Evaluation
Propose when it may be beneficial to have additional insurance.	Affective	Valuing
Calculate monthly expenses on a given vehicle.	Cognitive	Application
Explain depreciation.	Cognitive	Comprehension
Differentiate between maintenance and repairs.	Cognitive	Analysis
Chapter 4. Repair Facilities		
Describe how technicians can become certified.	Cognitive	Knowledge
Communicate effectively with a technician or service writer.	Affective	Responding
Interpret a repair invoice.	Cognitive	Evaluation
Demonstrate use of the three C's (concern, cause, and correction).	Psychomotor	Imitation
List and describe different types of facilities.	Cognitive	Knowledge
Conduct research to locate a quality repair facility.	Psychomotor	Manipulation
Characterize business ethics.	Affective	Characterization
Summarize differences between warranty types.	Cognitive	Evaluation

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4	3	2	1	0	Task/Skill	Domain	Level
					Chapter 5. Safety Around the Automobile		
					Demonstrate safe work practices.	Psychomotor	Precision
					Identify types of fires and explain what types of fire extinguishers to use.	Cognitive	Synthesis
					Explain the fire triangle.	Cognitive	Comprehension
					Evaluate when to wear specific personal protection equipment.	Cognitive	Evaluation
					Describe the purpose of OSHA and EPA.	Cognitive	Knowledge
					Use different types of automotive lifts to safely support a vehicle.	Psychomotor	Precision
					Operate a jack and use jack stands to safely support a vehicle.	Psychomotor	Precision
					Judge when it is safe to work on a vehicle with airbag systems.	Affective	Organization
					Explain right-to-know laws.	Cognitive	Comprehension
					Interpret safety data sheets.	Cognitive	Comprehension
					Practice safe lifting and carrying techniques.	Psychomotor	Imitation
					Identify factors that affect noise-induced hearing loss.	Cognitive	Knowledge
					Insert foam earplugs properly.	Psychomotor	Precision
					Chapter 6. Tools and Equipment		
					Recognize basic hand tools.	Cognitive	Comprehension
					Select the correct tool for the job.	Cognitive	Evaluation
					Use tools properly.	Psychomotor	Precision
					Utilize print and online service manuals.	Psychomotor	Precision
					Classify socket types.	Cognitive	Analysis
					Identify different types of wrenches.	Cognitive	Analysis
					Identify different types of pliers.	Cognitive	Analysis
					List the different types of screwdriver tips.	Cognitive	Knowledge
					Decide when it is justified to invest in a specialty tool.	Affective	Organization
					Categorize units into the metric or English system.	Cognitive	Synthesis
					Differentiate between electric-, air-, and battery-powered tools.	Cognitive	Analysis
					Demonstrate the proper use of fender covers.	Psychomotor	Precision
					Chapter 7. Auto Care and Cleaning		
					Identify different automotive finishes.	Cognitive	Knowledge
					Explain the importance of interior and exterior cleaning.	Cognitive	Evaluation
					Clean a vehicle inside and out.	Psychomotor	Articulation
					Wax a vehicle.	Psychomotor	Manipulation
					Differentiate between polishing and waxing.	Cognitive	Synthesis
					Describe how to clean an engine compartment.	Cognitive	Comprehension
					Locate and lubricate hinges, latches, and locks.	Psychomotor	Manipulation
					Repair a chip or scratch.	Psychomotor	Manipulation
					Explain how paintless dent repair works.	Cognitive	Knowledge
					Chapter 8. Fluid Level Check		
					Identify vehicle information for the correct fluid type.	Cognitive	Knowledge
					Identify different types of fluids used in the automobile.	Cognitive	Knowledge
					Describe differences between coolant types.	Cognitive	Knowledge
					Follow safety warnings listed on chemical containers.	Psychomotor	Precision
					Analyze fluid conditions.	Cognitive	Analysis
					Perform basic fluid level checks.	Psychomotor	Articulation
					Add fluids when required.	Psychomotor	Manipulation
					Justify using more environmentally friendly coolants.	Affective	Valuing
					Summarize why it is important to add the correct types of fluids.	Cognitive	Evaluation
					Store and dispose of chemicals properly.	Psychomotor	Manipulation

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4	3	2	1	0	Task/Skill	Domain	Level
					Chapter 9. Electrical System		
					Define electricity in terms of voltage, current, and resistance.	Cognitive	Knowledge
					Interpret a wiring diagram.	Cognitive	Analysis
					Explain different types of electrical circuits.	Cognitive	Comprehension
					Analyze different types of circuit problems.	Cognitive	Analysis
					Use a digital multimeter to test for voltage, resistance, and current.	Psychomotor	Manipulation
					Use Ohm's law to calculate for voltage, resistance, or current.	Cognitive	Application
					Identify and locate starting system components.	Psychomotor	Manipulation
					Identify and locate charging system components.	Psychomotor	Manipulation
					Test an alternator.	Psychomotor	Manipulation
					Test a starter.	Psychomotor	Manipulation
					Clean and test a battery.	Psychomotor	Manipulation
					Explain battery performance ratings.	Cognitive	Comprehension
					Inspect belt conditions.	Psychomotor	Manipulation
					Locate fuse junction blocks.	Psychomotor	Manipulation
					Describe different fuse types.	Cognitive	Knowledge
					Remove, inspect, and replace a blade style fuse.	Psychomotor	Imitation
					Differentiate between bulb types.	Cognitive	Analysis
					Chapter 10. Lubrication System		
					Define the purpose of engine oil.	Cognitive	Knowledge
					List and describe engine oil additives.	Cognitive	Comprehension
					Explain oil service and viscosity ratings.	Cognitive	Comprehension
					Differentiate between conventional, synthetic, and semi-synthetic oils.	Cognitive	Analysis
					Discuss the importance of oil filters.	Cognitive	Comprehension
					Change the oil and filter on a vehicle.	Psychomotor	Manipulation
					Advocate for the importance of oil recycling.	Affective	Characterization
					Chapter 11. Fuel System		
					Explain the purpose of the fuel system.	Cognitive	Comprehension
					Identify and describe the parts of the fuel system.	Cognitive	Comprehension
					Remove, inspect, and replace an air filter.	Psychomotor	Manipulation
					Remove and replace a fuel filter.	Psychomotor	Manipulation
					State gasoline and diesel properties.	Cognitive	Knowledge
					Identify ways to improve fuel economy.	Cognitive	Comprehension
					Explain how fuel is priced.	Cognitive	Evaluation
					Justify the use of clean burning fuels.	Affective	Valuing
					Explain how a turbocharger works.	Cognitive	Comprehension
					Chapter 12. Cooling System and Climate Control		
					Identify the purpose of the cooling system.	Cognitive	Comprehension
					Describe the components in the cooling system.	Cognitive	Comprehension
					Define coolant properties.	Cognitive	Knowledge
					Explain how coolant flows in an engine.	Cognitive	Comprehension
					Test coolant properties.	Psychomotor	Manipulation
					Change a cabin air filter.	Psychomotor	Manipulation
					List causes of engine overheating.	Cognitive	Knowledge
					Identify what to do if a vehicle overheats.	Cognitive	Knowledge
					Explain how charge-air coolers work.	Cognitive	Comprehension
					Analyze the benefits of active warm-up devices.	Cognitive	Analysis
					Explain how the air conditioning system works.	Cognitive	Comprehension

4	3	2	1	0	Task/Skill	Domain	Level
					Chapter 13. Ignition System		
					Define the purpose of the ignition system.	Cognitive	Knowledge
					Identify ignition system generations.	Cognitive	Analysis
					Categorize ignition system components into respective generations.	Cognitive	Analysis
					Remove, inspect, gap, and replace spark plugs.	Psychomotor	Manipulation
					Test spark plug wire resistance.	Psychomotor	Manipulation
					Remove, inspect, and replace distributor cap and rotor.	Psychomotor	Manipulation
					Differentiate between interference and non-interference engines.	Cognitive	Analysis
					Chapter 14. Suspension, Steering, and Tires		
					Define the purpose of the suspension system.	Cognitive	Knowledge
					Define the purpose of the steering system.	Cognitive	Knowledge
					Identify components in the suspension system.	Cognitive	Comprehension
					Identify components in the steering system.	Cognitive	Comprehension
					Inspect suspension and steering components.	Psychomotor	Manipulation
					Describe different tread designs.	Cognitive	Knowledge
					Identify repairable and non-repairable areas on a tire.	Cognitive	Knowledge
					Inspect and rotate tires.	Psychomotor	Manipulation
					Measure tire tread depth.	Psychomotor	Manipulation
					Locate the tire placard on a vehicle.	Psychomotor	Manipulation
					List causes of excessive tire wear.	Cognitive	Knowledge
					Propose reasons for snow tire use vs. all season tires.	Affective	Valuing
					Explain when run flat technology may be beneficial.	Affective	Organization
					Chapter 15. Braking System		
					Define the purpose and principles of the braking system.	Cognitive	Knowledge
					Explain how regenerative braking works.	Cognitive	Comprehension
					Identify components in the brake system.	Cognitive	Comprehension
					Identify brake fluid properties.	Cognitive	Comprehension
					Discuss the advantage of antilock brakes.	Cognitive	Comprehension
					Explain how the parking brake works.	Cognitive	Comprehension
					Perform brake inspections and measure brake pad thickness.	Psychomotor	Articulation
					Categorize different types of control and safety systems.	Cognitive	Synthesis
					Chapter 16. Drivetrain		
					Define the purpose of the drivetrain.	Cognitive	Knowledge
					Identify drivetrain components.	Cognitive	Comprehension
					Describe different drivetrain systems.	Cognitive	Comprehension
					Inspect drivetrain system components.	Psychomotor	Manipulation
					Explain the operational stages of a torque converter.	Cognitive	Comprehension
					Compare various types of differentials.	Cognitive	Comprehension
					Communicate CVT benefits.	Affective	Responding
					Chapter 17. Exhaust and Emission System		
					Define the purpose of the exhaust and emission system.	Cognitive	Knowledge
					Identify components in the exhaust and emission system.	Cognitive	Comprehension
					Inspect exhaust and emission system components.	Psychomotor	Manipulation
					Identify different types of automotive emissions.	Cognitive	Comprehension
					Explain how the catalytic converter works.	Cognitive	Comprehension
					Locate the vehicle emission control information (VECI) sticker.	Psychomotor	Manipulation
					Explain how diesel aftertreatment technologies work.	Cognitive	Comprehension
					Describe the benefits of a properly working emission system.	Affective	Valuing

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4	3	2	1	0	Task/Skill	Domain	Level
Chapter 18. Alternative Fuels and Designs							
					Identify differences in automotive design, depending on the fuel source.	Cognitive	Analysis
					Differentiate tailpipe and upstream emissions.	Affective	Valuing
					Compare and contrast different alternative vehicle types.	Cognitive	Evaluation
					Compare petrobased and biobased fuels.	Cognitive	Evaluation
					Calculate the payback period on an alternative fueled vehicle.	Cognitive	Analysis
					Conduct research to determine if a vehicle is E85 compatible.	Psychomotor	Manipulation
					Compare energy content in different fuel types.	Cognitive	Evaluation
					Differentiate between full, plug-in, and mild hybrids.	Cognitive	Analysis
					Describe different types of hybrid drivetrains.	Cognitive	Knowledge
					Illustrate how hydrogen can be used to power an electric motor.	Cognitive	Application
					Categorize different levels of automation.	Cognitive	Synthesis
					Discuss technological issues with alternative fueled vehicles.	Affective	Responding
Chapter 19. Automotive Accessories							
					Identify available automotive accessories.	Cognitive	Analysis
					Explain different accessory functions.	Cognitive	Comprehension
					Estimate the cost of selected accessories for a specific vehicle.	Cognitive	Application
					Discuss the issues associated using electronic devices while driving.	Affective	Valuing
					Describe how global positioning systems work.	Cognitive	Comprehension
					Discuss negative impacts of remote starters.	Affective	Organizing
					Describe hitch classifications.	Cognitive	Knowledge
Chapter 20. Common Problems and Roadside Emergencies							
					Identify common automotive problems.	Cognitive	Analysis
					Analyze basic automotive problems and formulate a solution.	Cognitive	Analysis
					Remove and replace a headlight.	Psychomotor	Manipulation
					Explain the different causes of black, blue, and white smoke.	Cognitive	Comprehension
					Identify unusual sounds and associate a possible problem to that sound.	Cognitive	Analysis
					Identify unusual smells and associate a possible problem to that smell.	Cognitive	Analysis
					Explain what might cause a “no-start” situation.	Cognitive	Comprehension
					Clean a battery.	Psychomotor	Manipulation
					Inspect, remove, and replace wiper blades.	Psychomotor	Manipulation
					Locate a leak on a tire.	Psychomotor	Manipulation
					List items that should be in an emergency roadside and a winter safety kit.	Cognitive	Knowledge
					Perform a jump-start safely.	Psychomotor	Manipulation
					Inspect, remove, and replace a drive belt.	Psychomotor	Manipulation
					Remove and replace a flat tire with a spare tire.	Psychomotor	Manipulation

Name _____ Class _____ Week ___/___/___ Score _____

Daily Reflection Log

Directions - At the end of each day, write a short 3-5 sentence reflection on what you learned.

MONDAY

TUESDAY

WEDNESDAY

THURSDAY

FRIDAY

Name _____ Class _____ Date ___/___/___ Score _____

Article, Website, or Video Review

BIBLIOGRAPHY

SUMMARY

OPINIONS/CONCLUSIONS/REACTIONS

Name _____ Class _____ Date ___/___/___ Score _____

Career Exploration

Directions - Use the Occupational Outlook Website (www.bls.gov/ooh) to research a career. As you identify the following, write complete sentences in your own words. Do not copy verbatim from the website.

Career

_____

Salary Potential

_____

Education/Training Required

_____

_____

_____

Job Outlook

_____

_____

_____

Nature of the Work

_____

_____

_____

Working Conditions

_____

_____

_____

Reason You Chose this Career

_____

_____

_____

Name _____ **Class** _____ **Date** ___/___/___ **Score** _____

Repair and Service Facility
123 Any Town, USA
(555) 555-0100

Work Order Number: _____
Date & Time Received: ___/___/___ ___:___A.M. P.M.
Promised: ___/___/___ ___:___A.M. P.M.
Order Written By: _____

Customer Contact Information		
Name:		
Address:		
City:	State:	Zip:
Phone Home: ( )		
Work: ( )	Cell: ( )	

Vehicle Information		
Make and Model		
Year/Color		
License Number		
Odometer Reading	IN	OUT
Engine Size		
VIN		

Description of Customer Concern

Possible Cause

Customer Rights	
Do you want your parts returned?	Yes ❑ No ❑
If the job exceeds the estimate by 10% or more, do you authorize us in proceeding?	Yes ❑ No ❑
If additional repairs are found necessary, do you authorize us in proceeding?	Yes ❑ No ❑
Do you request a written estimate for repairs with cost in excess of $50.00?	Yes ❑ No ❑

Estimate of Repair	
Parts	$
Labor Rate $ ____ Per Hr. x ___ Hrs.	$
Other/Supplies	$
Preliminary Estimate Total	$

I hereby authorize the above repair work to be done with the necessary material, and hereby grant you and/or your employees permission to operate the vehicle herein described on streets, highways, or elsewhere for the purpose of testing and/or inspection. An express mechanic's lien is hereby acknowledged on above vehicle to secure the amount of repairs thereof.
Authorized By_____

❑ **Lubricate Chassis** ❑ **Change Oil** ❑ **Check All Fluids** ❑ **Rotate Tires** ❑ **Wash**

Parts Required			
Qty.	Item No.	Description	Price
		Total Parts	

Labor Required		
Service Description	Hours	Charge
	Total Labor	

Other/Supplies Required			
Qty.	Item No.	Description	Price
Towing			
Environmental Fees			
Supplies			
		Total Other/Supplies	

Repair Total	
Total Parts	$
Total Labor	$
Total Other/Supplies	$
Subtotal	$
Tax	$
Total Amount Due ►	$

Repair Summary - Correction to Problem

Signed_____

Date_____

(This Page May Be Photocopied)

Name _____ Class _____ Date ___/___/___ Score _____

Vehicle Reference Information

Make _____

Model _____

Model Year _____

Production Date _____

Drivetrain FWD, RWD, 4WD, or AWD _____

VIN (Vehicle Identification Number) _____

Engine Size (L or cu. in.) _____

Number of Cylinders _____

Fuel Efficiency (City and Highway) _____

Fuel Type _____

Fuel Capacity _____

Octane or Cetane Number Required _____

Oil SAE & API Requirements (Summer/Winter) _____

Oil Capacity _____

Oil Filter Number _____

Coolant Type Required _____

Antifreeze to Water Ratio _____

Air Filter Number/Brand _____

Tire Size (Front, Rear, and Spare) _____

Tire PSI (Front, Rear, and Spare) _____

Lug Nut Torque Requirement _____

Brake Fluid Type _____

Brakes Front and Rear Type (Disc or Drum) _____

Transmission Fluid Type _____

Power Steering Fluid Type _____

Spark Plug Number and Gap _____

Headlight Number and Style _____

Wiper Blade Length and Style _____

Battery Group Number (Size/Terminal Position) _____

Belt Type (Serpentine, Stretch, or V) _____

Cabin Air Filter Number _____

Paint Color and Code _____

Radio Security Code _____

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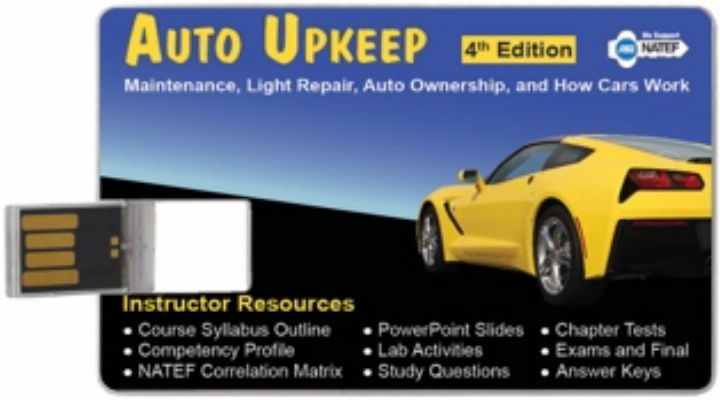


Sample USB Resource Files

Chapter 1 – Introduction and How Cars Work

Lesson Plans

Chapter 1 – Introduction and How Cars Work

Lesson 1: Car Identification
Chapter 1 – Introduction and How Cars Work
Auto Upkeep 4th Edition

Course: Auto Upkeep/Automotive Basics
Grade Level: 9th-12th
Unit Title: Introduction and How Cars Work
Lesson Title: Car Identification
Date:
Instructor:
Estimated Time: 1 to 3 class periods

Website:
www.AutoUpkeep.com/resources
Smartphone and Tablet Apps:
(Search your App Store)
www.AutoUpkeep.com/apps
Videos:
www.Video.AutoUpkeep.com

Tools and Materials: None
Print Resources: Auto Upkeep Textbook and Workbook 4th Edition © 2018
Safety Considerations: Follow all procedures and safety guidelines specified by your instructor.
Student Prior Knowledge: Students have read Chapter 1 Introduction and How Cars Work in the Auto Upkeep Textbook.
Vocabulary/Abbreviations/Acronyms: VIN, SUV, Inline, Opposed, V, VECI, L, Force, Work, Power, Energy, Torque

Lesson Annotation – (Brief overview of the lesson in a sentence or two.)

Upon completion of this activity, you will be able to correctly identify an automobile by manufacturer, make, model, year and type.

Desired Results – (What should students know, understand, and be able to do?)
Content Standards and Benchmarks: (National, State, or Industry Standard)
ASE Education (NATEF) – Maintenance and Light Repair
Preparing Vehicle for Service
Vehicle identifying information.

TEKS - Texas Essential Knowledge and Skills for Transportation, Distribution, and Logistics
Automotive Basics
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:
(A) demonstrate knowledge of the technical knowledge and skills related to health and safety in the workplace such as wearing safety glasses and other personal protective equipment (PPE) and maintaining safety data sheets (SDS);
(B) identify career and employment opportunities, including entrepreneurship opportunities, internships, and industry recognized certification requirements for the field of automotive technology;
(C) demonstrate the principles of group participation, team concept, and leadership related to citizenship and career preparation;
(D) apply competencies related to resources, information, interpersonal skills, problem solving, critical thinking, and systems of operation in the automotive technology industry;

(H) develop personal goals, objectives, and strategies as part of a plan for future career and educational opportunities.
(2) The student demonstrates appropriate personal and communication skills. The student is expected to:
(D) demonstrate effective written and oral communication skills and employ effective listening skills.
(4) The student understands the technical knowledge and skills of basic automotive systems. The student is expected to:
(A) describe the eight major vehicle systems;
(B) locate, read, and interpret vehicle maintenance and service information; and
(C) describe the basic and emerging vehicle power systems.
(6) The student applies technical knowledge and skills in simulated or actual work situations. The student is expected to:
(B) demonstrate an understanding of the operation theory of internal combustion engines.

Lesson Objectives: (Start with a "Bloom" verb from cognitive, psychomotor, or affective domain.)
After completing this lesson, students will be able to:
Identify an automobile by manufacturer, make, model, year, and type.

Essential Questions for Lesson: (The lesson's "Big Idea" framed as a question.)
How do cars work?
How are vehicles classified?
Why is it a good idea to know the size of your vehicle's engine?

Determine Acceptable Evidence – (What is the evidence that students understand?)
Assessment Methods:
Readability Worksheet – Auto Upkeep Instructor USB
Car Identification Activity – Auto Upkeep Workbook
Introduction and How Cars Work Questions – Auto Upkeep Workbook
Introduction and How Cars Work Test – Auto Upkeep Instructor USB

Lesson 1: Car Identification
Chapter 1 – Introduction and How Cars Work
Auto Upkeep 4th Edition

Learning Experiences and Instruction – (What instructional method makes the most sense to support the desired learning?)
Lesson Outline: (Warm-Up, Review, Lesson Introduction, Activity, Closure/Summary, Enrichment/Extension Activities)

Warm-Up:
Present essential questions.
Ask students to identify the manufacturer, make, model, year, and type of vehicle that they have at home. See how many know the size/displacement and configuration of the engine.

Review:
Review content in Auto Upkeep Textbook – Chapter 1 – Automotive Timeline, How Cars Work, Fuels and Designs, Engine Identification, Vehicle Identification, Parts and Systems, Careers.

Lesson Introduction:
Show students and discuss the characteristics of a doorjamb VIN.
Show students and discuss the four-stroke cycle using the illustration on page 14-15 in the Auto Upkeep Textbook. Go to www.HowStuffWorks.com and show the class an animation of the 4-stroke engine.

Activity:
Have each student complete the activity titled "Car Identification Activity" in the Auto Upkeep Workbook – pages 11-12.

Closure/Summary:
Discuss the results of the activity. Did students locate and identify the vehicles VIN? Did students find the VECI sticker and identify the model year and engine size? What difficulties did students have during the activity?

Enrichment/Extension Activities:
At the end of each day, students can write a short 3-5 sentence reflection on what they learned – use Appendix D on page 171 in the Auto Upkeep Workbook to organize their log.
Have students use the Auto Upkeep App on Smartphones, Tablets, Laptops, or PCs to review an automotive manufacturer's website. Use Appendix E on page 172 in the Auto Upkeep Workbook to complete the website review.
Use the Occupational Outlook Website (www.bls.gov/ooh) to research a career. Complete Appendix F on page 173 in the Auto Upkeep Workbook.

Reflection and Self Evaluation – (What worked, what didn't? What should I change? Notes for next time.)

Lesson 2: Owner's Manual
Chapter 1 – Introduction and How Cars Work
Auto Upkeep 4th Edition

Course: Auto Upkeep/Automotive Basics
Grade Level: 9th-12th
Unit Title: Introduction and How Cars Work
Lesson Title: Owner's Manual
Date:
Instructor:
Estimated Time: 1 to 3 class periods

Website:
www.AutoUpkeep.com/resources
Smartphone and Tablet Apps:
(Search your App Store)
www.AutoUpkeep.com/apps
Videos:
www.Video.AutoUpkeep.com

Tools and Materials: Internet access
Print Resources: Auto Upkeep Textbook and Workbook 4th Edition © 2018
Safety Considerations: Follow all procedures and safety guidelines specified by your instructor.
Student Prior Knowledge: Students have read Chapter 1 Introduction and How Cars Work in the Auto Upkeep Textbook.
Vocabulary/Abbreviations/Acronyms: VIN, SUV, Inline, Opposed, V, VECI, L, Force, Work, Power, Energy, Torque

Lesson Annotation – (Brief overview of the lesson in a sentence or two.)

Upon completion of this activity, you will be able to locate and use an online owner's manual.

Desired Results – (What should students know, understand, and be able to do?)
Content Standards and Benchmarks: (National, State, or Industry Standard)
ASE Education (NATEF) – Maintenance and Light Repair
Shop and Personal Safety
Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS).
Preparing Vehicle for Service
Vehicle identifying information.
Engine Repair, Automatic Transmission and Transaxle, Manual Drivetrain and Axles, Suspension and Steering, Brakes, Electrical/Electronic Systems, HVAC, Engine Performance
Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.

TEKS - Texas Essential Knowledge and Skills for Transportation, Distribution, and Logistics
Automotive Basics
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:
(A) demonstrate knowledge of the technical knowledge and skills related to health and safety in the workplace such as wearing safety glasses and other personal protective equipment (PPE) and maintaining safety data sheets (SDS);

Lesson 2: Owner's Manual
Chapter 1 – Introduction and How Cars Work
Auto Upkeep 4th Edition

(B) identify career and employment opportunities, including entrepreneurship opportunities, internships, and industry recognized certification requirements for the field of automotive technology;
(C) demonstrate the principles of group participation, team concept, and leadership related to citizenship and career preparation;
(D) apply competencies related to resources, information, interpersonal skills, problem solving, critical thinking, and systems of operation in the automotive technology industry;
(H) develop personal goals, objectives, and strategies as part of a plan for future career and educational opportunities.
(2) The student demonstrates appropriate personal and communication skills. The student is expected to:
(D) demonstrate effective written and oral communication skills and employ effective listening skills.
(4) The student understands the technical knowledge and skills of basic automotive systems. The student is expected to:
(A) describe the eight major vehicle systems;
(B) locate, read, and interpret vehicle maintenance and service information; and
(C) describe the basic and emerging vehicle power systems.
(6) The student applies technical knowledge and skills in simulated or actual work situations. The student is expected to:
(B) demonstrate an understanding of the operation theory of internal combustion engines.

Lesson Objectives: (Start with a "Bloom" verb from cognitive, psychomotor, or affective domain.)
After completing this lesson, students will be able to:
Locate and use an online owner's manual.

Essential Questions for Lesson: (The lesson's "Big Idea" framed as a question.)
How do you find an online owner's manual?
What type of information is found in the owner's manual?

Determine Acceptable Evidence – (What is the evidence that students understand?)
Assessment Methods:
Readability Worksheet – Auto Upkeep Instructor USB
Owner's Manual Activity – Auto Upkeep Workbook
Introduction and How Cars Work Questions – Auto Upkeep Workbook
Introduction and How Cars Work Test – Auto Upkeep Instructor USB

Lesson 2: Owner's Manual
Chapter 1 – Introduction and How Cars Work
Auto Upkeep 4th Edition

Learning Experiences and Instruction – (What instructional method makes the most sense to support the desired learning?)
Lesson Outline: (Warm-Up, Review, Lesson Introduction, Activity, Closure/Summary, Enrichment/Extension Activities)

Warm-Up:
Present essential questions.
Ask students to if they have every looked at and read an owner's manual. This could be an owner's manual for any type of product, equipment, or tool. Then ask if they have ever read an automotive owner's manual. Ask them what type of information they think should be available in an owner's manual.

Review:
Review content in Auto Upkeep Textbook – Chapter 1 – Automotive Timeline, How Cars Work, Fuels and Designs, Engine Identification, Vehicle Identification, Parts and Systems, Careers.

Lesson Introduction:
Show students and discuss an automotive owner's manual. You may have a print manual or show an online manual on the overhead screen.

Activity:
Have each student complete the activity titled "Owner's Manual Activity" in the Auto Upkeep Workbook – pages 13-14.

Closure/Summary:
Discuss the results of the activity. What type of information did students find in the owner's manual? How did specifications differ between vehicles? How do you reset the oil life monitoring system in different vehicles? What were some warnings found in the owner's manual about the supplemental restraint system (SRS)?

Enrichment/Extension Activities:
At the end of each day, students can write a short 3-5 sentence reflection on what they learned – use Appendix D on page 171 in the Auto Upkeep Workbook to organize their log.
Have students use the Auto Upkeep App on Smartphones, Tablets, Laptops, or PCs to review an automotive manufacturer's website. Use Appendix E on page 172 in the Auto Upkeep Workbook to complete the website review.
Use the Occupational Outlook Website (www.bls.gov/ooh) to research a career. Complete Appendix F on page 173 in the Auto Upkeep Workbook.

Reflection and Self Evaluation – (What worked, what didn't? What should I change? Notes for next time.)

PowerPoint Presentation

Chapter 1 – Introduction and How Cars Work

Auto Upkeep

(4th Edition © 2018)

Chapter 1

Introduction and How Cars Work

Online Resources

www.AutoUpkeep.com/resources/ch1

Fuel for Thought

- How do cars work?
- How are vehicles classified?
- Why is it good to know the size of your vehicle's engine?

Introduction

- The word “automobile” literally means self-moving.
- Before the automobile, most people traveled on land from one place to another by foot, train, bicycle, or horse and carriage.
- Today, there are millions of vehicles on the roadways.

Objectives

- Upon completion of this chapter and activities, you will be able to:
  - Identify early automotive contributors.
  - Differentiate between vehicle manufacturers, makes, models, and types.
  - Describe how cars work.
  - Locate and use an online owner's manual.

Automotive Timeline

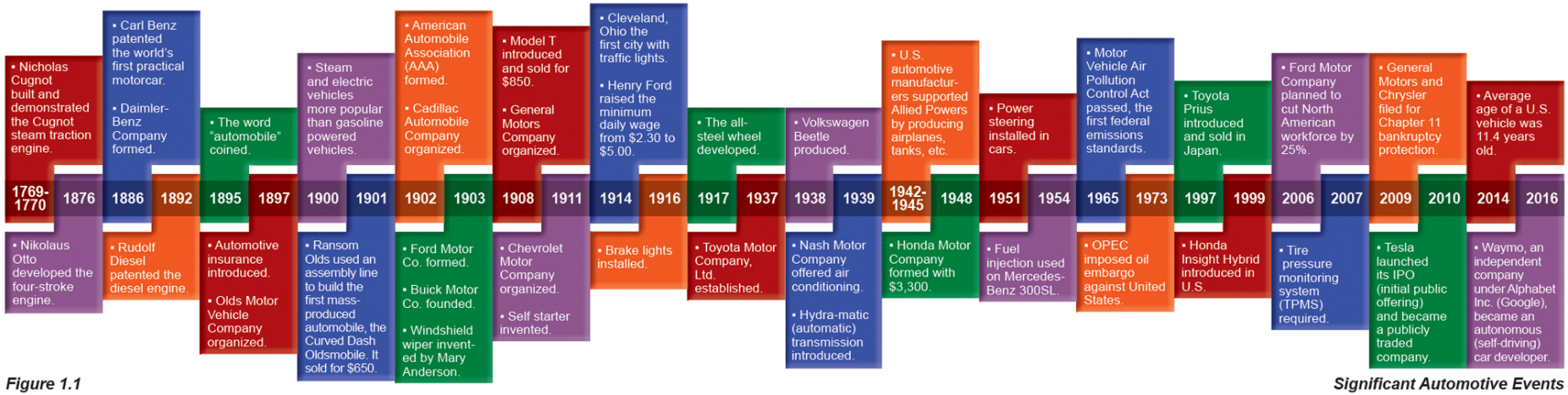


Figure 1.1 *Significant Automotive Events*

Automotive Timeline

Early Years and Henry Ford

- 1769-1770 Cugnot steam traction engine
- 1886 Carl Benz – first practical motorcar
- 1914 Henry Ford – moving assembly line

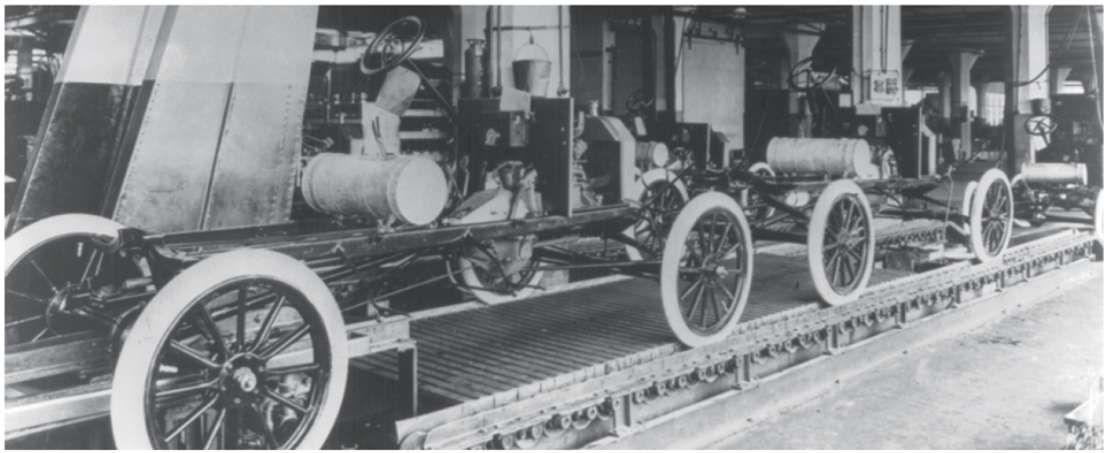


Figure 1.2 ***Model T Ford Assembly Line***

Source: Library of Congress

How Cars Work

Conservation of Energy

- Vehicles need energy to move.
- Losses occur in the engine, drivetrain, overcoming the wind, rolling resistance, and running accessories.
- Energy into the system is going to equal the energy out of the system.

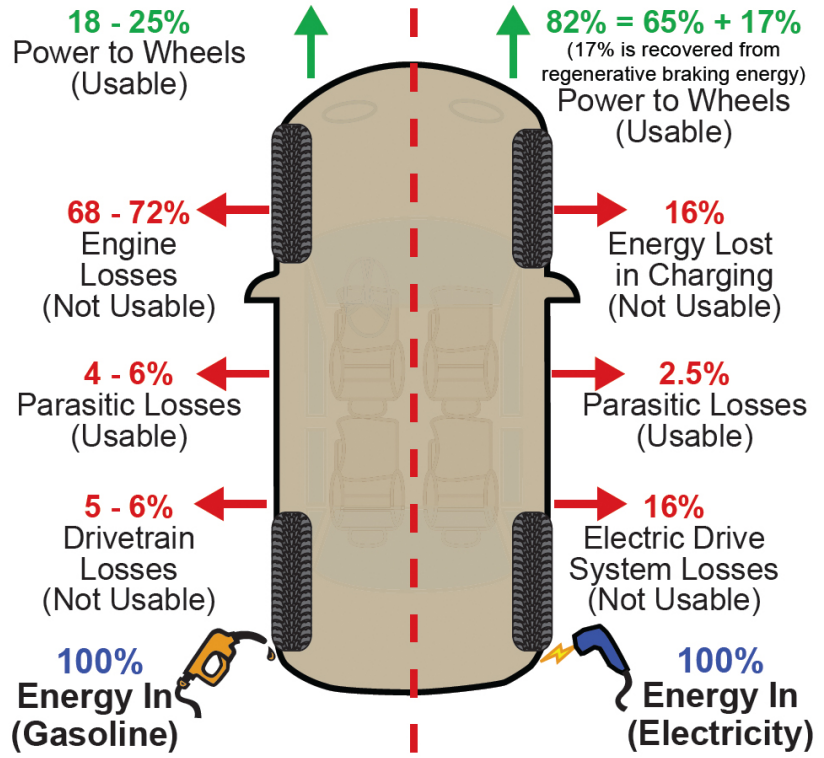


Figure 1.3 *Gasoline vs. Electric Energy Usage*

Source: U.S. Department of Energy EERE - www.fueleconomy.gov

How Cars Work

Force

- Force is a push or pull interaction between objects.

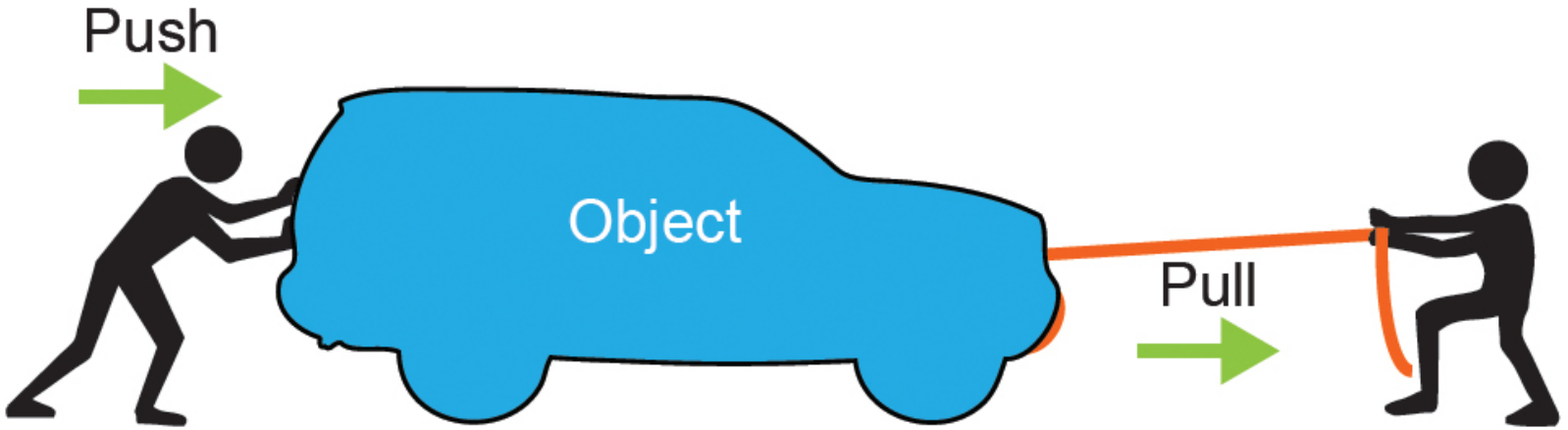


Figure 1.4

Force

How Cars Work

Work

- When an object has moved from a force, the position of the object has changed and work has occurred.

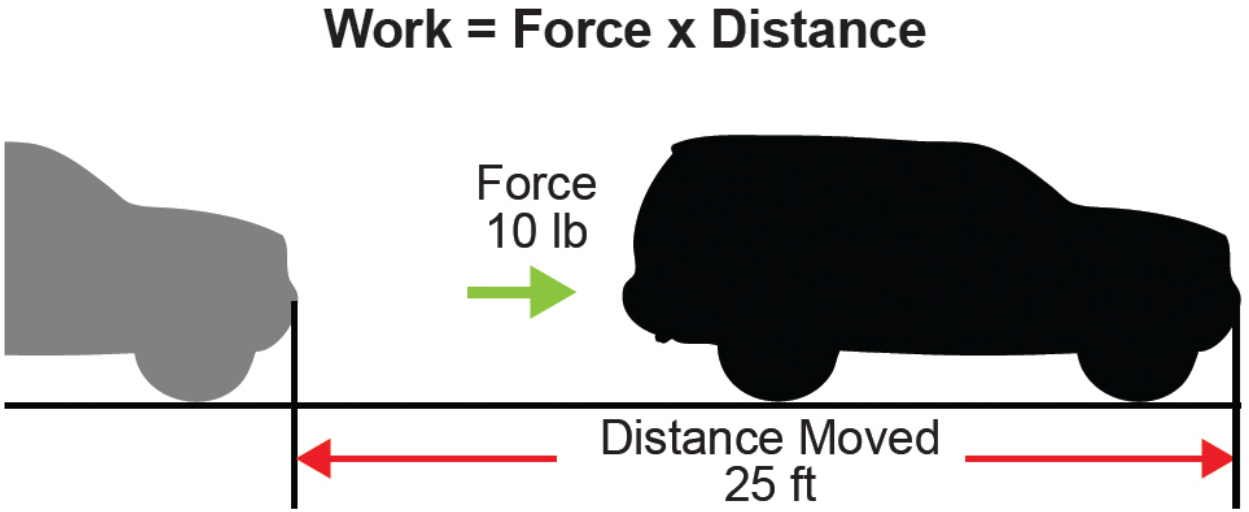


Figure 1.5 ***Work = Force x Distance***

How Cars Work

Calculating Work

Calculations

Calculating Work

Using the example from (***Figure 1.5***), calculate work.

Force		10 lb
x Distance		x 25 ft
Work	=	**250 ft-lb**

Note: To use this formula, the force must be parallel to the movement.

How Cars Work

Power and Energy

- Power is the rate at which work is done.

Power = Work/Time

- Objects have the ability to do work when they have energy.

Energy = Power x Time

How Cars Work

Measuring Engine Output - Torque

- When force is in a twisting motion it is called torque.

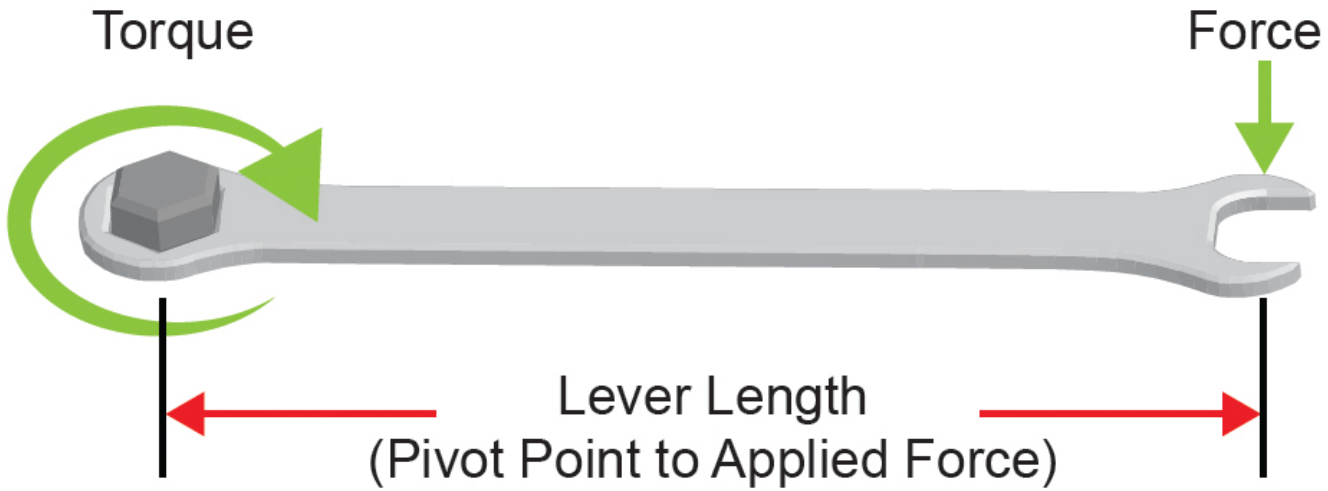


Figure 1.6 ***Torque = Force x Lever Length***

How Cars Work

Measuring Engine Output – Crankshaft Torque

- Torque is also used to describe the output rating of an engine, the crankshaft's turning force.

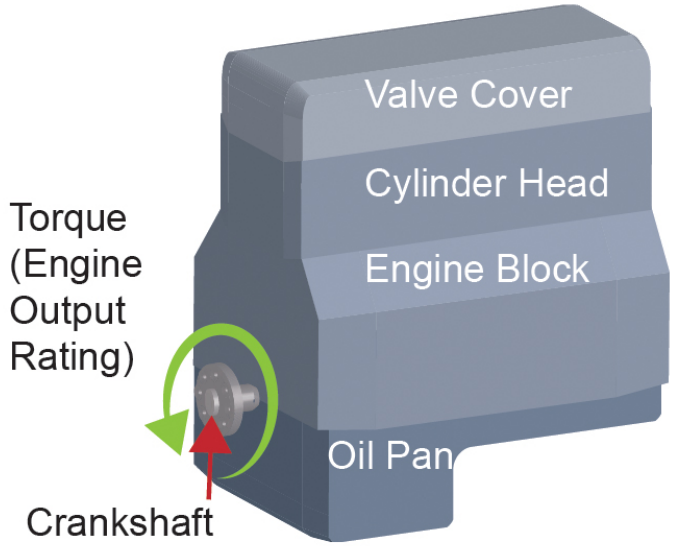


Figure 1.7 ***Crankshaft Torque***

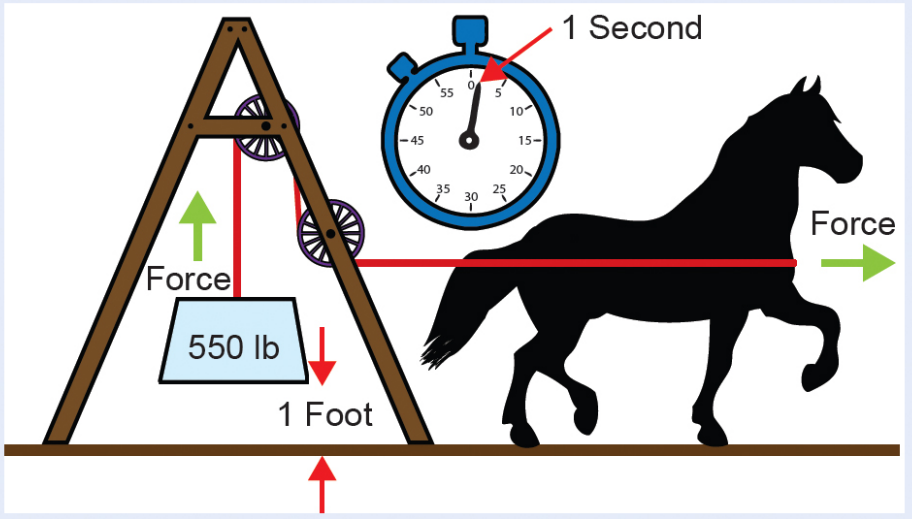
How Cars Work

Measuring Engine Output - Horsepower

- A unit of power that is common in the automotive field is horsepower (hp).

Horsepower (English System)

1 Horsepower = 550 foot-pounds/second
1 Horsepower = 33,000 foot-pounds/minute



Watt (Metric System)

1 Horsepower = 746 watts = 0.746 kilowatts

Figure 1.8 ***One Horsepower***

How Cars Work

Measuring Engine Output - RPM

- Torque and horsepower change as engine speed (revolutions per minute or rpm) changes.

Vehicle	Engine	HP	Torque
1920 Ford Model T	2.9 L Gasoline	20 hp @ 1600 rpm	83 lb-ft @ 900 rpm
2017 Ford Super Duty	6.7 L Turbo Diesel	440 hp @ 2800 rpm	925 lb-ft @ 1800 rpm

Figure 1.9 ***Horsepower Comparison***

How Cars Work

Engine Components

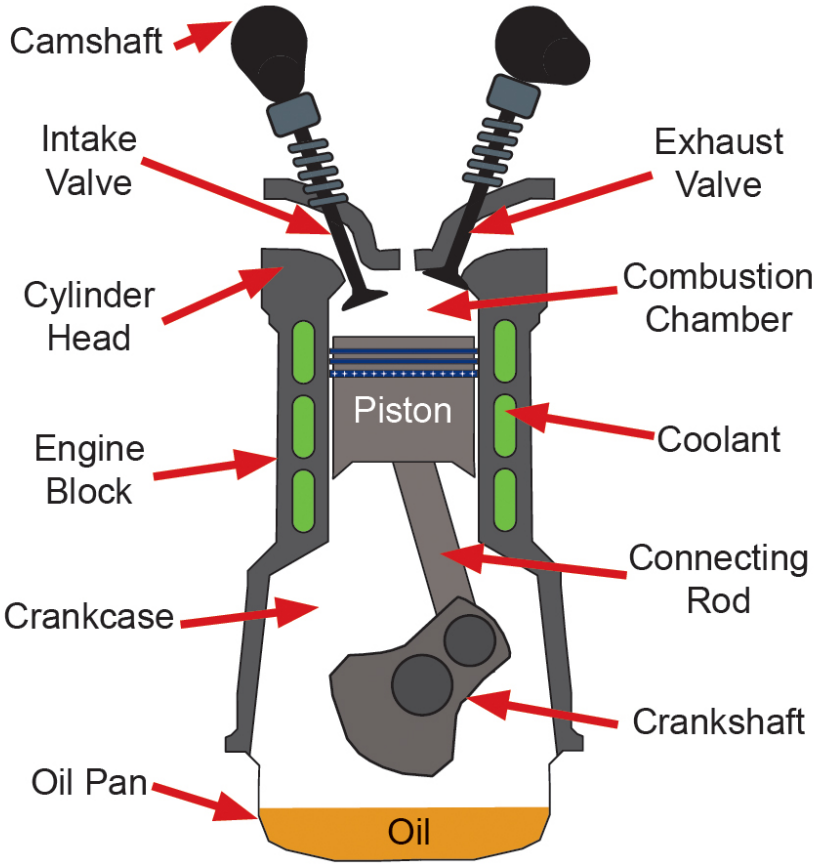


Figure 1.10 Dual Overhead Camshaft (DOHC) Engine

How Cars Work

Four-Stroke Engine – Spark Ignition

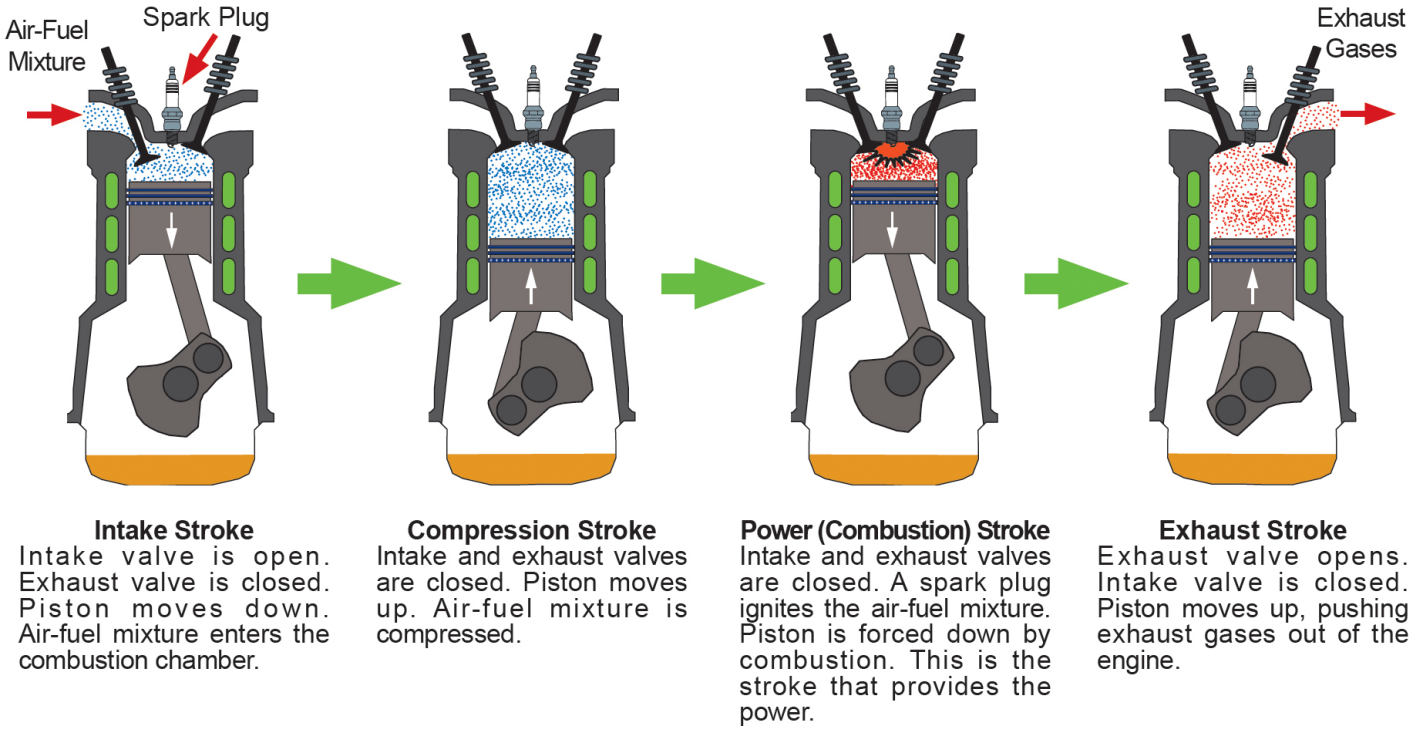


Figure 1.11 ***Four-Stroke Spark Ignition Engine Compression Ratio Commonly 8:1 to 12:1***

How Cars Work

Four-Stoke Engine – Compression Ignition

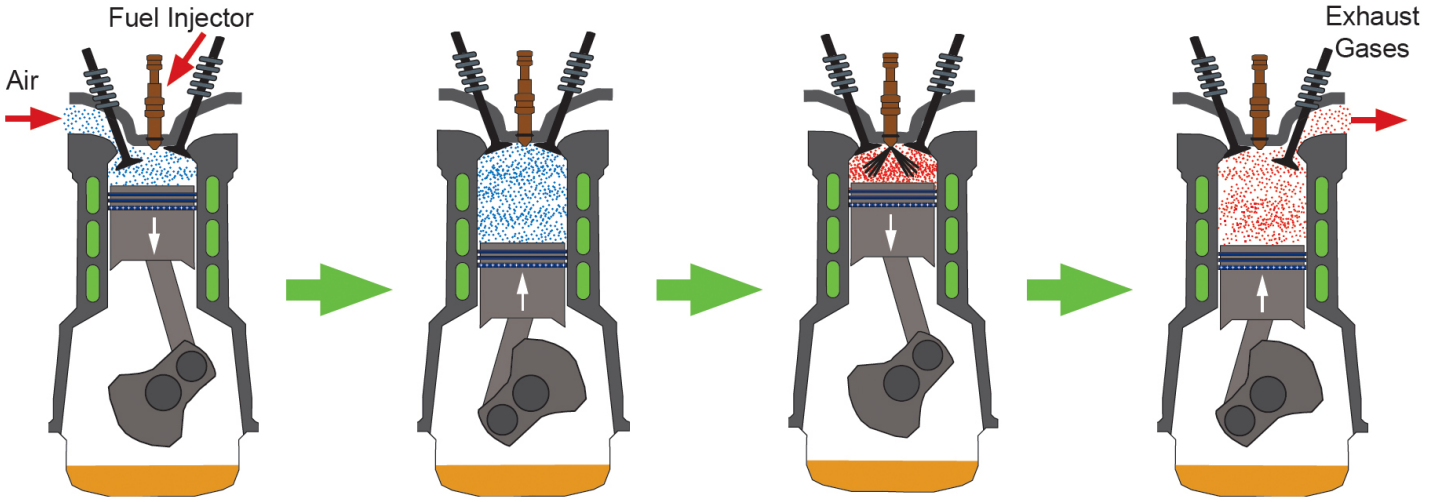


Figure 1.12 ***Four-Stroke Compression Ignition Engine (Direct Injection Diesel)***
Compression Ratio Commonly 16:1 to 20:1

How Cars Work

Power Transfer

Power Transfer Process	
1	Fuel is stored as chemical energy in the gas tank.
2	Fuel is transported to the engine by a fuel pump.
3	Air-fuel mixture enters the engine.
4	Electrical energy is used to create a spark at the spark plug.
5	Combustion occurs, converting the chemical energy to kinetic energy. The piston moves linearly, reciprocating up and down or back and forth.
6	The reciprocating motion of the pistons is converted to rotary (circular) motion of the crankshaft.
7	The crankshaft's rotary motion turns the transmission.
8	On front-wheel drive (FWD) vehicles, rotary motion is transferred through a transaxle (transmission and differential combined). From the transaxle, rotary power is moved through constant velocity (CV) shafts. On rear-wheel drive (RWD) vehicles, rotary motion is transferred from the transmission through the drive shaft then to a differential and final drive assembly. In this situation, the differential changes the power flow 90° and allows the drive wheels to turn at different speeds when cornering. Power is transferred from the differential to axle shafts.
9	The axle shafts or CV shafts turn the wheels.
10	The rotary motion of the wheels converts to linear motion on the roadway.

Figure 1.13 ***How Power is Transferred***

Fuels and Designs

Gasoline Power Vehicles

- Gasoline powered vehicles highly popular.
- Gasoline prices fluctuate over time.

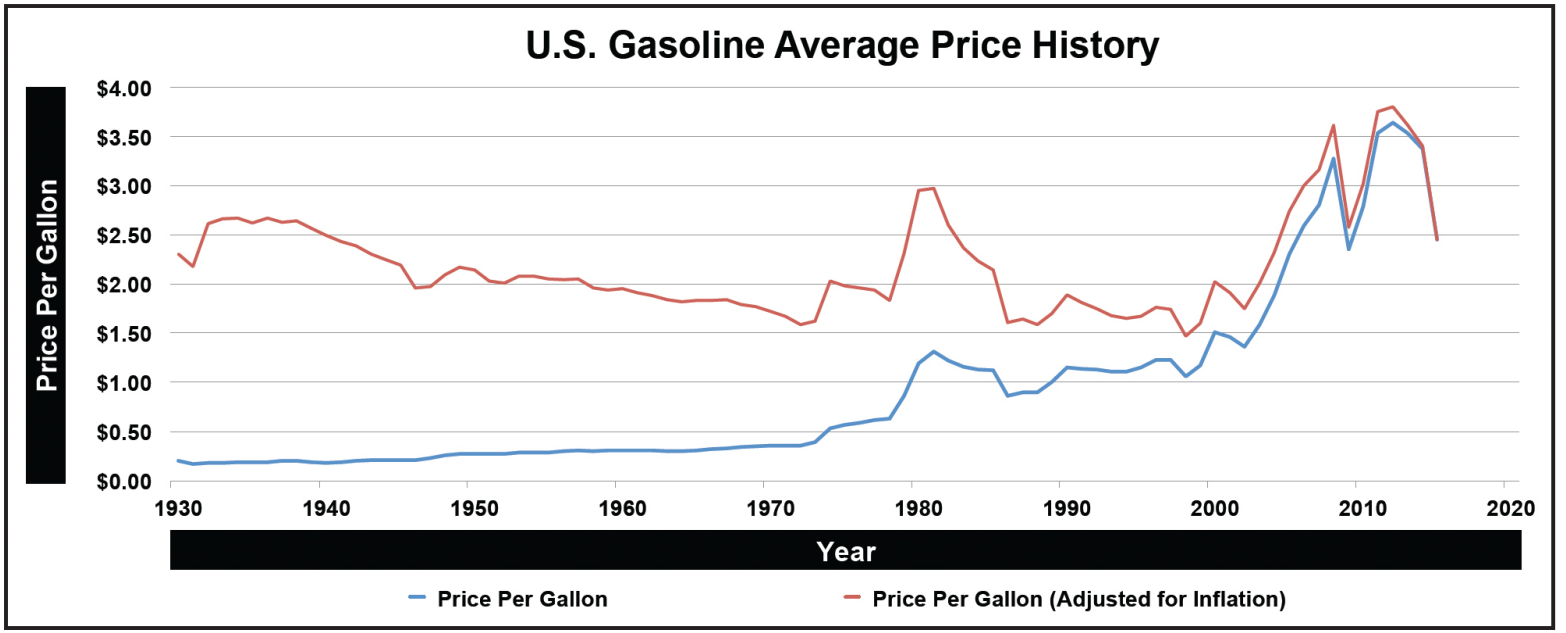


Figure 1.14 *U.S. Gasoline Price History*

Fuels and Designs

Diesel Powered Vehicles

- Diesel engines are compression ignition engines.
- Common in trucks and passenger vehicles.

Figure 1.15 **Ford F 650 Medium Duty**

Courtesy of Ford Motor Company

Fuels and Designs

Diesel Powered Vehicles – Diesel Fuels

- Diesel fuel has more energy per gallon as compared to gasoline.

Figure 1.16 ***Diesel Fuel Dispenser***

Fuels and Designs

Emerging Technologies

- Electric vehicles produced by many manufacturers.

Electric Vehicles	MPGe
Hyundai Ioniq Electric	136 MPGe
BMW i3	124 MPGe
Nissan Leaf	112 MPGe
Mitsubishi i-MiEV	112 MPGe
Tesla Model X	93 MPGe
Mercedes-Benz B250e	84 MPGe

Figure 1.17 ***Electric Vehicles***

www.AutoUpkeep.com

Fuels and Designs

Emerging Technologies – EV Charging

- EV charging stations becoming more popular.

Figure 1.18 ***Tesla Supercharger Station***

Photo: Tesla

Engine Identification

Size/Displacement

- The size of the engine is the combined volume of the cylinders.

International System of Units (Metric System)		U.S. Customary Units (English System)
1.8 L	=	110 cu. in.
2.4 L	=	147 cu. in.
4.6 L	=	281 cu. in.
5.0 L	=	305 cu. in.
5.3 L	=	323 cu. in.
6.8 L	=	415 cu. in.

Figure 1.19 ***Common Engine Sizes***

www.AutoUpkeep.com

Engine Identification

Configuration

- Engine configuration is the design of the engine block.

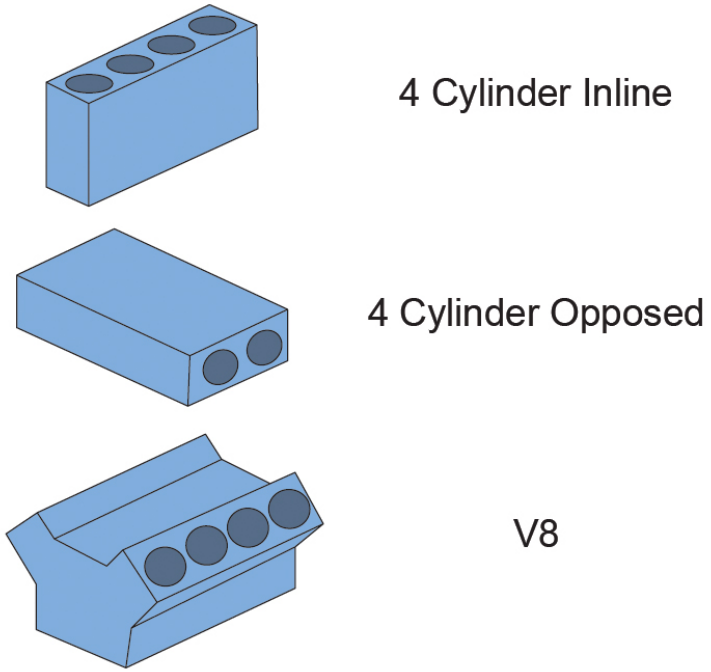


Figure 1.20 ***Engine Configurations***

Vehicle Identification

VIN

- The Vehicle Identification Number (VIN) contains information that identify the engine type, body type, model year, assembly plant, and more.

Figure 1.21 *Doorjamb VIN*

Vehicle Identification

Manufacturer

- An automotive manufacturer is a company that produces vehicles.

Figure 1.22 Automotive Manufacturer Logos

Vehicle Identification

Make

- Automotive manufacturers identify the various vehicles they produce by their "make" (also known as brands or divisions).

Manufacturer	Make/Brand/Division
GM	Buick, Cadillac, Chevrolet, and GMC
Fiat Chrysler Automobiles	Chrysler, Dodge, Jeep, Ram Truck, Alfa Romeo, Fiat, Lancia, Abarth, and Maserati
Daimler	Maybach, Mercedes-Benz, AMG, and smart
Ford	Ford and Lincoln
Toyota	Lexus and Toyota
Volkswagen Group	Volkswagen, Audi, Bentley, Bugatti, Lamborghini, Porsche, SEAT, and SKODA
Honda	Acura and Honda
Hyundai	Hyundai and Kia
Nissan	Infiniti, Nissan, and Datsun
Geely	Geely and Volvo
Tata	Jaguar, Land Rover, and Tata
BMW	BMW, MINI, and Rolls-Royce

Figure 1.23 ***Examples of Makes***

Vehicle Identification

Model

- The model of a vehicle refers to the specific name of each vehicle within a make.

Make	Model
Chevrolet	Bolt EV, Camaro, Colorado, Corvette, Cruze, Equinox, Impala, Malibu, Silverado, Sonic, Spark, Suburban, Trax, Traverse, Tahoe, and Volt

Figure 1.24 ***Examples of Models***

Vehicle Identification

Year

- The model year (MY) is the year of pollution standards conformance found on the vehicle emission control information (VECI) sticker under the hood.
- The date of manufacturer is listed inside the driver's door on the vehicle certification label. This is the actual month and year that the vehicle rolled off the assembly line.

Vehicle Identification

Type

Type	Model
Microcar	GEM e2, Nano, and smart fortwo
Subcompact Car	Accent, Fiesta, Fit, Spark, Versa, and Yaris
Compact Car	Civic, Corolla, Focus, Golf, and Sentra
Mid-size Car	Accord, Camry, Fusion, and Malibu
Full-size Car	Avalon, Charger, Impala, and Maxima
Sports Car	Challenger, Corvette, Mustang, and Porsche 911
Compact SUV	Escape, RAV4, CR-V, and Wrangler
Mid-size SUV	Durango, Explorer, Grand Cherokee, Highlander, and Pathfinder
Crossover SUV	Edge, Flex, Murano, Outback, and Tiguan
Full-size SUV	Escalade, Expedition, Suburban, and Tahoe
Compact Pickup	Colorado, Frontier, Ridgeline, and Tacoma
Full-size Pickup	F-Series, Ram, Sierra, Silverado, Titan, and Tundra
Minivan	Caravan, Pacifica, Odyssey, Quest, Sedona, Sienna, and Transit Connect
Van	Express, Savana, and Transit

Figure 1.25 ***Examples of Types and Models***

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Parts and Systems

Parts

- The car's frame and body are large parts of the automobile.
- Smaller parts and assemblies work together to make the vehicle move.

Figure 1.26 *Vehicle Body*

Photo: Tesla

Parts and Systems

Systems

- Parts that work together to perform a specific task make up a system
  - Systems
    - Electrical
    - Lubrication
    - Fuel
    - Cooling System and Climate Control
    - Ignition
    - Suspension, Steering, and Tires
    - Braking
    - Drivetrain
    - Exhaust and Emission

Careers

Manufacturing Careers

- Manufacturing careers include designers, machinists, logistics personnel, production supervisors, and assembly line workers.

Figure 1.27 *Automotive Manufacturing*

Photo: Tesla

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Careers

Service and Repair Careers

- Service and repair careers include technicians, service writers, and service managers.

Figure 1.28 ***Repair Facility***

Courtesy of Ford Motor Company

Careers

Support Careers

- Careers that support the automotive industry include automotive teachers, salespeople, parts specialists, auto body technicians, insurance adjusters, auto loan specialists, car rental managers, and installers at specialty shops.

Summary

- The automobile has made land transportation easy.
- Automobiles allow people to work great distances from where they live.
- New technologies are emerging.

Readability Worksheet

Chapter 1 – Introduction and How Cars Work

Name _____Class _____ Date ___/___ /___ Score _____

CHAPTER 1: INTRODUCTION AND HOW CARS WORK

Readability Worksheet

Directions

Read the textbook to fill in the missing words from the sentences below.

1. The word "automobile" literally means _____.

2. The development of the _____ in 1860 made road vehicles more promising.

3. By the 1920s, _____ the cars in the world were Model T Fords.

4. A key concept to understand is that energy cannot be _____ or _____ in the vehicle, it is just converted from one form to another.

5. The energy into the system is going to _____ the energy out of the system, even if some of it is _____ and not usable.

6. Simply defined, force is a _____ or _____ interaction between objects.

7. When an object has moved from a force, the position of the object has _____ and _____ has occurred.

8. Power is the rate at which _____ is done (the amount of work done, energy delivered, in a given amount of _____).

9. The four-stroke internal combustion engine (also known as the _____ cycle, named after Nikolaus Otto) is the most common type used in automobiles.

10. The four-strokes of the spark ignition engine are _____, _____, _____ (combustion), and _____.

11. Compression ignition (CI) engines are fueled by _____.

12. Gasoline engines use _____ _____ to ignite the air-fuel mixture in the engine.

13. The size of the engine is the combined _____ of the cylinders.

14. The _____ describes the way cylinders are arranged in the block.

15. The _____ contains information including codes that identify the engine type, body type, model year (MY), assembly plant, production sequence number, and other information specific to that vehicle.

16. The _____ of a vehicle refers to the specific name of each vehicle within a make.

17. Parts that work together to perform a specific task make up a _____.

18. The _____ system moves oil throughout the engine to reduce wear.

19. The _____ transfers the power from the engine to the wheels.

20. Automotive _____ can work in a variety of repair facilities in different capacities to diagnose, service, and repair a vehicle.

Chapter Test

Chapter 1 – Introduction and How Cars Work

Auto Upkeep (4th Edition) Name _____
Chapter 1 Test Date ____/____/____
Introduction and How Cars Work Test Score ____

Section 1: Selected Response
Directions: Place the letter that corresponds to the correct answer on the space provided.

___ 1. The _____ was one of the earliest self-powered vehicles.
a. Hummer
b. Cugnot steam traction engine
c. Tucker
d. Taurus

___ 2. Most 4-cylinder engines are configured in this way.
a. V
b. Slant
c. X
d. Inline

___ 3. Automobiles became popular in the _____ century.
a. 14th
b. 16th
c. 18th
d. 20th

___ 4. The VIN is commonly located on the _____.
a. dashboard
b. taillight
c. headlight
d. wheel

___ 5. The Ford Model T became famous for being _____.
a. the first car
b. mass-produced on a moving assembly line
c. hand built
d. blue in color

___ 6. Who patented the world's first practical motorcar?
a. Carl Benz
b. Henry Ford
c. Nicholas Cugnot
d. Ferdinand Porsche

___ 7. What is a push or pull interaction between objects?
a. force
b. work
c. power
d. energy

___ 8. Objects have the ability to do work when they have _____.
   a. force
   b. work
   c. power
   d. energy

___ 9. _____ is the rate at which work is done.
   a. force
   b. distance
   c. power
   d. energy

___ 10. What is the transfer of energy from one object to another?
   a. force
   b. work
   c. power
   d. energy

___ 11. What is the term used to describe a twisting force?
   a. torque
   b. work
   c. horsepower
   d. energy

___ 12. One _____ is the work needed to lift 550 pounds a distance of 1 foot in 1 second.
   a. torque
   b. rpm
   c. horsepower
   d. energy

___ 13. Gasoline engines use _____ to ignite the air-fuel mixture in the engine.
   a. torque
   b. compression
   c. a catalyst
   d. spark plugs

___ 14. How much work has been done if a force of 20 pounds was used to move an object 50 feet?
   a. 20 lb
   b. 50 feet
   c. 70 ft-lb
   d. 1000 ft-lb

___ 15. What is stored energy or energy of position?
   a. potential
   b. kinetic
   c. movement
   d. force

Section 2: Selected Response ASE Style Questions
Directions: Place the letter that corresponds to the correct answer on the space provided.

___ 16. Technician A says that gasoline engines have spark plugs to ignite the air-fuel mixture. Technician B says that diesel engines use compression to ignite the air-fuel mixture. Who is correct?
a. Technician A
b. Technician B
c. Both Technician A and Technician B
d. Neither Technician A nor Technician B

___ 17. Technician A says that the day the vehicle comes off the assembly line is the model year. Technician B says that the model year can be located on the vehicle emission control information (VECI) sticker. Who is correct?
a. Technician A
b. Technician B
c. Both Technician A and Technician B
d. Neither Technician A nor Technician B

___ 18. Technician A says that the number of cylinders within the engine block is used to identify the engine design. Technician B says that the engine configuration is used to identify the engine design. Who is correct?
a. Technician A
b. Technician B
c. Both Technician A and Technician B
d. Neither Technician A nor Technician B

___ 19. Technician A says that engine size can be listed in liters. Technician B says that engine size can only be listed in cubic inches. Who is correct?
a. Technician A
b. Technician B
c. Both Technician A and Technician B
d. Neither Technician A nor Technician B

___ 20. Technician A says that rotary motion of the pistons is converted to reciprocating motion of the crankshaft. Technician B says that rotary motion is up and down or back and forth. Who is correct?
a. Technician A
b. Technician B
c. Both Technician A and Technician B
d. Neither Technician A nor Technician B

Section 3: Constructed Response

Directions: Use complete sentences to answer the following questions. The criteria below will be used to assess your answers.

Outstanding (A = 4.0)	Very Good (B = 3.0)	Acceptable (C = 2.0)	Attempted (D = 1.0)	Did Not Attempt (F = 0)
Student demonstrates a complete understanding of the problem. Several details and examples were given to support the answer. The response was extremely well organized.	Student demonstrates a considerable understanding of the problem. Some details and examples were given to support the answer. The response was presented in a thoughtful manner.	Student demonstrates a partial understanding of the problem. Few details and examples were given to support the answer. The response was somewhat organized, but did not have smooth transitions.	Student demonstrates little understanding of the problem. Details and examples were not relevant or not given. The response was difficult to follow and confusing to the reader. However, the student made an honest attempt at answering the question.	No attempt was made to answer the question.

21. How is power transferred in a gasoline powered vehicle?

22. What are the four strokes in the four-stroke spark ignition engine? What occurs during each stroke?

Answer Keys

Chapter 1 – Introduction and How Cars Work

CHAPTER 1: INTRODUCTION AND HOW CARS WORK

Study Questions

1. What was the earliest self-powered road vehicle?
   Cugnot steam traction engine in 1769-1770 was the earliest self-powered road vehicle.

2. Who was credited with the world's first motorcar?
   Carl Benz was credited with building the world's first motorcar.

3. What is the difference between force, work, power, and energy?
   Force is a push or pull interaction between objects. When an object has moved from a force, the position of the object has changed and work has occurred. Power is the rate at which work is done. Energy is the "fuel" stored or used to perform work.

4. What are the strokes in a four-stroke internal combustion engine? What is the difference between a gasoline and diesel engine?
   The four strokes are Intake, Compression, Power (Combustion), and Exhaust. Gasoline powered engines use spark plugs to ignite the air-fuel mixture in the engine. Diesel engines do not have spark plugs. Diesel engines are compression ignition engines.

5. What two units of measurement are used to classify engine sizes?
   Engine size is commonly listed in liters or cubic inches.

6. What is an engine configuration? List several examples.
   Engine configuration is the design of the engine block. Common engine configurations include inline, opposed, or V.

7. What does the acronym VIN represent?
   VIN stands for Vehicle Identification Number.

8. What is the difference between a manufacturer and make?
   An automotive manufacturer (example GM) is a company that produces vehicles. Automotive manufacturers identify the various vehicles they produce by their "make" (example Cadillac).

9. What are the systems of the automobile?
   Parts that work together to perform a specific task make up a system. Automotive systems include: electrical; lubrication; fuel; cooling and climate control; ignition; suspension, steering, and tires; braking; drivetrain; and exhaust and emission.

10. What types of careers exist in the automotive industry?
    Many automotive careers exist. These include, but are not limited to, automotive manufacturing, service and repair, and careers that support the industry.

Name _____Class _____ Date ___/___ /___ Score _____

CHAPTER 1: INTRODUCTION AND HOW CARS WORK

Readability Worksheet – Answer Key

Directions

Read the textbook to fill in the missing words from the sentences below.

1. The word "automobile" literally means self-moving.

2. The development of the internal combustion engine in 1860 made road vehicles more promising.

3. By the 1920s, half the cars in the world were Model T Fords.

4. A key concept to understand is that energy cannot be created or destroyed in the vehicle, it is just converted from one form to another.

5. The energy into the system is going to equal the energy out of the system, even if some of it is unwanted and not usable.

6. Simply defined, force is a push or pull interaction between objects.

7. When an object has moved from a force, the position of the object has changed and work has occurred.

8. Power is the rate at which work is done (the amount of work done, energy delivered, in a given amount of time).

9. The four-stroke internal combustion engine (also known as the Otto cycle, named after Nikolaus Otto) is the most common type used in automobiles.

10. The four-strokes of the spark ignition engine are intake, compression, power (combustion), and exhaust.

11. Compression ignition (CI) engines are fueled by diesel.

12. Gasoline engines use spark plugs to ignite the air-fuel mixture in the engine.

13. The size of the engine is the combined volume of the cylinders.

14. The configuration describes the way cylinders are arranged in the block.

15. The VIN contains information including codes that identify the engine type, body type, model year (MY), assembly plant, production sequence number, and other information specific to that vehicle.

16. The model of a vehicle refers to the specific name of each vehicle within a make.

17. Parts that work together to perform a specific task make up a system.

18. The lubrication system moves oil throughout the engine to reduce wear.

19. The drivetrain transfers the power from the engine to the wheels.

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Auto Upkeep (4th Edition) Name __Answer Key
Chapter 1 Test Date ____/____/____
Introduction and How Cars Work Test Score ____

Section 1: Selected Response
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_b_ 1. The _____ was one of the earliest self-powered vehicles.
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d. Taurus

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d. 20th

_a_ 4. The VIN is commonly located on the _____.
a. dashboard
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c. headlight
d. wheel

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c. hand built
d. blue in color

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c. Nicholas Cugnot
d. Ferdinand Porsche

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c. power
d. energy

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   b. work
   c. power
   d. energy

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   d. energy

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_d_ 20. Technician A says that rotary motion of the pistons is converted to reciprocating motion of the crankshaft. Technician B says that rotary motion is up and down or back and forth. Who is correct?
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21. How is power transferred in a gasoline powered vehicle?

1. Fuel is stored as chemical energy in the gas tank. 2. Fuel is transported to the engine by a fuel pump. 3. Air-fuel mixture enters the engine. 4. Electrical energy is used to create a spark at the spark plug. 5. Combustion occurs, converting the chemical energy to kinetic energy. 6. The reciprocating motion of the pistons is converted to rotary (circular) motion of the crankshaft. 7. The crankshaft's rotary motion turns the transmission. 8. On FWD vehicles, rotary motion is transferred through a transaxle then through the CV shafts. On RWD vehicles, rotary power is transferred from the transmission through the drive shaft, to a differential, and then through axles. 9. The axle shafts or CV shafts turn the wheels. 10. The rotary motion of the wheels converts to linear motion on the roadway.

22. What are the four strokes in the four-stroke spark ignition engine? What occurs during each stroke?

Intake stroke – Intake valve is open. Exhaust valve is closed. Piston moves down. Air-fuel mixture enters the combustion chamber.

Compression stroke – Intake and exhaust valves are closed. Piston moves up. Air-fuel mixture is compressed.

Power (Combustion) stroke – Intake and exhaust valves are closed. A spark plug ignites the fuel. Piston is forced down by combustion. This is the stroke that provides the power.

Exhaust stroke – Exhaust valve opens. Intake valve is closed. Piston moves up, pushing exhaust gases out of the engine.