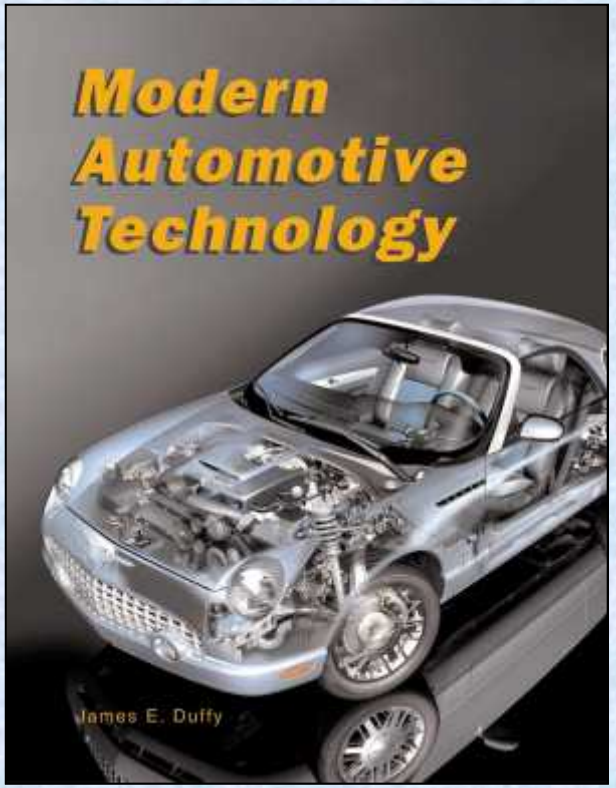
PowerPoint for

Modern Automotive Technology



by

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Chapter 1

The Automobile

Contents (11 Topics)

- Parts, assemblies, and systems
- Frame, body, and chassis
- Engine
- Computer system
- Fuel system
- Electrical system

Contents

- Cooling and lubrication systems
- Exhaust and emission control systems
- Drive train systems
- Suspension, steering, and brake systems
- Accessory and safety systems

Automobile

Derived from the Greek word *autos*, which means self.

Derived from the French word *mobile*, which means moving.

Parts, Assemblies, and Systems

Part

- The smallest removable item on a vehicle
- Not normally disassembled
- Electrical or electronic parts are often called components

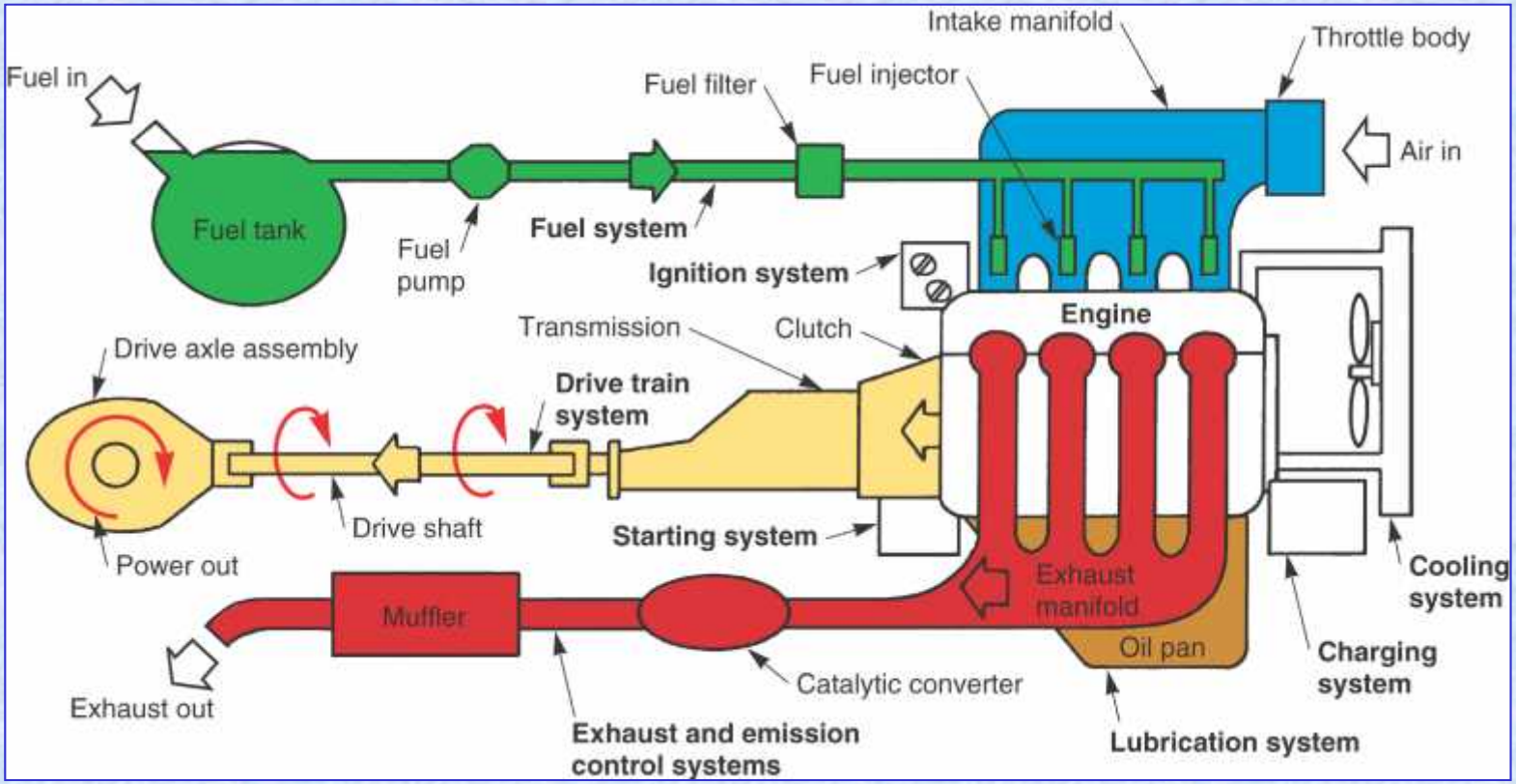
Assembly

- Set of fitted parts designed to complete a function
  - the engine is an assembly that converts fuel into usable power to move the vehicle
- Technicians take assemblies apart and put them back together during maintenance, service, and repair operations

System

- Group of related parts and assemblies that performs a specific job
  - the steering system is comprised of the steering wheel, gears, swivel joints, and other parts
    - allows the driver to turn the wheels when maneuvering the vehicle

Major Vehicle Systems



Frame, Body, and Chassis

Body

- Made of steel, aluminum, fiberglass, plastic, or composite materials
- Forms the outside of the vehicle
- Serves as an attractive covering for the chassis

Chassis

- Consists of the vehicle's frame and everything attached to it except the body
- Includes the tires, wheels, engine, transmission, drive axle assembly, and frame

Frame

- Strong metal structure that provides a mounting place for other parts of the vehicle
- Body-over-frame construction
  - chassis parts and body bolt to the frame
- Unibody (unitized) construction
  - sheet metal body panels are welded together to form the body and frame

Unibody Construction

The frame is an integral part of the body

Body-over-Frame Construction

The body bolts to a thick steel frame

Body Types

- Automobiles are available in several body types, including:
  - sedan
  - hardtop
  - convertible
  - hatchback
  - station wagon
  - minivan
  - sport-utility vehicle

Sedan

Uses center body pillars, or “B” pillars, between the front and rear doors. A hardtop does not use “B” pillars.

Convertible

Uses a vinyl or cloth top that can be raised and lowered

Hatchback

The large rear door allows easy access when hauling items

Station Wagon

Provides a large rear interior compartment

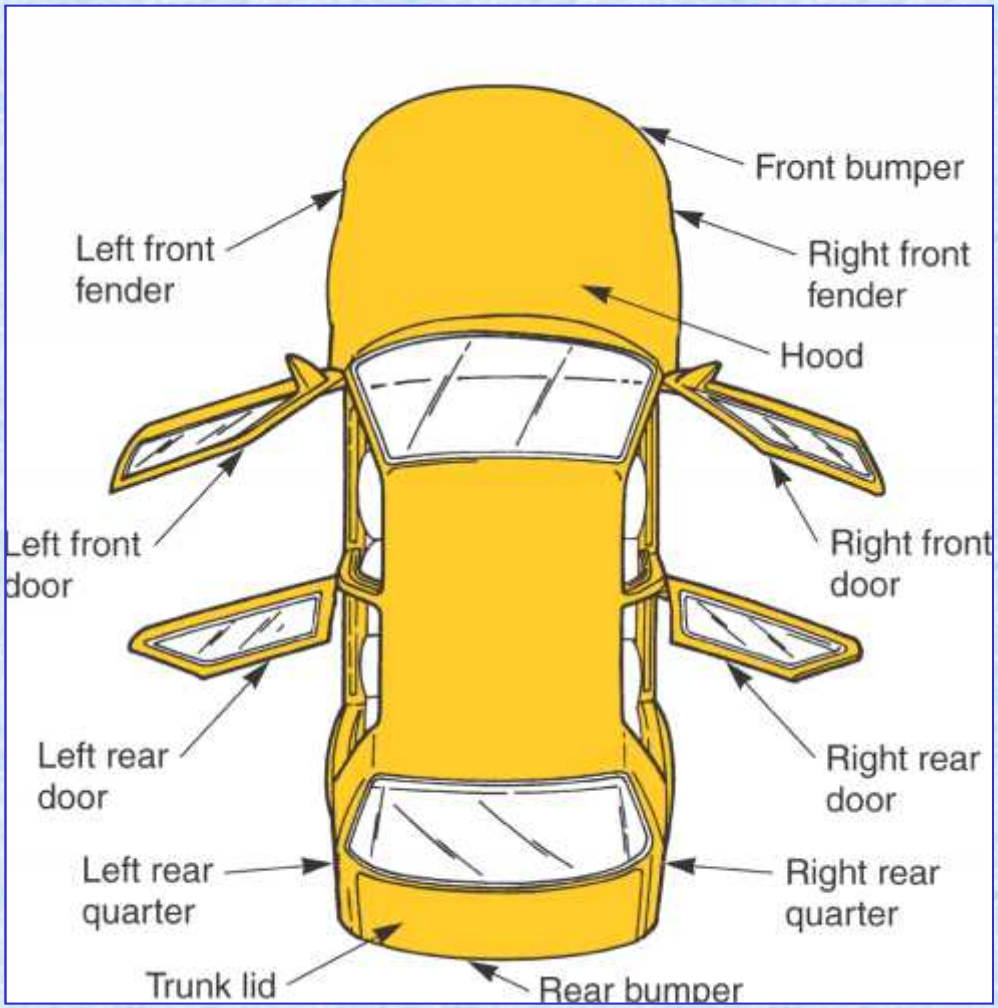
Minivan

Has a higher roofline for more headroom and cargo space

Sport-Utility Vehicle

Provides the comfort of a passenger car, the interior space of a station wagon, and the durability of a truck

Automobile Body Parts



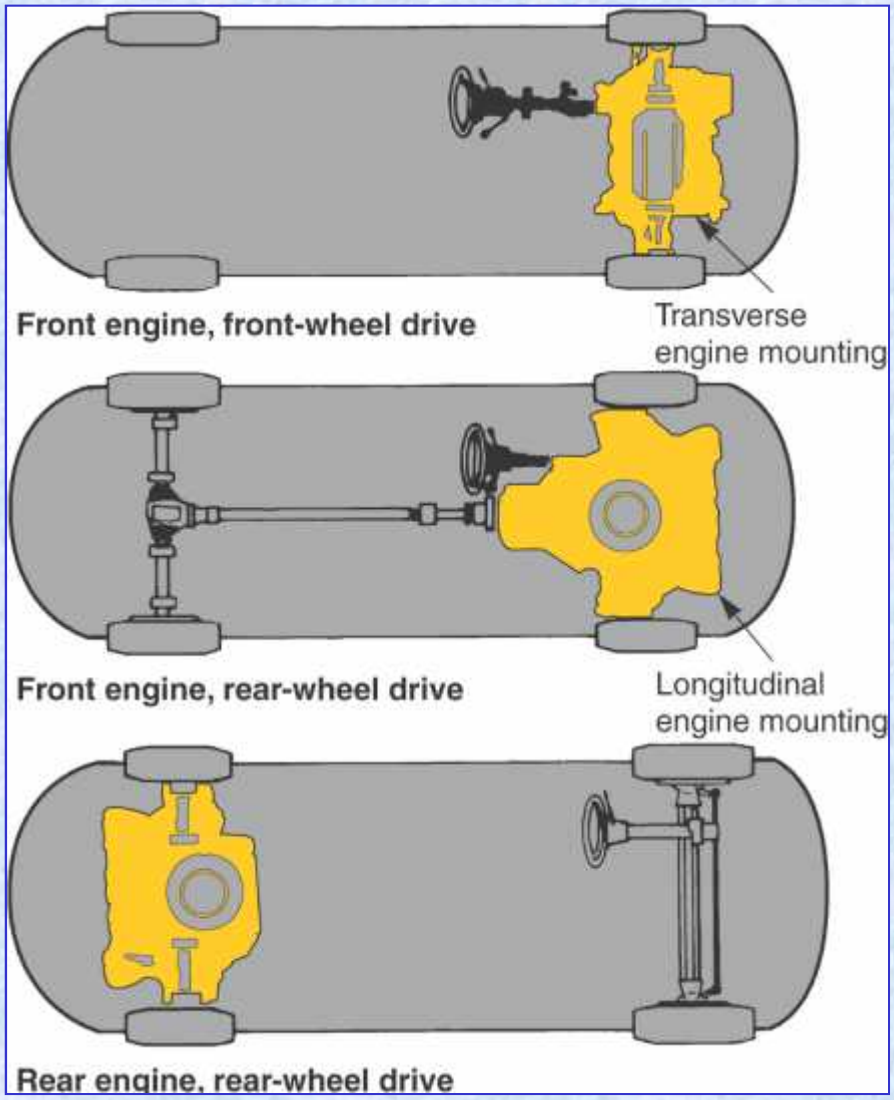
Engine

Engine

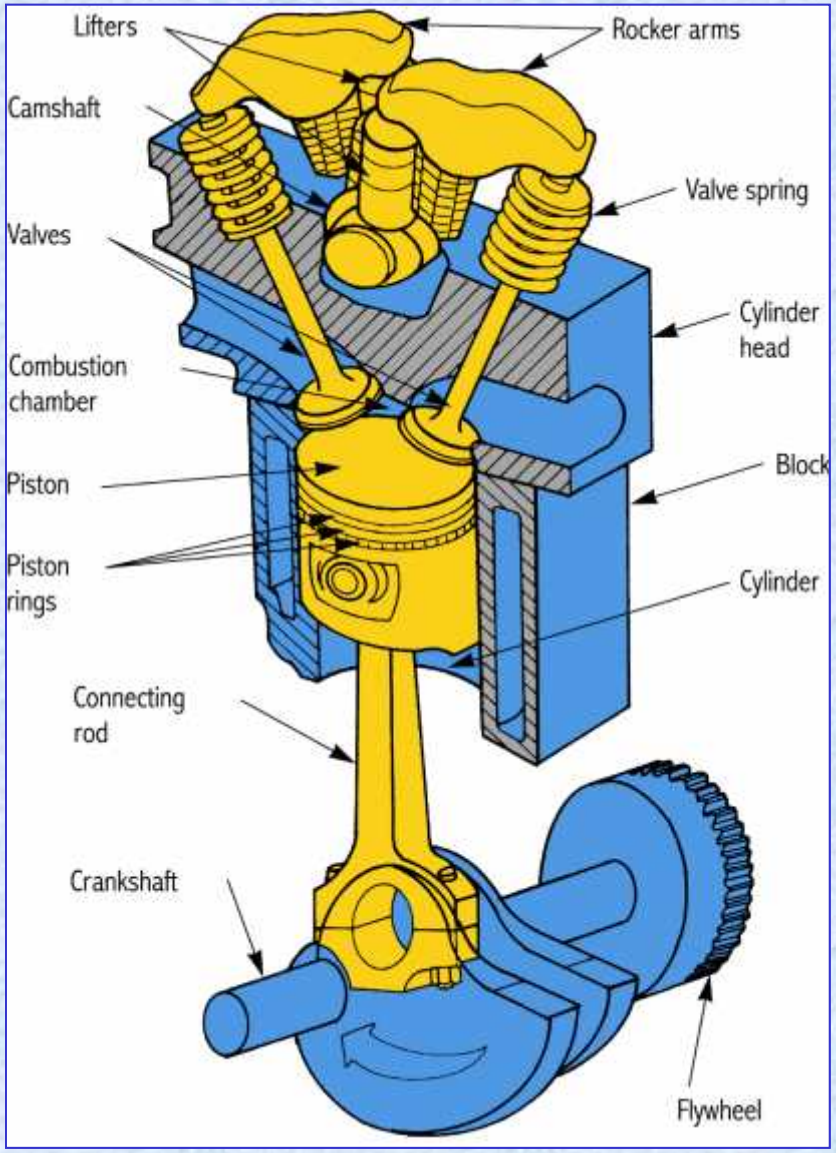
- Provides the energy to propel the vehicle and operate the other systems
- Most engines burn gasoline or diesel fuel
- The fuel burns to produce heat
- The heat causes gas expansion, creating pressure
- The pressure moves the internal engine parts to produce power

Automotive Engine

Engine Locations



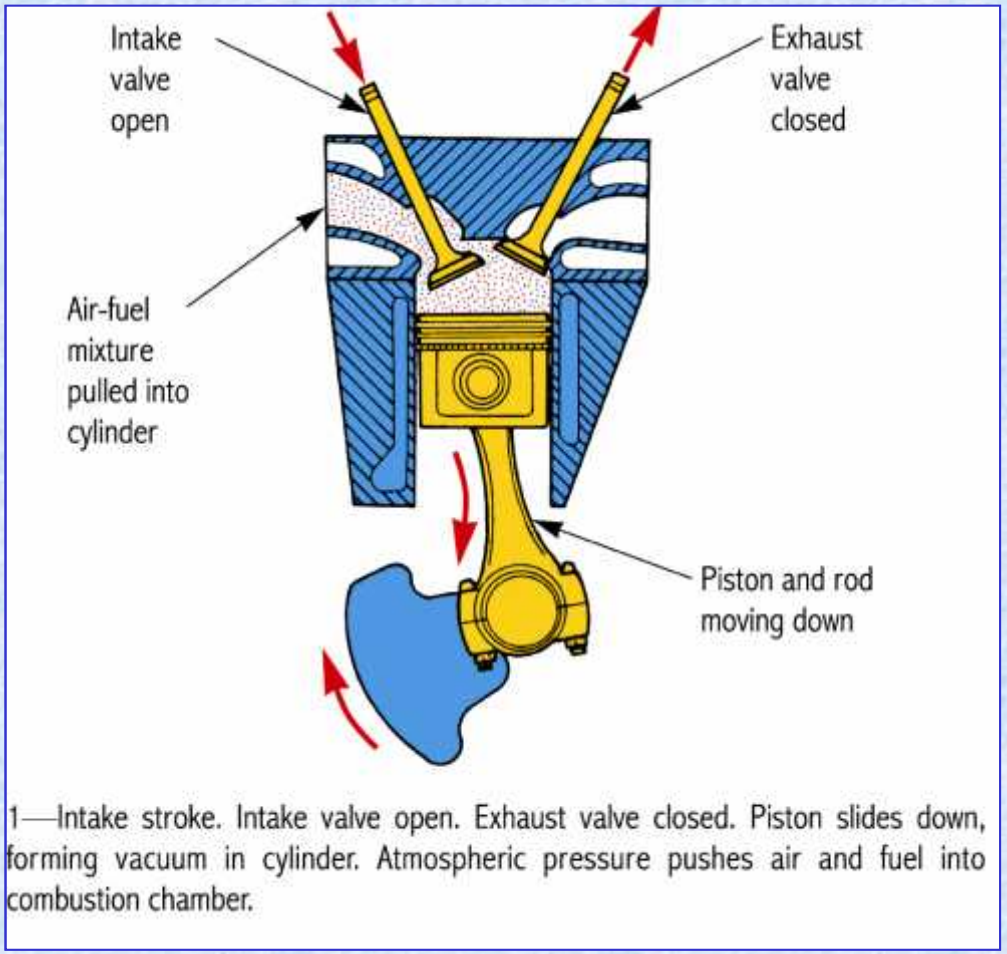
Basic Engine Parts



Four-Stroke Cycle

- Four separate piston strokes are needed to produce one cycle:
  - intake stroke
  - compression stroke
  - power stroke
  - exhaust stroke
- The piston must slide down, up, down, and up again to complete one cycle

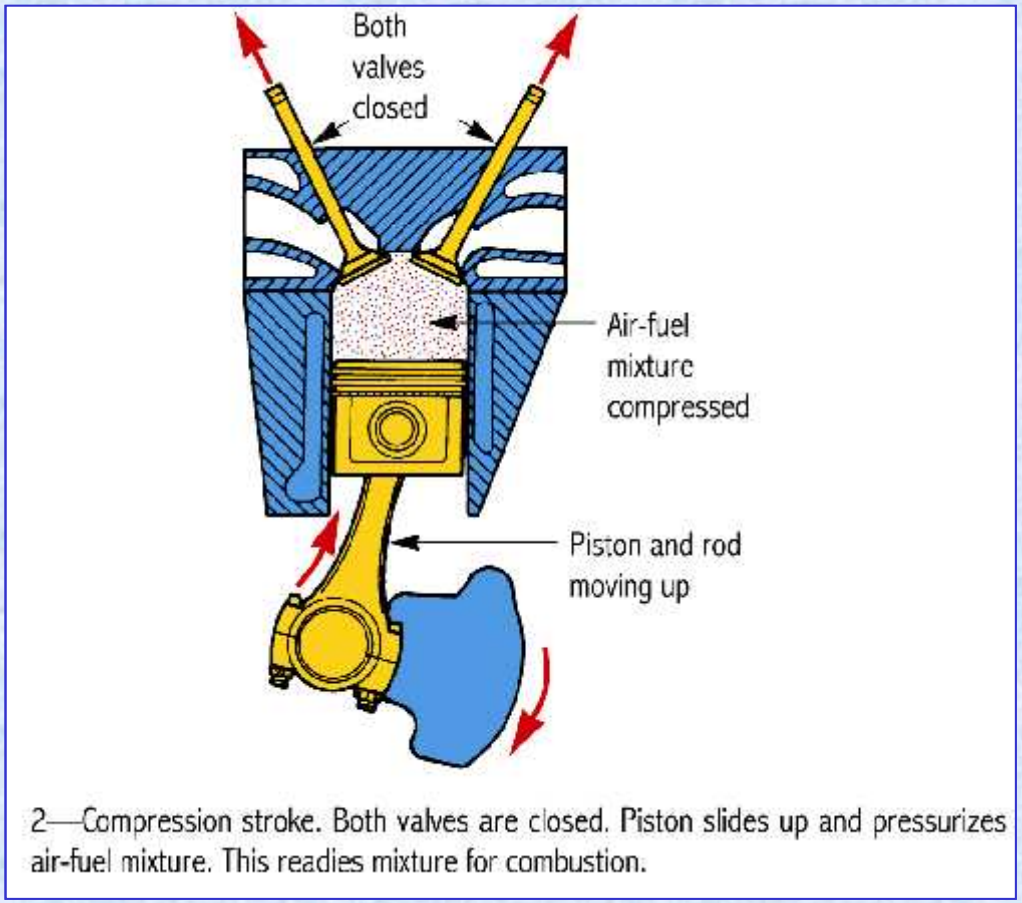
Intake Stroke



1—Intake stroke. Intake valve open. Exhaust valve closed. Piston slides down, forming vacuum in cylinder. Atmospheric pressure pushes air and fuel into combustion chamber.

Draws the air-fuel mixture into the cylinder

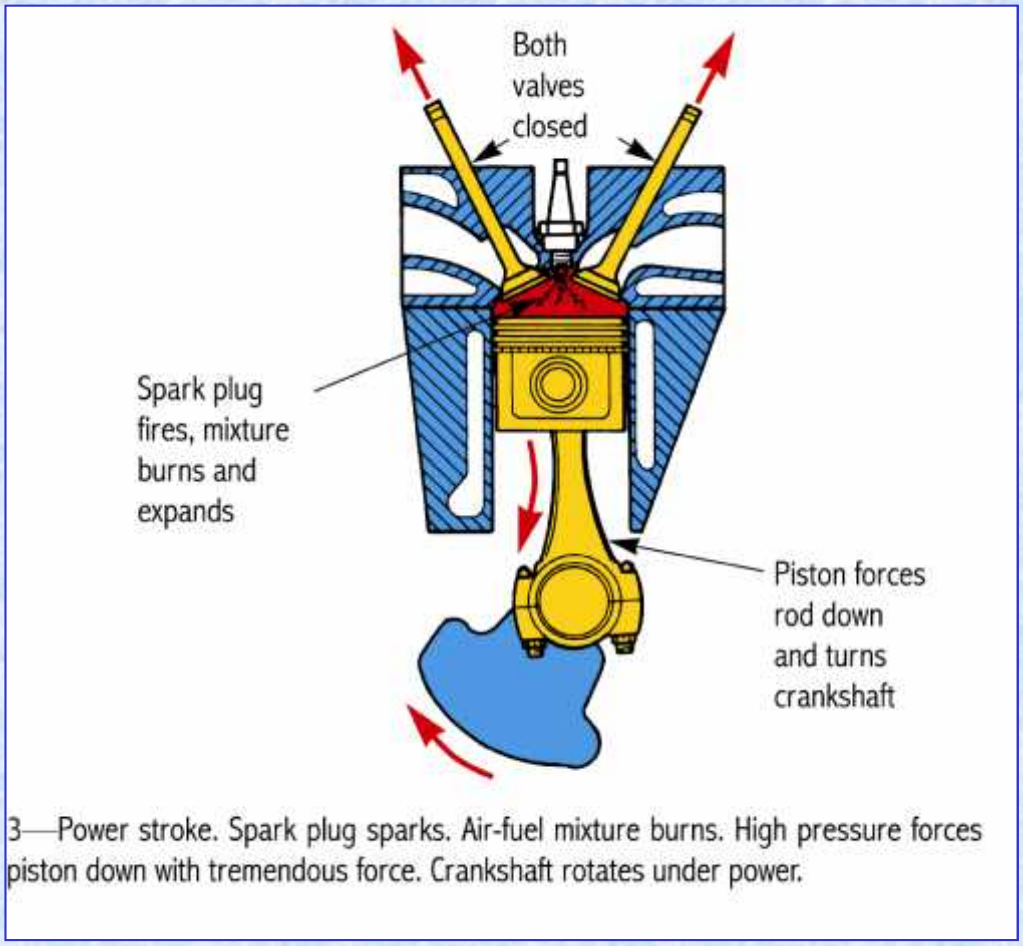
Compression Stroke



2—Compression stroke. Both valves are closed. Piston slides up and pressurizes air-fuel mixture. This readies mixture for combustion.

Compresses the air-fuel mixture

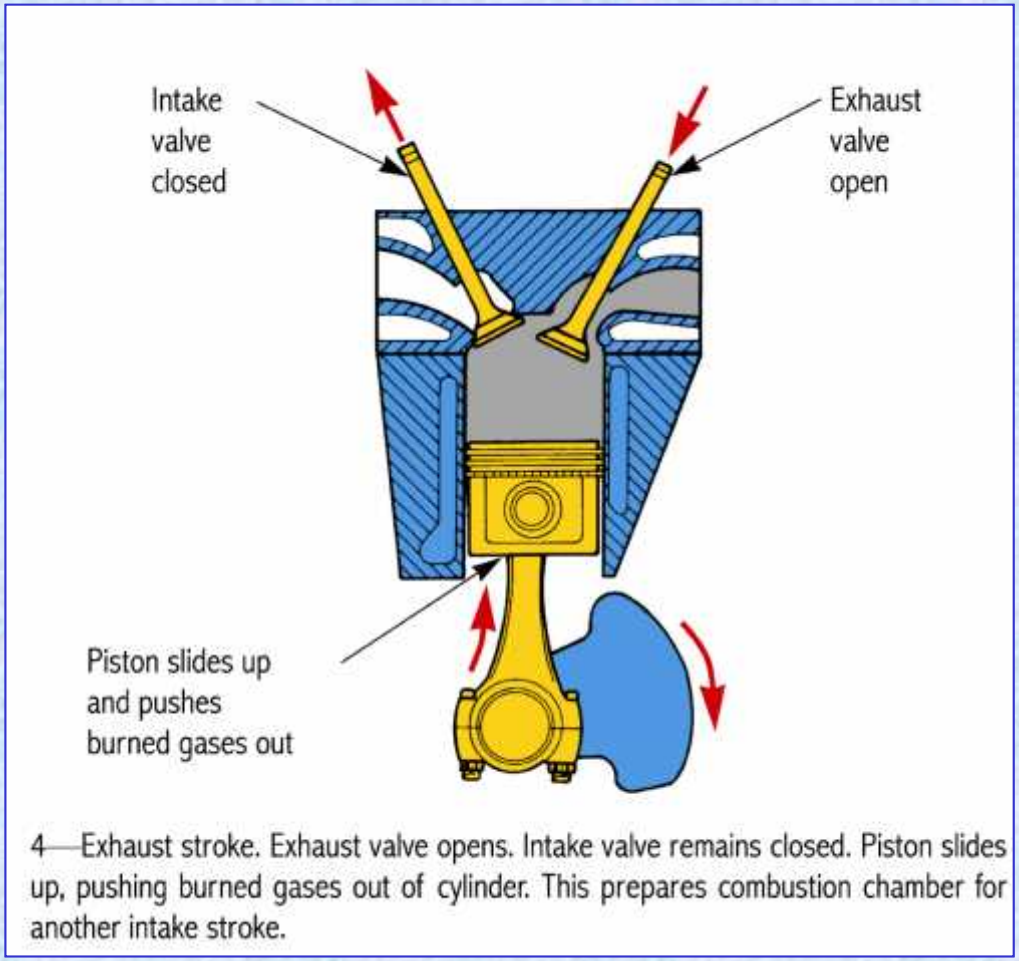
Power Stroke



3—Power stroke. Spark plug sparks. Air-fuel mixture burns. High pressure forces piston down with tremendous force. Crankshaft rotates under power.

Produces the energy to operate the engine

Exhaust Stroke



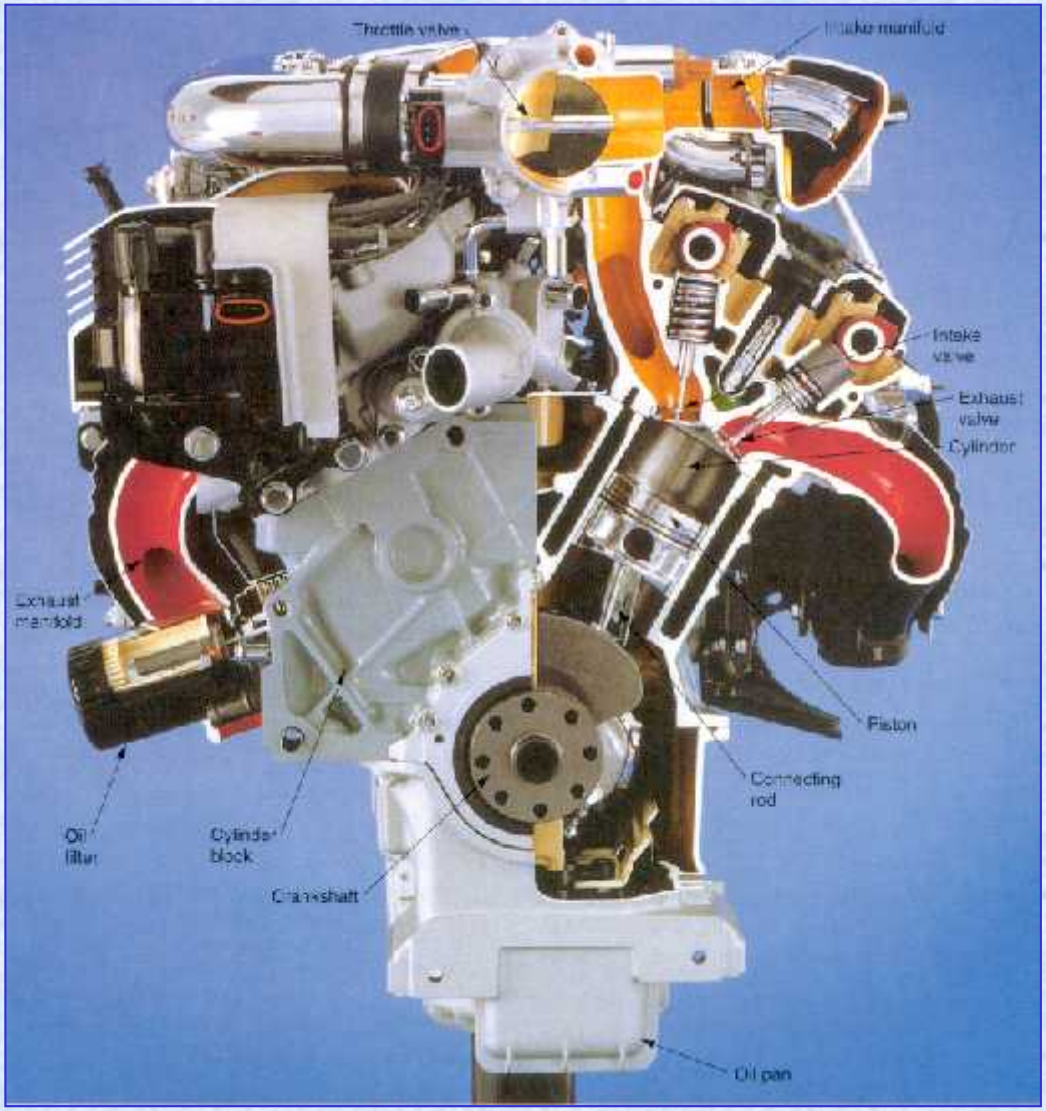
4—Exhaust stroke. Exhaust valve opens. Intake valve remains closed. Piston slides up, pushing burned gases out of cylinder. This prepares combustion chamber for another intake stroke.

Removes the burned gases from the combustion chamber

Automotive Engines

- Multi-cylinder engines are used
- 4,5,6,8, or 10 cylinders may be used
- Additional cylinders smooth engine operation and increase power output because there is less time between power strokes

Engine Components



Computer System

Computer System

- Uses electronic and electrical devices to monitor and control various systems
- The systems controlled include the:
  - fuel system
  - ignition system
  - drive train
  - safety and security systems

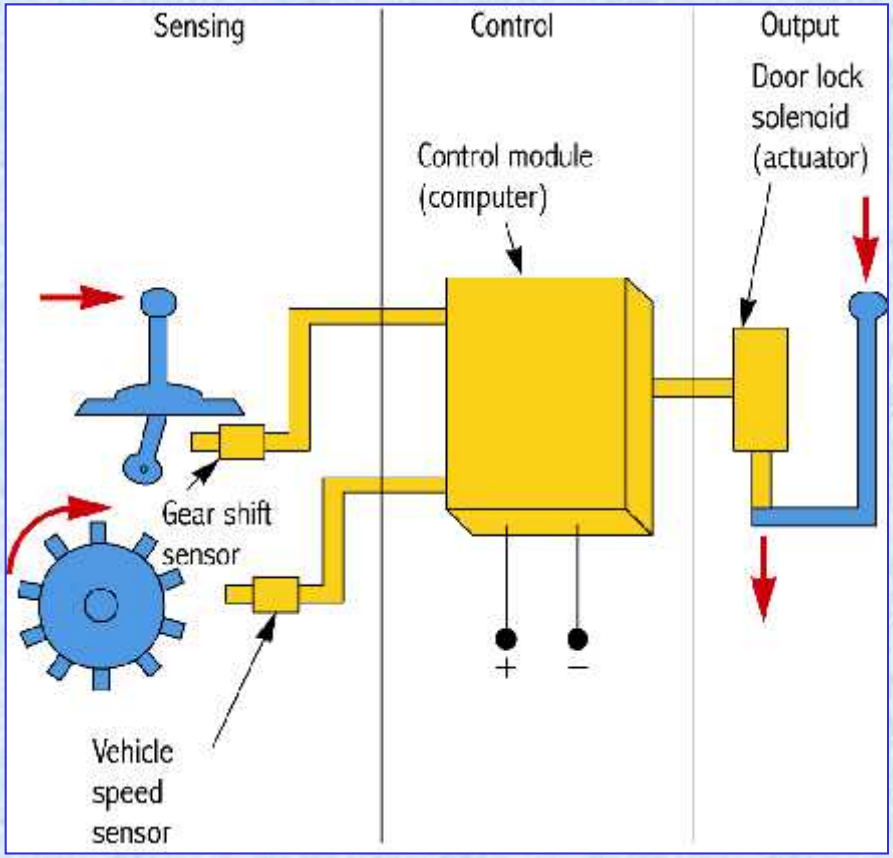
Computer System Components

- Sensors
  - input devices that can produce or modify electrical signals with changes in a condition, such as motion, temperature, or pressure
- Control module
  - computer that uses signals from input devices (sensors) to control various output devices

Computer System Components

- Actuators
  - output devices that can move parts when energized by the control module
  - output devices include electric motors and solenoids

Computerized Door Locks



The doors are locked as soon as the vehicle starts moving in drive or reverse

Fuel System

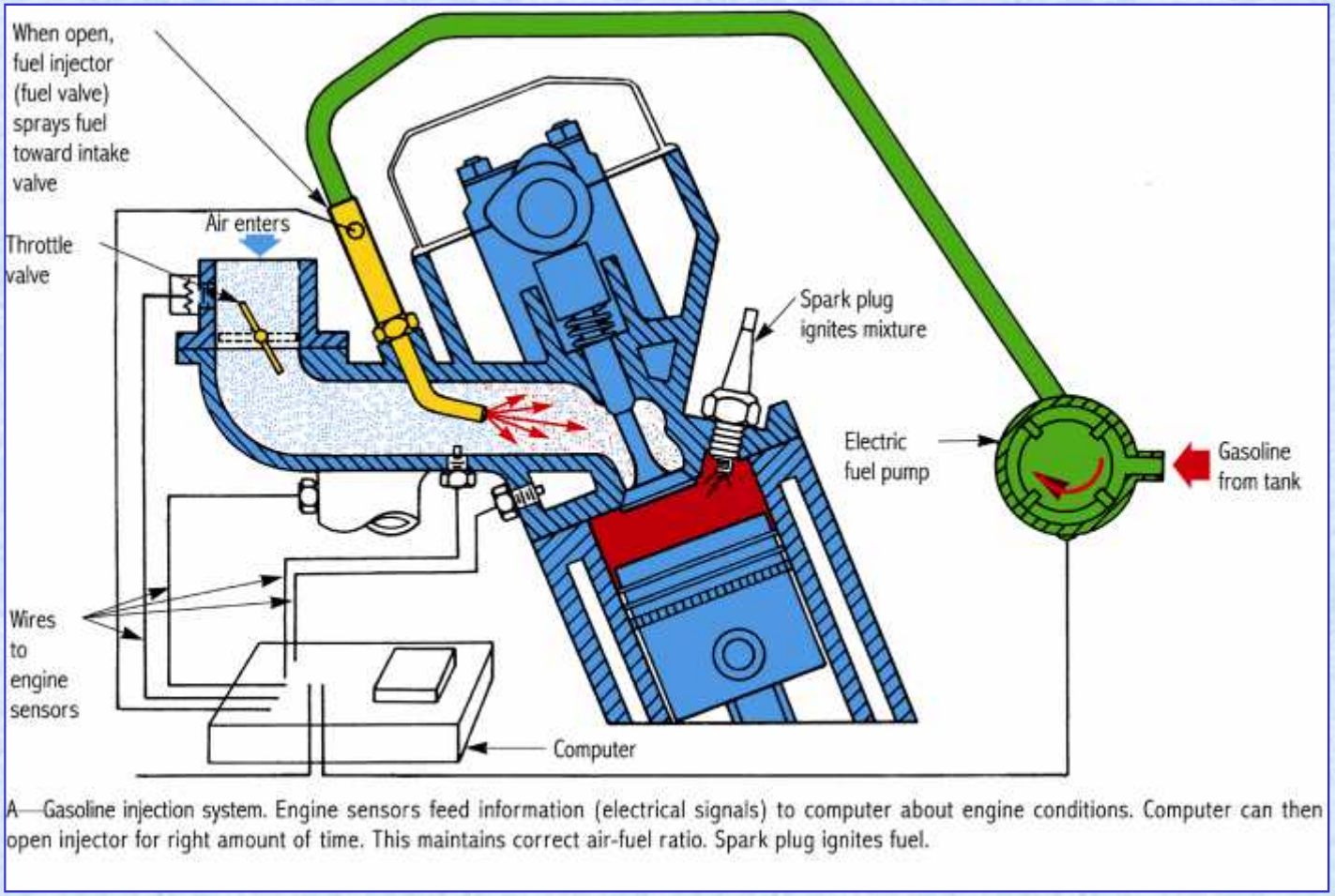
Fuel System

- Provides the correct mixture of air and fuel for efficient combustion
- Alters the air-fuel ratio with changes in operating conditions such as engine temperature, speed, and load
- Fuel system types:
  - gasoline injection system
  - diesel injection system
  - carburetor system

Gasoline Injection System

- Uses a control module, sensors, and electrically operated fuel injectors to meter fuel into the engine
- An electric fuel pump pressurizes the fuel
- The control module monitors sensor values and opens the injectors for the correct amount of time to deliver the desired quantity of fuel

Gasoline Injection System

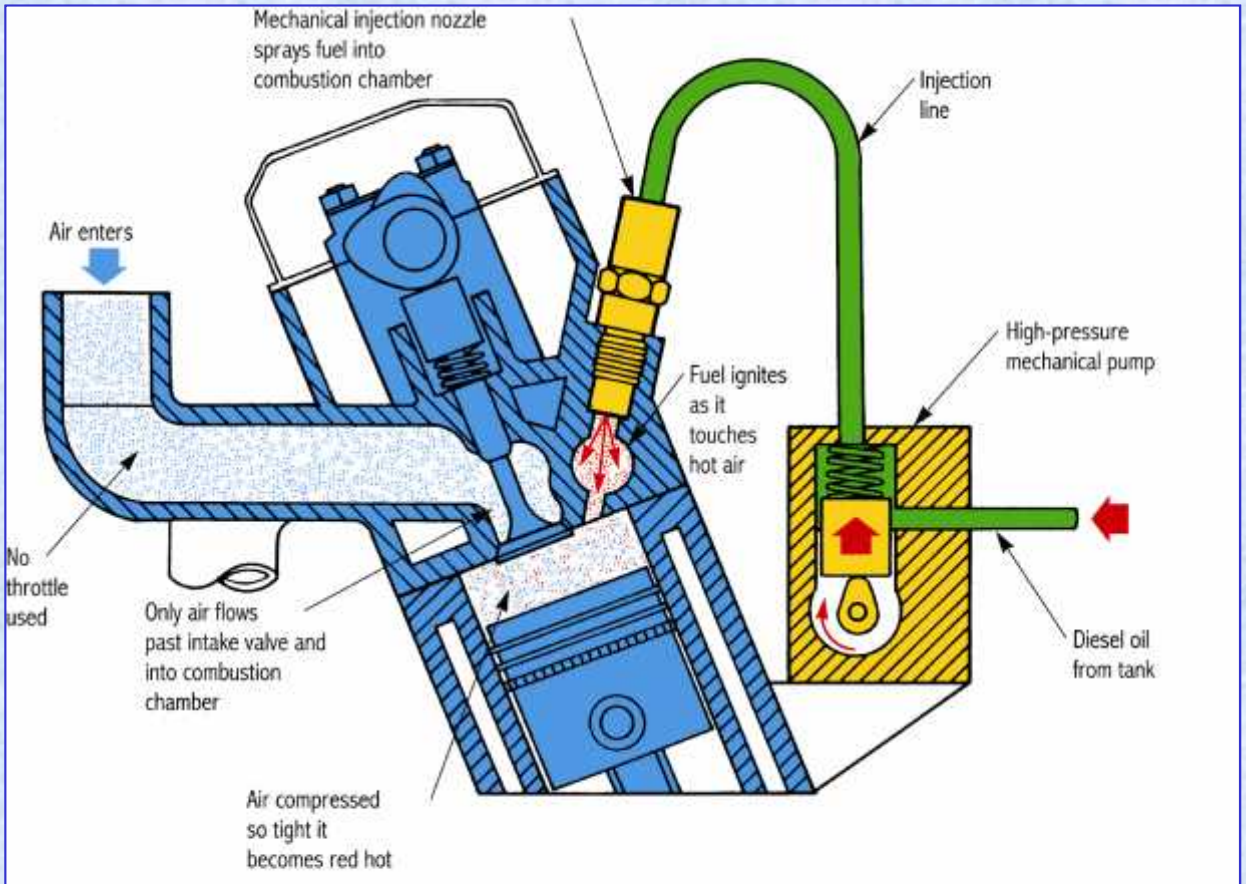


A—Gasoline injection system. Engine sensors feed information (electrical signals) to computer about engine conditions. Computer can then open injector for right amount of time. This maintains correct air-fuel ratio. Spark plug ignites fuel.

Diesel Injection System

- Forces fuel directly into the combustion chambers
- High pressure produced during compression heats the air enough to ignite the fuel
- When fuel is injected into the cylinder, the heated air causes the fuel to ignite and burn

Diesel Injection System

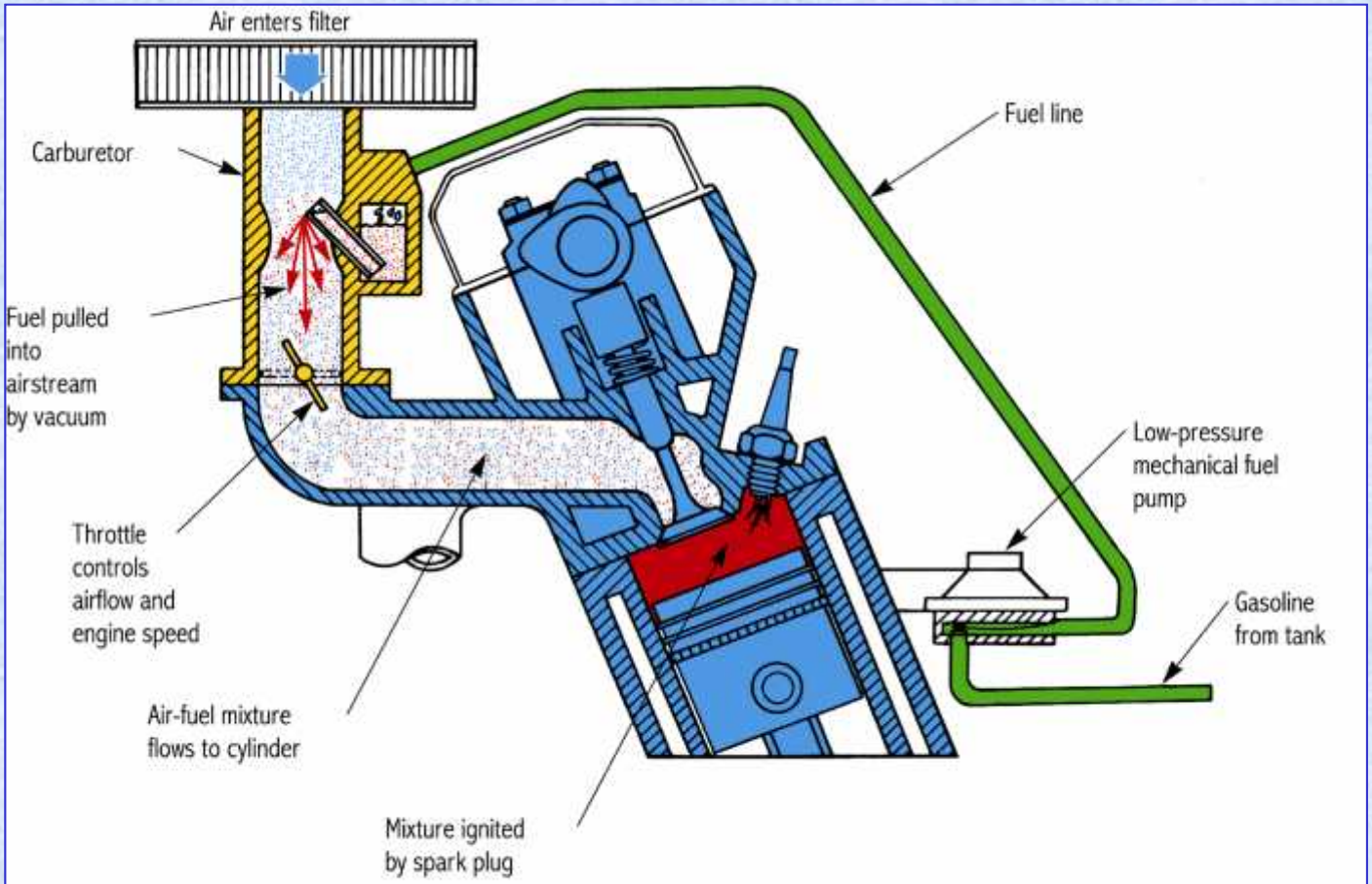


8—Diesel injection system. High-pressure mechanical pump sprays fuel directly into combustion chamber. Piston squeezes and heats air enough to ignite diesel fuel. Fuel begins to burn as soon as it touches heated air. Note that no throttle valve or spark plug is used. Amount of fuel injected into chamber controls diesel engine power and speed.

Carburetor Fuel System

- Uses vacuum to draw fuel into the engine
- A mechanical or electric fuel pump delivers fuel to the carburetor
- A throttle valve controls airflow and engine power output

Carburetor Fuel System



C—Carburetor fuel system. Fuel pump fills carburetor with fuel. When air flows through carburetor, fuel is pulled into engine in correct proportions. Throttle valve controls airflow and engine power output.

Electrical System

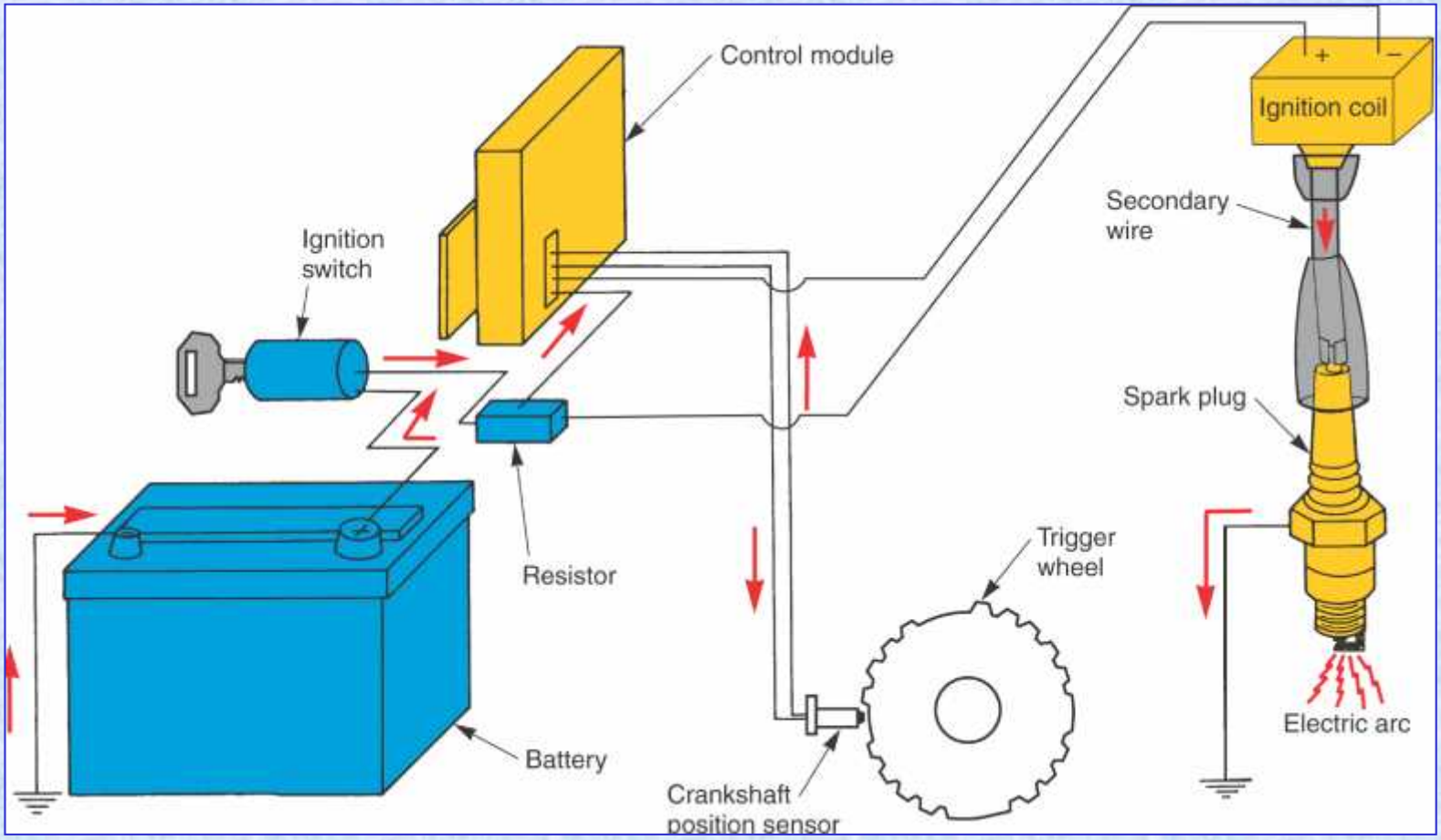
Electrical System

- Consists of several subsystems:
  - ignition system
  - starting system
  - charging system
  - lighting system
- Each subsystem is designed to perform a specific function

Ignition System

- Needed on gasoline engines to ignite the air-fuel mixture
- Produces an extremely high voltage surge, which operates the spark plugs
- An electric arc jumps across the tip of each spark plug at the correct time, causing the air-fuel mixture to burn

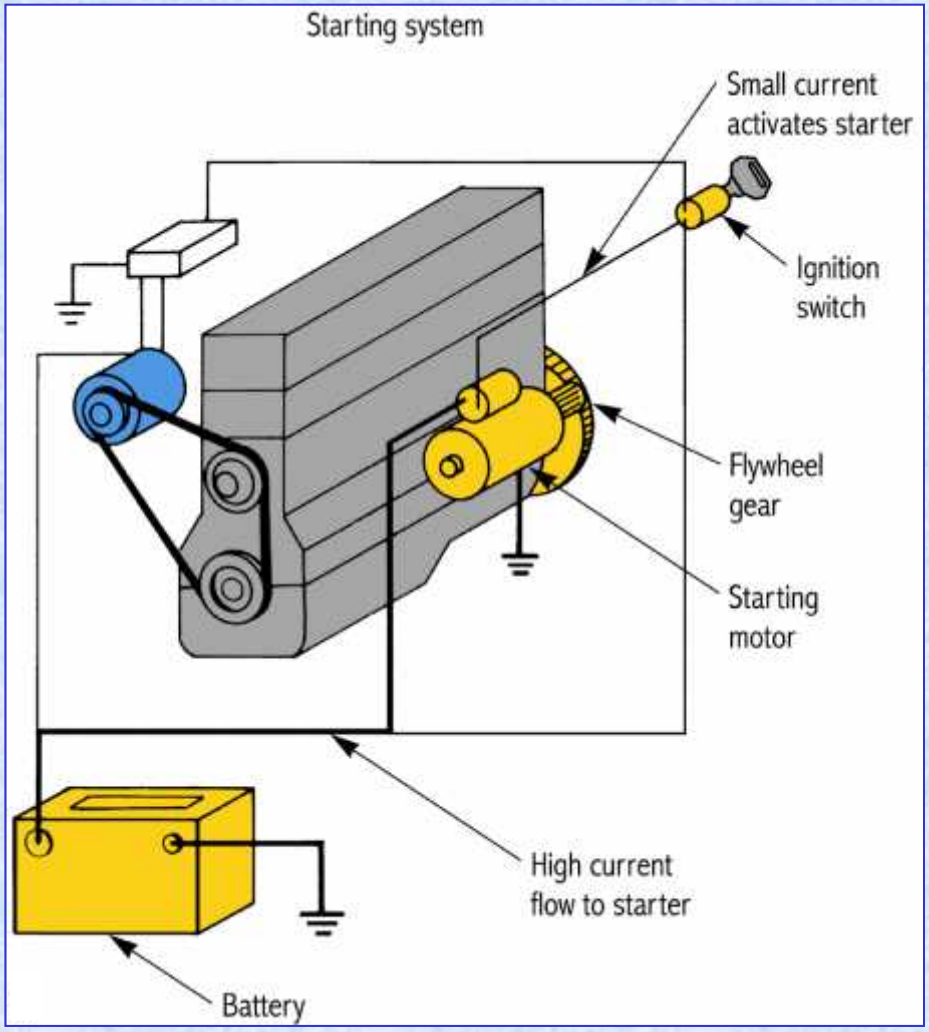
Ignition System



Starting System

- An electric starting motor rotates the engine until it “fires” and runs on its own power
- When the key is turned to the start position, current flows from the battery through the starting system circuit
- The starting motor turns, and the starting motor pinion gear engages a gear on the flywheel, turning the crankshaft

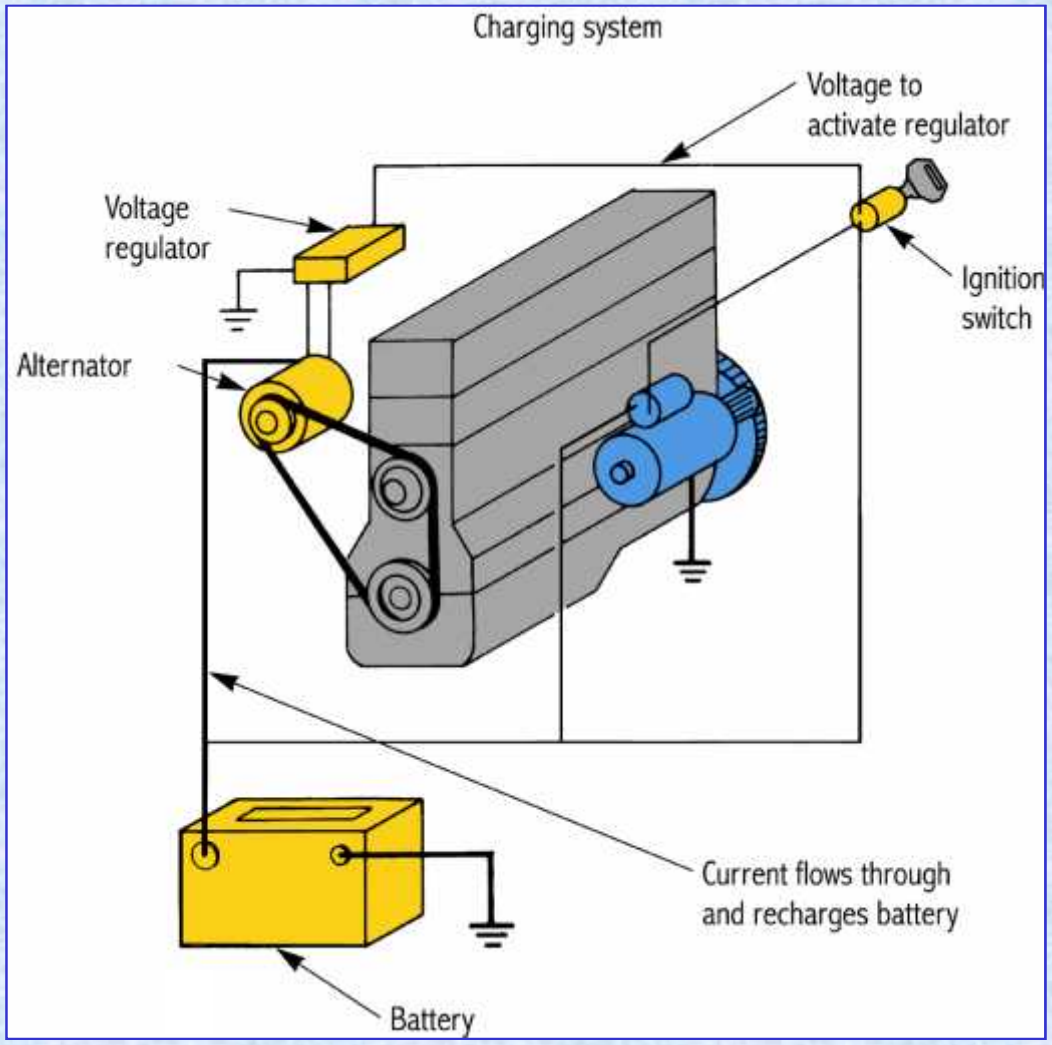
Starting System



Charging System

- Replaces electrical energy drawn from the battery by forcing electric current back into it
- When the engine is running, the alternator produces electricity to recharge the battery and operate other electrical devices
- The voltage regulator controls system voltage

Charging System



Lighting System

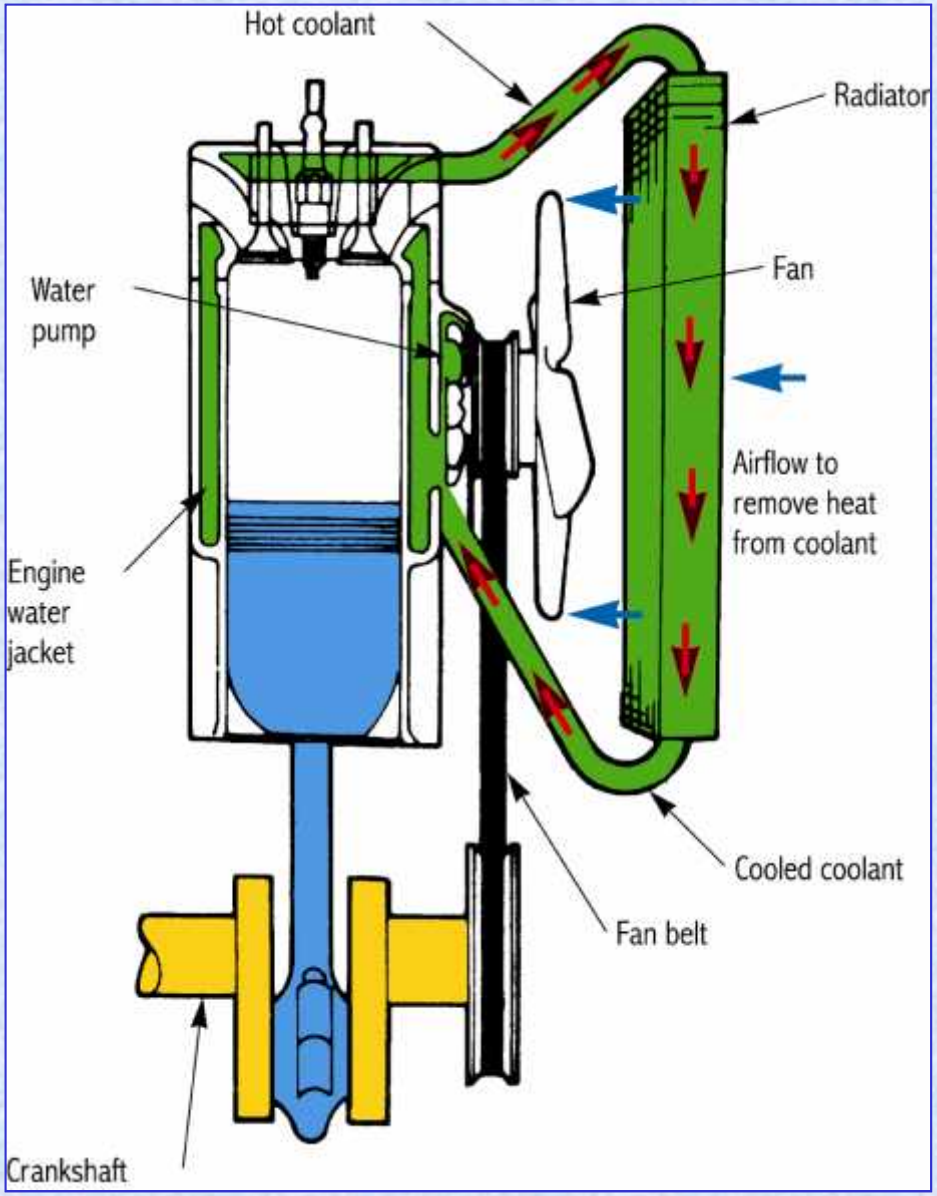
- Consists of the components that operate a vehicle's interior and exterior lights
- Components may include:
  - fuses
  - wires
  - switches
  - relays
  - control modules

Cooling and Lubrication Systems

Cooling System

- Maintains a constant engine operating temperature
- Removes excess combustion heat to prevent engine damage
- Minimizes engine warm-up time
- Coolant is pumped through the engine, where it absorbs heat
- Coolant then flows to the radiator, where heat is released to the outside air

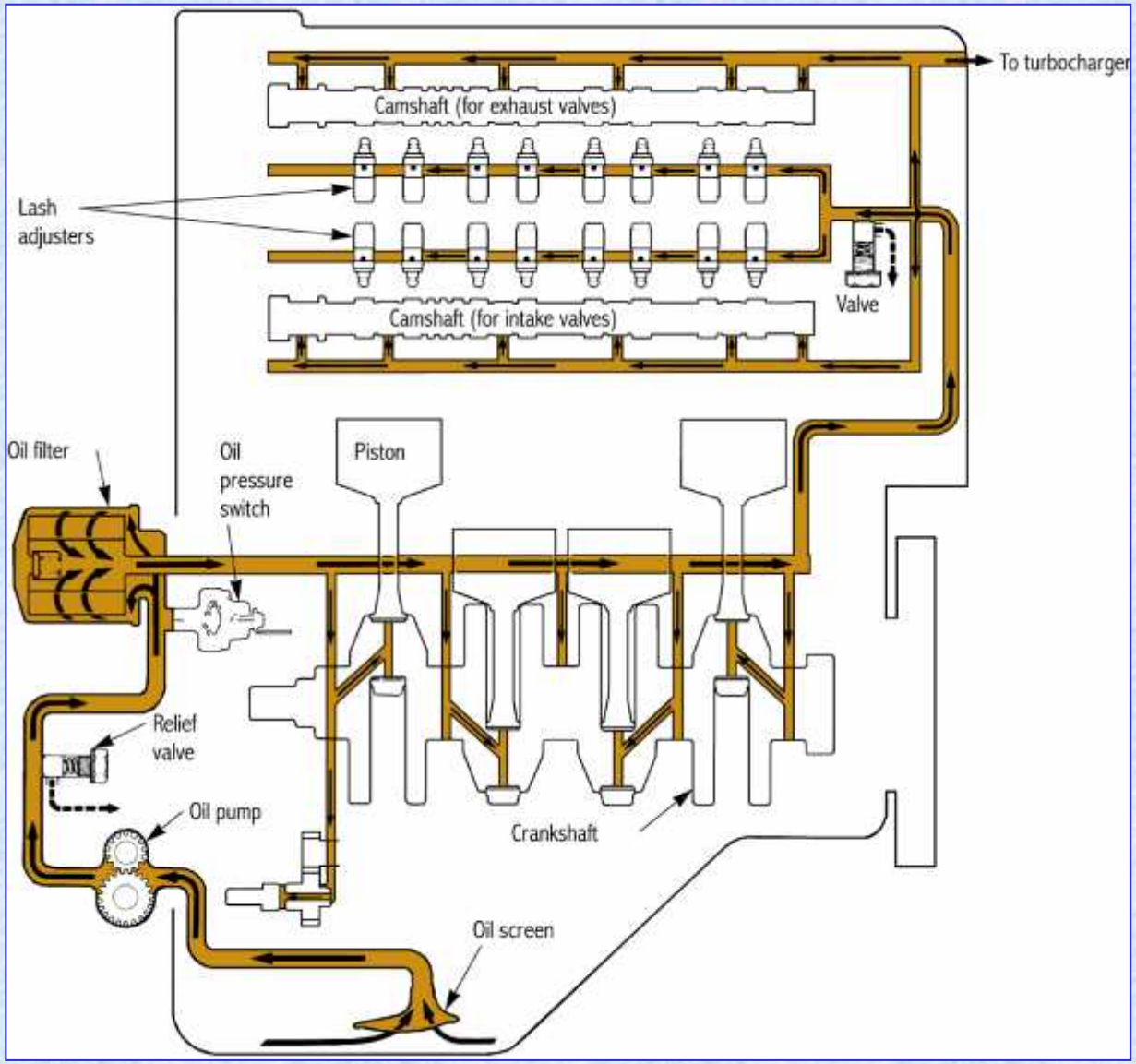
Cooling System



Lubrication System

- Reduces friction and wear between internal engine parts by circulating filtered oil to high-friction points in the engine
- Helps cool the engine by carrying heat away from internal engine parts

Lubrication System

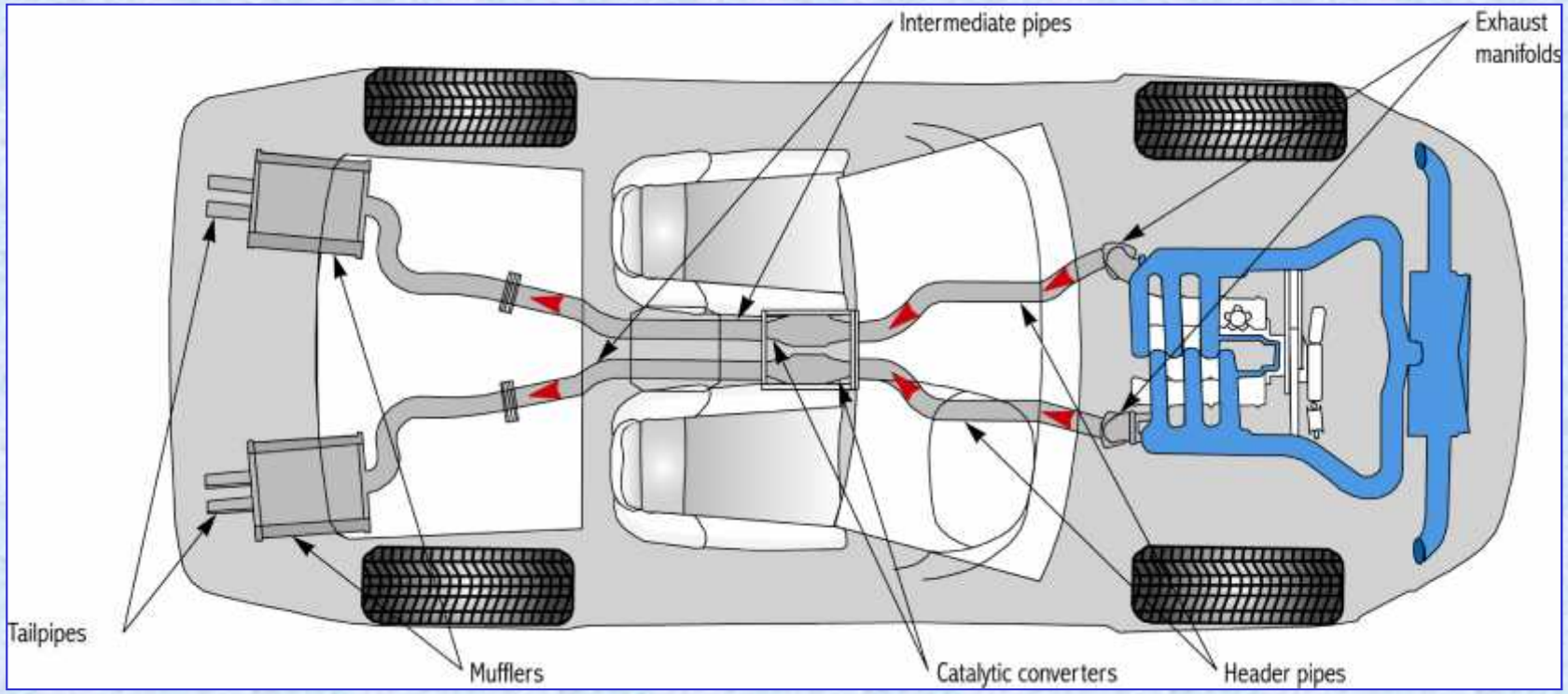


Exhaust and Emission Control Systems

Exhaust System

- Quiets the noise produced by engine operation
- Routes engine exhaust gases to the rear of the vehicle body

Exhaust System

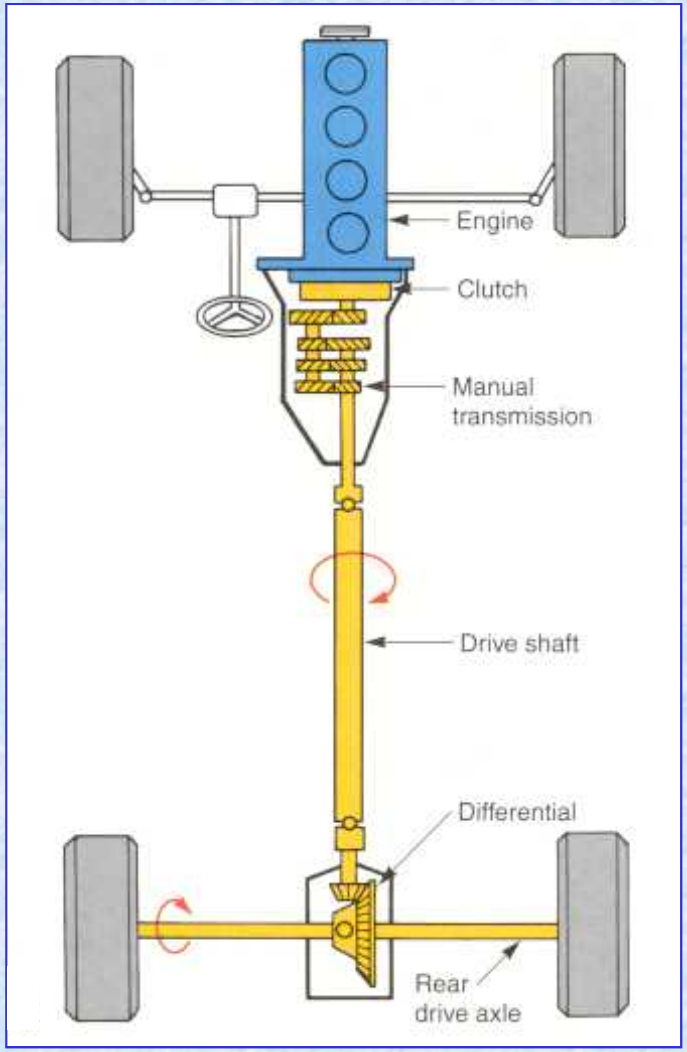


Emission Control Systems

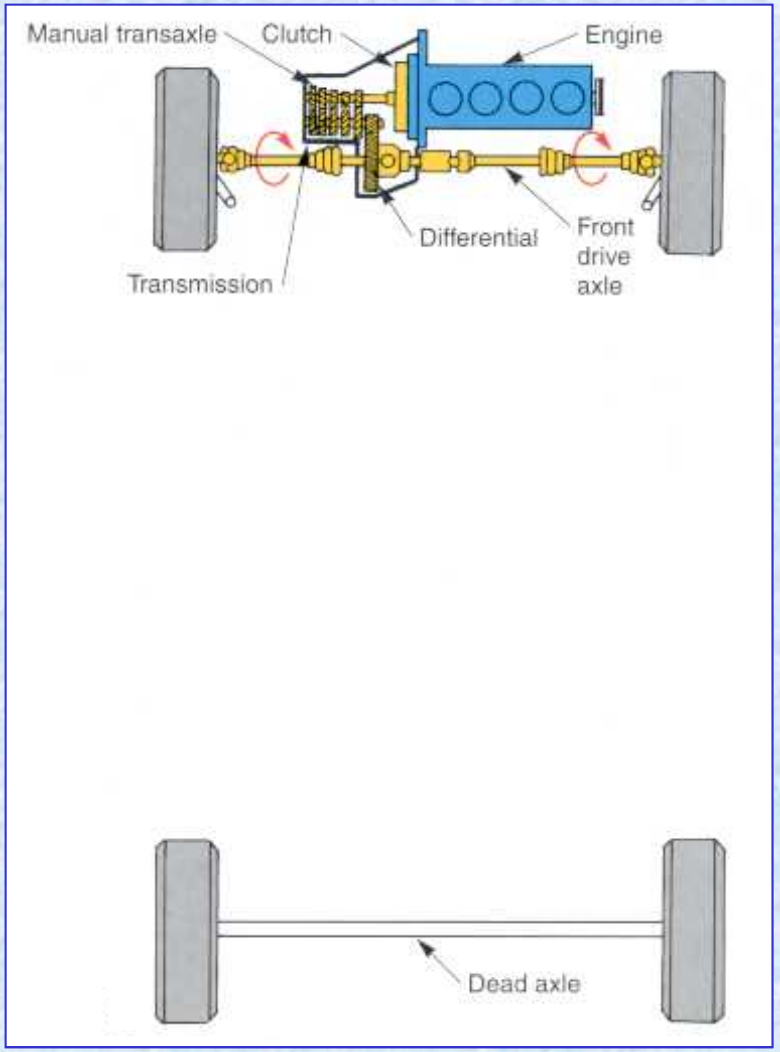
- Reduce the amount of toxic substances produced by an engine
  - prevent fuel vapors from entering the atmosphere
  - remove unburned and partially burned fuel from the engine exhaust

Drive Train Systems

Drive Train Systems



Rear-wheel-drive



Front-wheel-drive

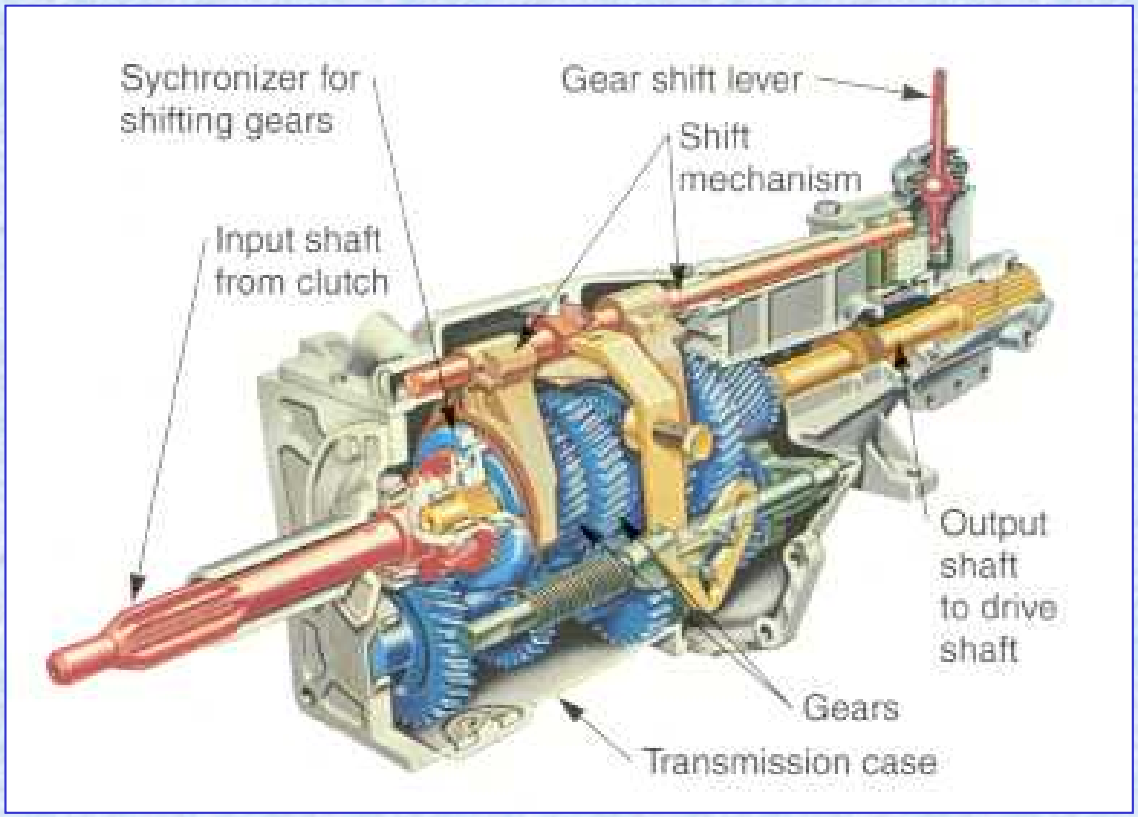
Clutch

- Allows the driver to engage or disengage the engine and manual transmission or transaxle
- Clutch pedal released
  - clutch locks the flywheel and the transmission together
  - power flows to the transmission
- Clutch pedal depressed
  - clutch disengages power flow

Transmission

- Uses various gear combinations (ratios), to multiply engine speed and torque to accommodate driving conditions
- Low gear ratios allow the vehicle to accelerate quickly
- High gear ratios permit lower engine speed, providing good fuel economy

Manual Transmission

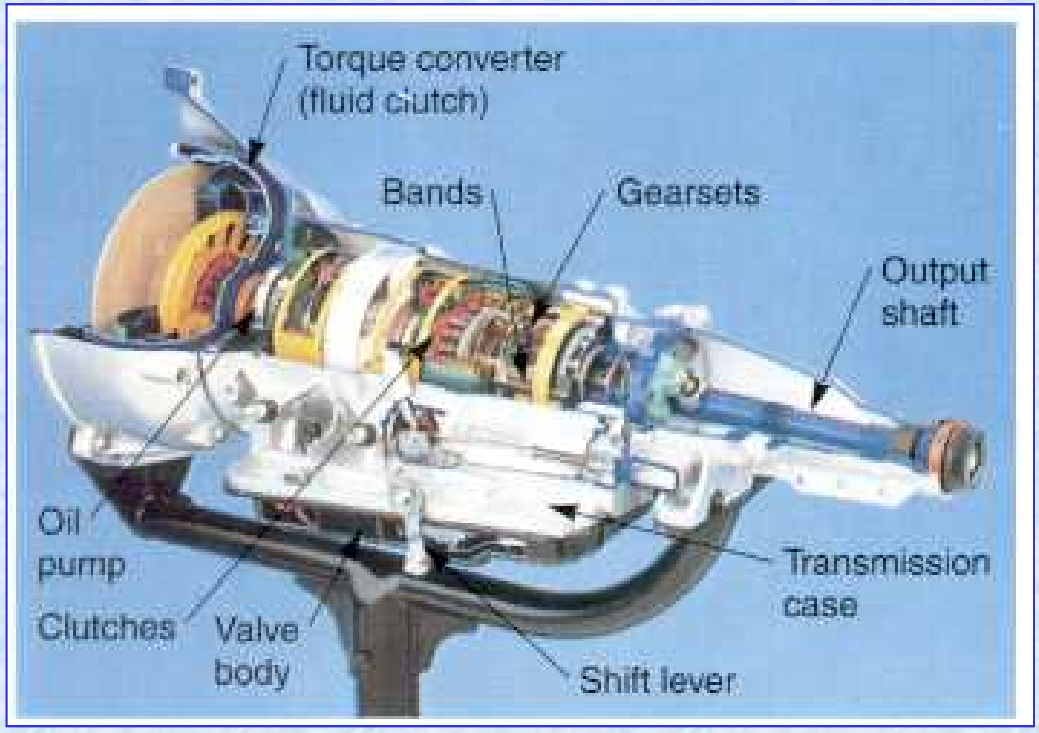


Uses gears and shafts to achieve various gear ratios

Automatic Transmission

- Does not have to be shifted by the driver
- Uses an internal hydraulic system and, in most cases, electronic controls to shift gears
- Internal clutches or bands control gearsets to provide various gear ratios
- Input shaft is connected to the engine crankshaft through a torque converter

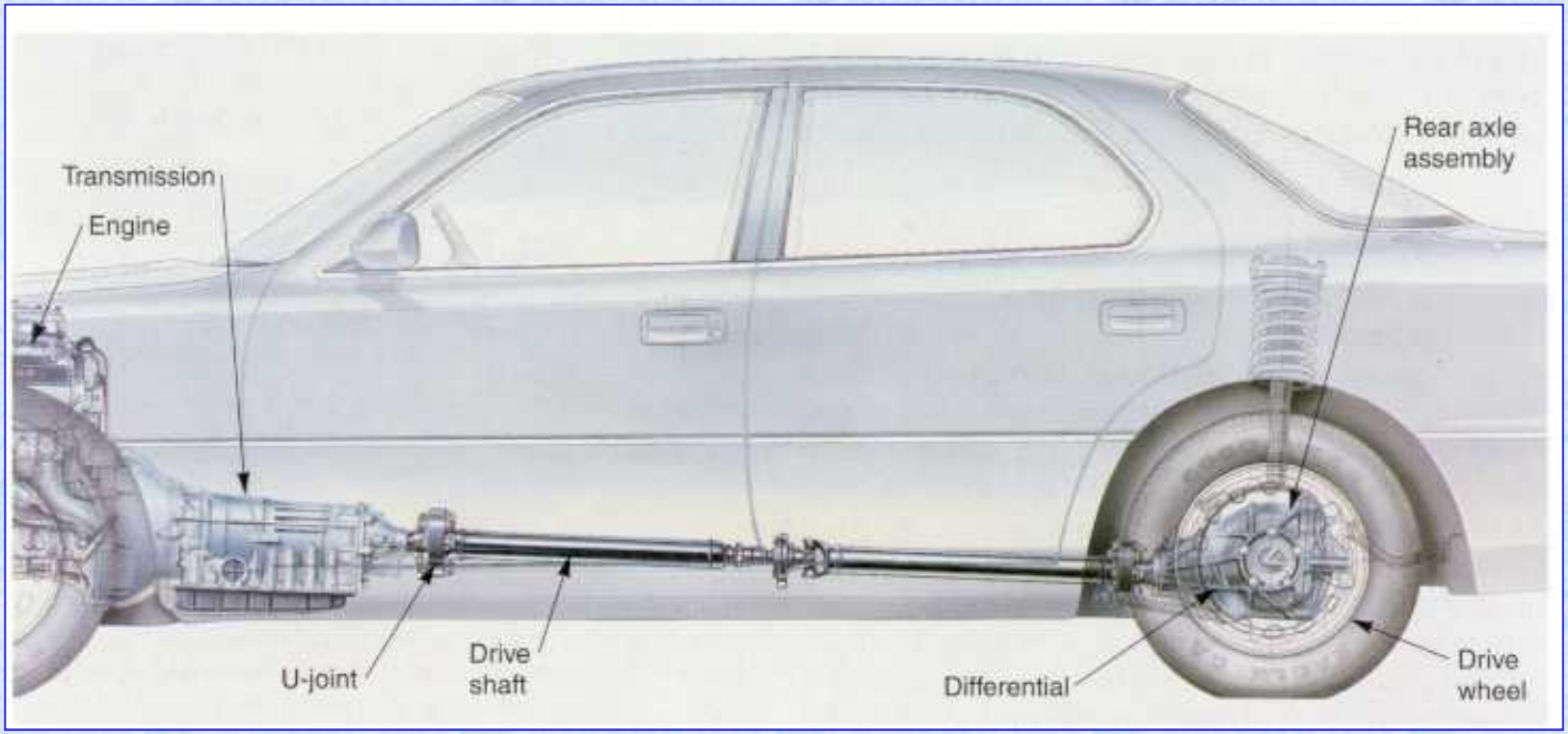
Automatic Transmission



Drive Shaft

- Transfers power from the transmission to the rear axle assembly
- Universal joints allow the rear suspension to move up and down without damaging the drive shaft

Drive Shaft

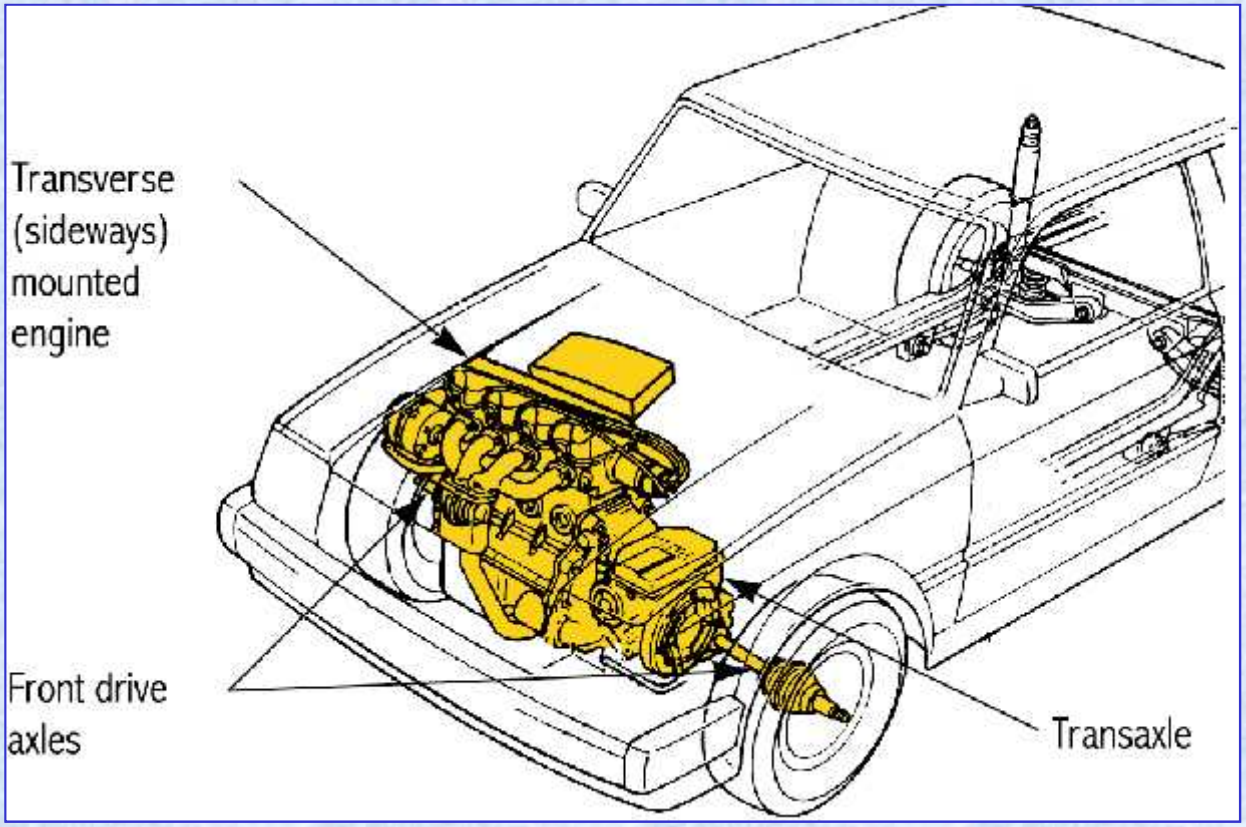


Rear Axle Assembly

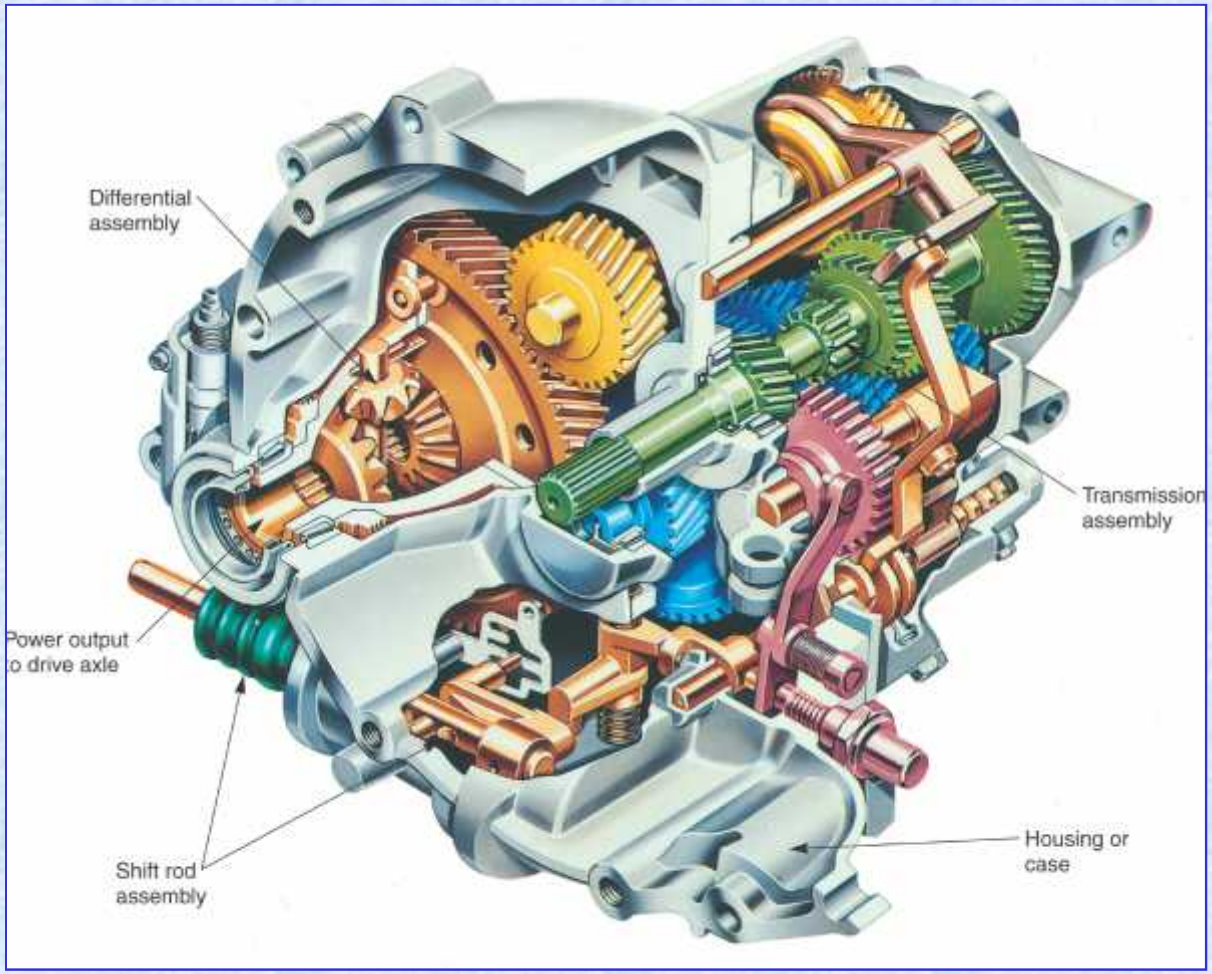
- Contains a differential and two axles
- Differential
  - set of gears and shafts that transmits power from the drive shaft to the axles
- Axles
  - steel shafts that connect the differential and drive wheels

Transaxle

- Used with front-wheel-drive vehicles
- Both manual and automatic transaxles are available



Transaxle



Consists of a transmission and a differential in a single housing

Front Drive Axles

- Connect the transaxle differential to the hubs and wheels of the vehicle
- Equipped with constant-velocity joints
  - constant-velocity joints allow the front wheels to be turned to the left or right and to move up and down

Suspension, Steering, and Brake Systems

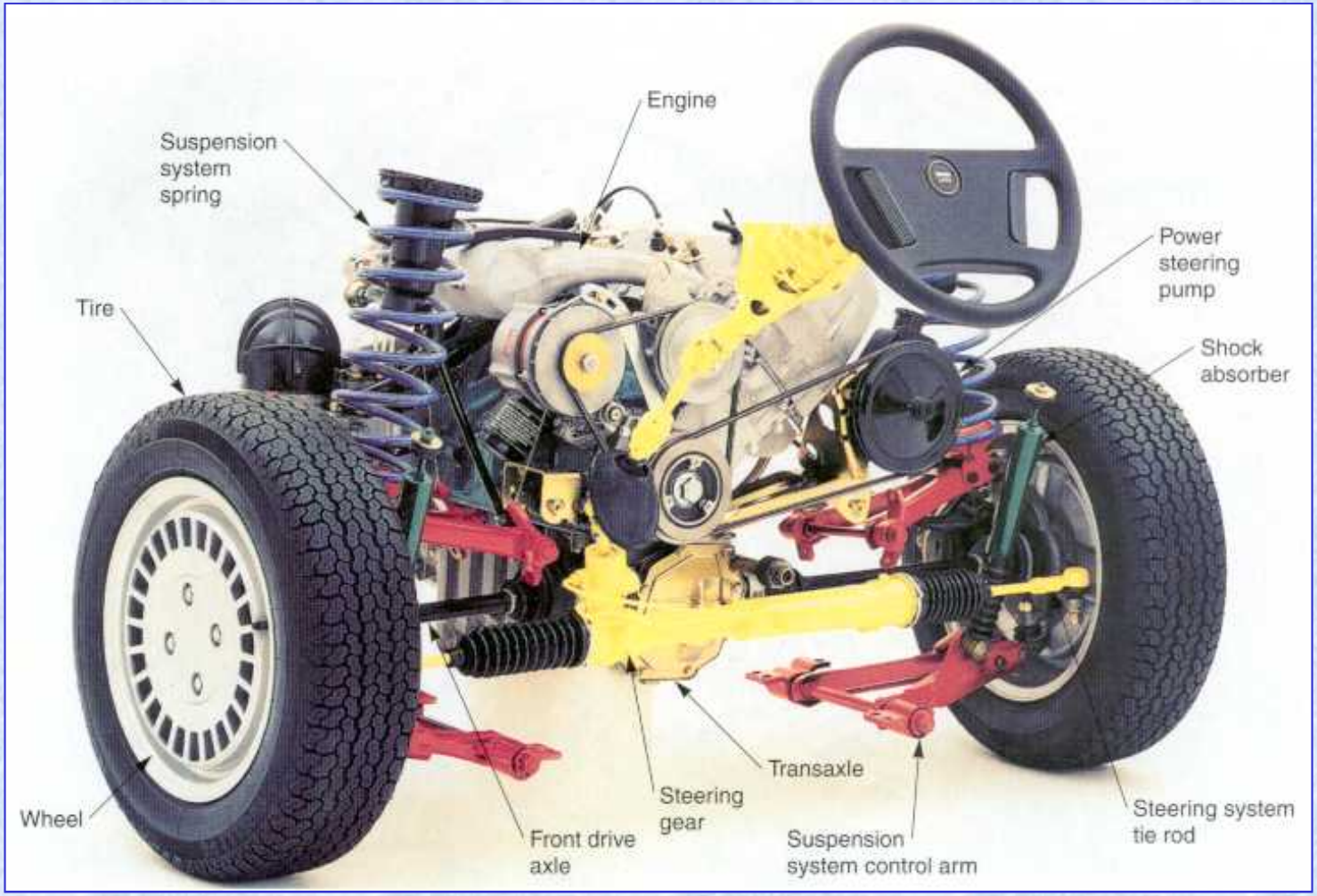
Suspension System

- Allows the vehicle's wheels and tires to move up and down with little effect on body movement
- Prevents excessive body lean when cornering quickly
- Various springs, bars, swivel joints, and arms make up the system

Steering System

- Allows the driver to control vehicle direction by turning the wheels right or left
- Uses a series of gears, swivel joints, and rods

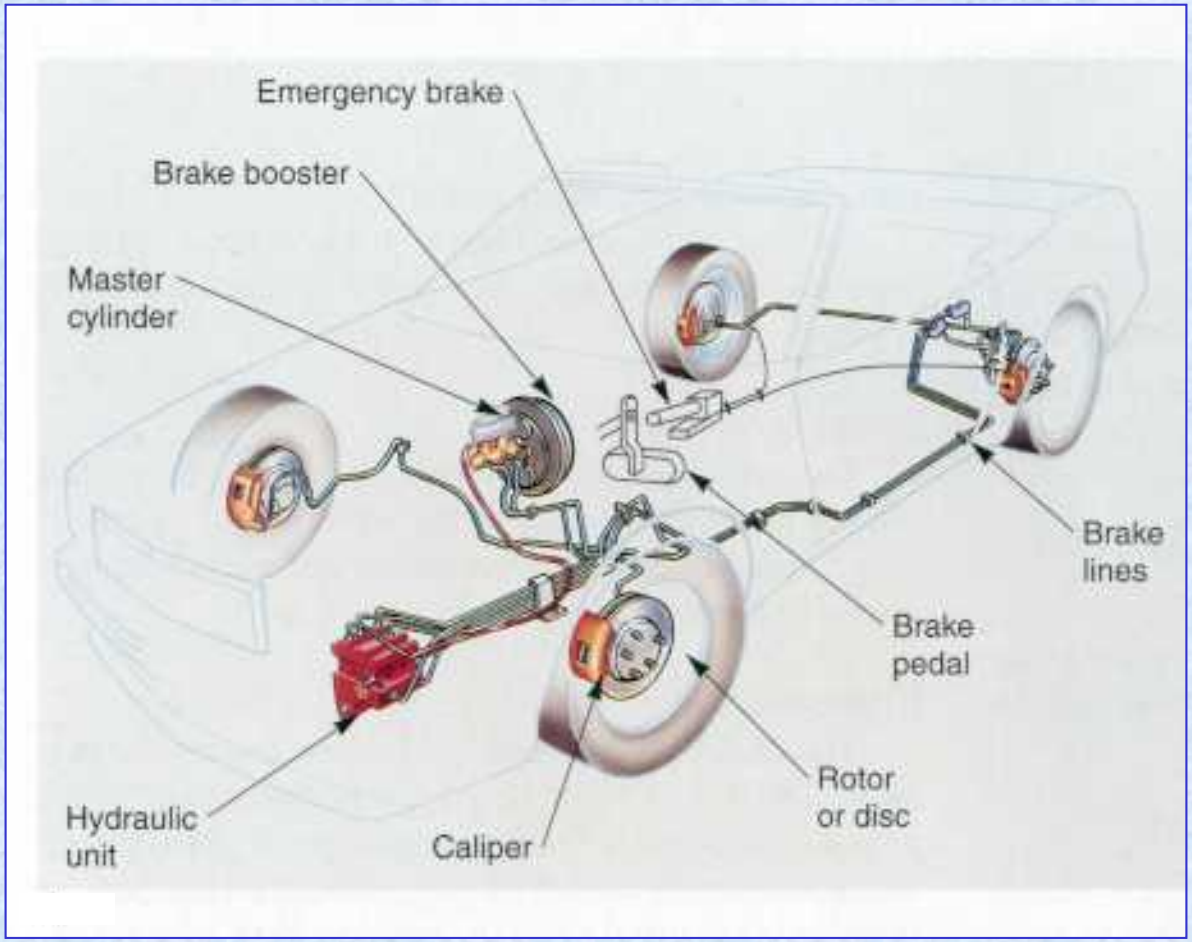
Suspension and Steering Systems



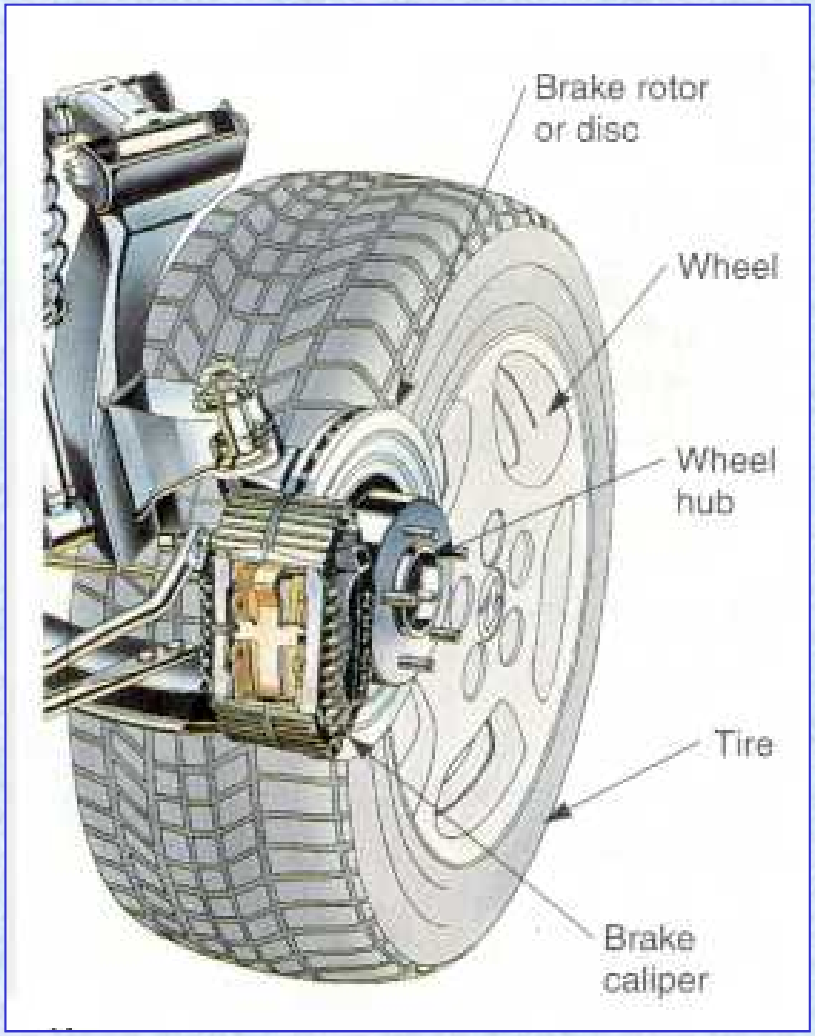
Brake System

- Produces friction to slow or stop the vehicle
- When the driver presses the brake pedal, fluid pressure actuates a brake mechanism at each wheel
- Mechanisms force friction material against metal discs or drums to slow wheel rotation

Complete Brake System



Wheel Brake Assembly



Accessory and Safety Systems

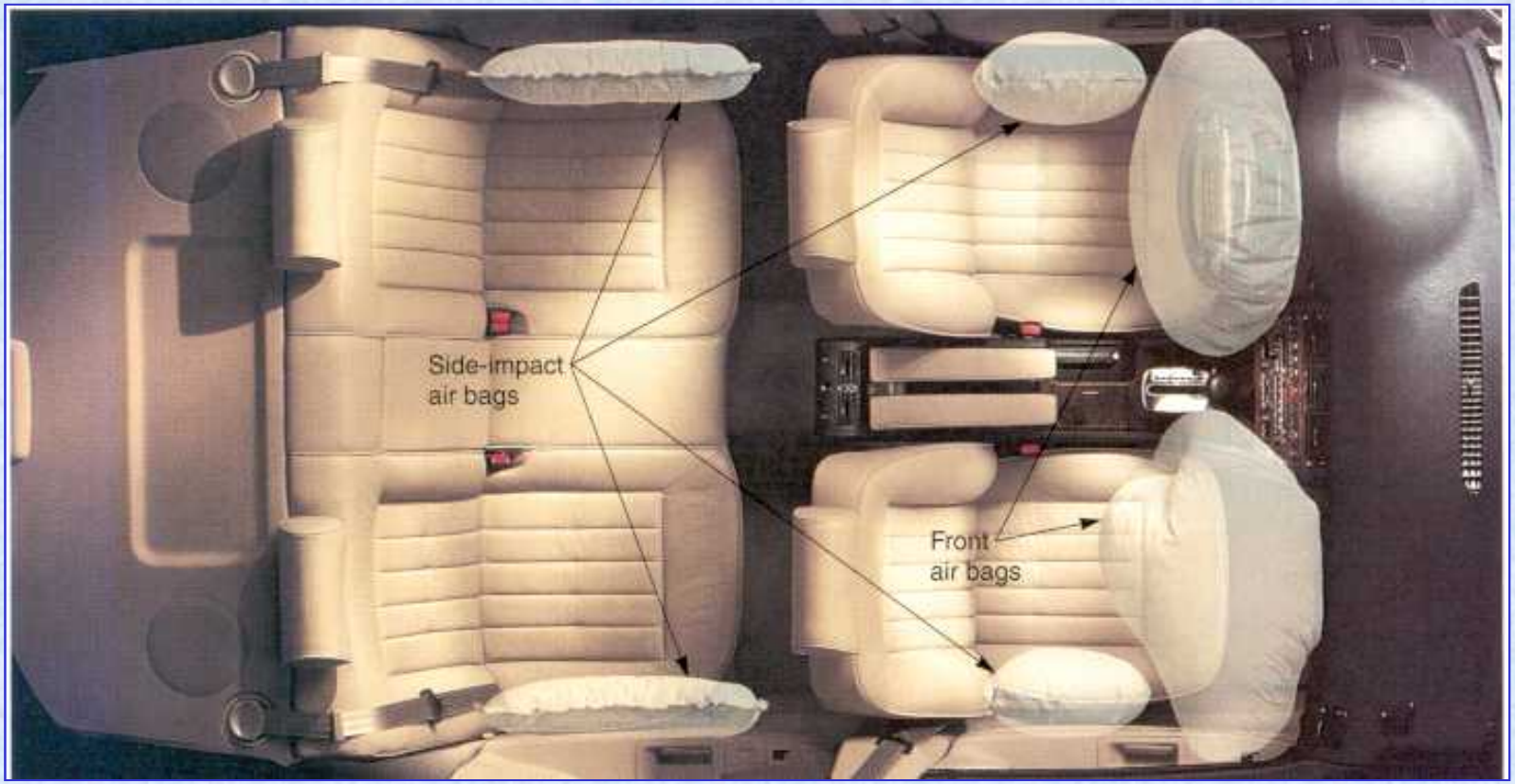
Accessory Systems

- Common accessory systems include:
  - air conditioner
  - sound system
  - power seats
  - power windows
  - rear window defogger

Safety Systems

- Common safety systems include:
  - seat belts
  - air bags
  - security systems

Safety Systems



This vehicle is equipped with front and side-impact air bags