FIGURE 6.1 A typical truck frame is an excellent example of a ladder-type frame. The two side members are connected by a crossmember.

FIGURE 6.2 Rubber cushions used in body or frame construction isolate noise and vibration from traveling to the passenger compartment.
FIGURE 6.3A Separate body and frame construction

FIGURE 6.3B Unitized construction: the small frame members are for support of the engine and suspension components.

FIGURE 6.4 Welded metal sections create a platform that combines the body with the frame using unit-body construction.
FIGURE 6.5 Solid I-beam axle with leaf springs.

FIGURE 6.6 When one wheel hits a bump or drops into a hole, both left and right wheels are moved. Because both wheels are affected, the ride is often harsh and feels stiff.

FIGURE 6.7 A typical independent front suspension used on a rear-wheel-drive vehicle. Each wheel can hit a bump or hole in the road independently without affecting the opposite wheel.
FIGURE 6.8 This spring was depressed 4 inch due to a weight of 2,000 lb. This means that this spring has a spring rate (K) of 500 lb per inch (2,000 ÷ 4 in. = 500 lb./in.).

FIGURE 6.9 The spring rate of a coil spring is determined by the diameter of the spring and the diameter of the steel used in its construction, plus the number of coils and the free length (height).

FIGURE 6.10 Coil spring ends are shaped to fit the needs of a variety of suspension designs.
FIGURE 6.11 A constant-rate spring compresses at the same rate regardless of the amount of weight that is applied.

FIGURE 6.12 Variable-rate springs come in a variety of shapes and compress more slowly as weight is applied.

FIGURE 6.13 Two springs, each with a different spring rate and length, can provide the same ride height even though the higher rate spring will give a stiffer ride.
**FIGURE 6.14** Stiffer springs bounce at a higher frequency than softer springs.

**FIGURE 6.15** The wheel and arm act as a lever to compress the spring.

**FIGURE 6.16** The spring cushion helps isolate noise and vibration from being transferred to the passenger compartment.
FIGURE 6.17 This replacement coil spring is coated to prevent rust and corrosion and colored to help identify the spring and/or spring manufacturer.

FIGURE 6.18 A typical leaf spring used on the rear of a pickup truck showing the plastic insulator between the leaves, which allows the spring to move without creating wear or noise.

FIGURE 6.19 A typical leaf spring installation. The longest leaf, called the main leaf, attaches to the frame through a shackle and a hanger.
FIGURE 6.20 All multileaf springs use a center bolt to not only hold the leaves together but also help retain the leaf spring in the center of the spring perch.

FIGURE 6.21 When a leaf spring is compressed, the spring flattens and becomes longer. The shackles allow for this lengthening.

FIGURE 6.22 Typical rear leaf—spring suspension of a rear-wheel-drive vehicle.
FIGURE 6.23 As the vehicle is loaded, the leaf spring contacts a section of the frame. This shortens the effective length of the spring, which makes it stiffer.

FIGURE 6.24 Many pickup trucks, vans, and sport-utility vehicles (SUVs) use auxiliary leaf springs that contact the other leaves when the load is increased.

FIGURE 6.25A A fiberglass spring is composed of long fibers locked together in an epoxy (resin) matrix.
FIGURE 6.25B When the spring compresses, the bottom of the spring expands and the top compresses.

FIGURE 6.26 A torsion bar resists twisting and is used as a spring on some cars and many four-wheel-drive pickup trucks and sport-utility vehicles.

FIGURE 6.27 Longitudinal torsion bars attach at the lower control arm at the front and at the frame at the rear of the bar.
FIGURE 6.28 One end of the torsion bar attaches to the lower control arm and the other to an anchor arm that is adjustable.

FIGURE 6.29 The spindle supports the wheels and attaches to the control arm with ball-and-socket joints called ball joints.

FIGURE 6.30 The strut rods provide longitudinal support to the suspension to prevent forward or rearward movement of the control arms.
FIGURE 6.31 The steering knuckle used on a short/long-arm front suspension.

FIGURE 6.32 A kingpin is a steel shaft or pin that joins the steering knuckle to the suspension and allows the steering knuckle to pivot.

FIGURE 6.33 Control arms are used to connect the steering knuckle to the frame or body of the vehicle and provide the structural support for the suspension system.
FIGURE 6.34 Ball joints provide the freedom of movement necessary for steering and suspension movements.

FIGURE 6.35 The upper ball joint is load carrying in this type of suspension because the weight of the vehicle is applied through the spring, upper control arm, and ball joint to the wheel.

FIGURE 6.36 The lower ball joint is load carrying in this type of suspension because the weight of the vehicle is applied through the spring, lower control arm, and ball joint to the wheel.
FIGURE 6.37 All ball joints, whether tension or compression loaded, have a bearing surface between the ball stud and socket.

FIGURE 6.38 A strut rod is the longitudinal support to prevent front-to-back wheel movement.

FIGURE 6.39 Strut rod bushings insulate the steel bar from the vehicle frame or body.
FIGURE 6.40 Typical stabilizer bar installation.

FIGURE 6.41 As the body of the vehicle leans, the stabilizer bar is twisted. The force exerted by the stabilizer bar counteracts the body lean.

FIGURE 6.42 Stabilizer bar links are sold as a kit consisting of the long bolt with steel sleeve and rubber bushings. Steel washers are used on both sides of the rubber bushings as shown.
FIGURE 6.43 A high-performance stabilizer bar that uses a urethane bushing instead of a rubber bushing used in most vehicles.

FIGURE 6.44 (a) Movement of the vehicle is supported by springs without a dampening device. (b) Spring action is dampened with a shock absorber. (c) The function of any shock absorber is to dampen the movement or action of a spring, similar to using a liquid to control the movement of a weight on a spring (d).

FIGURE 6.45 Shock absorbers work best when mounted as close to the spring as possible. Shock absorbers that are mounted straight up and down offer the most dampening.
FIGURE 6.46 When a vehicle hits a bump in the road, the suspension moves upward. This is called compression or jounce. Rebound is when the spring (coil, torsion bar, or leaf) returns to its original position.

FIGURE 6.47A A cutaway drawing of a typical double-tube shock absorber.

FIGURE 6.47B Notice the position of the intake and compression valve during rebound (extension) and jounce (compression).
**FIGURE 6.48** Oil flow through a deflected disc-type piston valve. The deflecting disc can react rapidly to suspension movement.

**FIGURE 6.49** Gas-charged shock absorbers are manufactured with a double-tube design similar to conventional shock absorbers and with a single or monotube design.

**FIGURE 6.50** A rubber tube forms an inflatable air chamber at the top of an air shock. The higher the air pressure in the chamber, the stiffer the shock.
FIGURE 6.51A The front suspension of a Lincoln with an air-spring suspension.

FIGURE 6.51B Always check in the trunk for the cutoff switch for a vehicle equipped with an air suspension before hoisting or towing the vehicle.

FIGURE 6.52 Some air springs are auxiliary units to the coil spring and are used to control ride height while the coil spring is the weight-bearing unit.
FIGURE 6.53 A coil-over shock is a standard hydraulic shock absorber with a coil spring wrapped around it to increase stiffness and/or take some of the carrying weight off of the springs.

FIGURE 6.54 The shock absorber is on the right and the fluid reservoir for the shock is on the left.

FIGURE 6.55 A strut is a structural part of the suspension and includes the spring and shock absorber in one assembly.
FIGURE 6.56 A modified strut used on the rear suspension; it is the structural part of the assembly.

FIGURE 6.57 Suspension bumpers are used on all suspension systems to prevent metal-to-metal contact between the suspension and the frame or body of the vehicle when the suspension “bottoms out” over large bumps or dips in the road.

FIGURE 6.58 A bad suspension bumper (strike-out bumper) that was likely caused by a defective shock absorber. Both will require replacement.