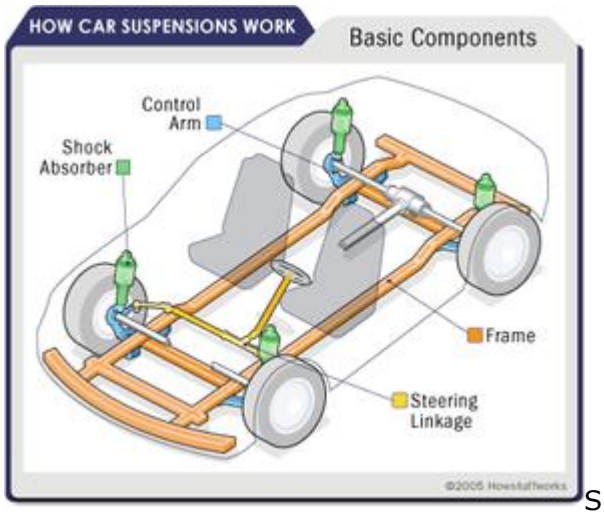
Car Suspension Parts



Suspension parts include springs, dampers and sway bars.

The suspension of a car is actually part of the chassis, which comprises all of the important systems located beneath the car's body. These systems include:

- The **frame**: structural, load-carrying component that supports the car's engine and body, which are in turn supported by the suspension
- The **suspension system**: setup that supports weight, absorbs and dampens shock and helps maintain tire contact
- The **steering system**: mechanism that enables the driver to guide and direct the vehicle
- The **tires and wheels**: components that make vehicle motion possible by way of grip and/or friction with the road

So the suspension is just one of the major systems in any vehicle.

With this big-picture overview in mind, it's time to look at the three fundamental components of any suspension: springs, dampers and sway bars.

Springs

Today's springing systems are based on one of four basic designs:

- **Coil springs** are the most common type of spring and is, in essence, a heavy-duty torsion bar coiled around an axis. Coil springs compress and expand to absorb the motion of the wheels.
- **Leaf springs** consist of several layers of metal (called "leaves") bound together to act as a single unit. Leaf springs were first used on horse-drawn carriages and were found on most American automobiles until 1985. They are still used today on most trucks and heavy-duty vehicles.
- **Torsion bars** use the twisting properties of a steel bar to provide coil-spring-like performance. This is how they work: One end of a bar is anchored to the vehicle frame. The other end is attached to a wishbone, which acts like a lever that moves

perpendicular to the torsion bar. When the wheel hits a bump, vertical motion is transferred to the wishbone and then, through the levering action, to the torsion bar. The torsion bar then twists along its axis to provide the spring force. European carmakers used this system extensively, as did Packard and Chrysler in the United States, through the 1950s and 1960s.

- **Air springs** consist of a cylindrical chamber of air positioned between the wheel and the car's body, and use the compressive qualities of air to absorb wheel vibrations. The technology is used in many luxury vehicles today, but the concept is actually more than a century old and could be found on horse-drawn buggies. Air springs from this era were made from air-filled, leather diaphragms, much like a bellows; they were replaced with molded-rubber air springs in the 1930s.

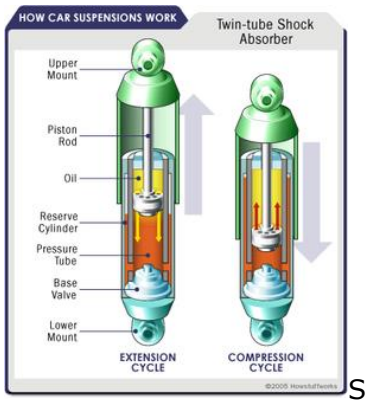
Based on where springs are located on a car — i.e., between the wheels and the frame — engineers often find it convenient to talk about the **sprung mass** and the **unsprung mass**.

Springs: Sprung and Unsprung Mass

The **sprung mass** is the mass of the vehicle supported on the springs, while the **unsprung mass** is loosely defined as the mass between the road and the suspension springs. The stiffness of the springs affects how the sprung mass responds while the car is being driven. Loosely sprung cars, such as luxury cars (think Mercedes-Benz C-Class), can swallow bumps and provide a super-smooth ride; however, such a car is prone to dive and squat during braking and acceleration and tends to experience body sway or roll during cornering. Tightly sprung cars, such as sports cars (think Mazda Miata MX-5), are less forgiving on bumpy roads, but they minimize body motion well, which means they can be driven aggressively, even around corners.

So, while springs by themselves seem like simple devices, designing and implementing them on a car to balance passenger comfort with handling is a complex task. And to make matters more complex, springs alone can't provide a perfectly smooth ride. Why? Because springs are great at absorbing energy, but not so good at **dissipating** it. Other structures, known as **dampers**, are required to do this.

Dampers: Shock Absorbers



Shocks, or shock absorbers, control unwanted spring motion through a process known as dampening.

Unless a **dampening structure** is present, a car spring will extend and release the energy it absorbs from a bump at an uncontrolled rate. The spring will continue to bounce at its

natural frequency until all of the energy originally put into it is used up. A suspension built on springs alone would make for an extremely bouncy ride and, depending on the terrain, an uncontrollable car.

Enter the **shock absorber**, or snubber, a device that controls unwanted spring motion through a process known as **dampening**. Shock absorbers slow down and reduce the magnitude of vibratory motions by turning the kinetic energy of suspension movement into heat energy that can be dissipated through hydraulic fluid. To understand how this works, it's best to look inside a shock absorber to see its structure and function.

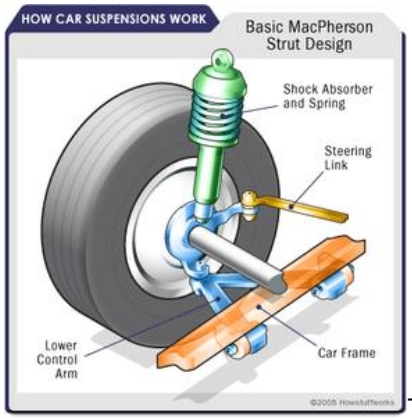
A shock absorber is basically an **oil pump** placed between the frame of the car and the wheels. The upper mount of the shock connects to the frame (i.e., the sprung weight), while the lower mount connects to the axle, near the wheel (i.e., the unsprung weight). In a **twin-tube design**, one of the most common types of shock absorbers, the upper mount is connected to a piston rod, which in turn is connected to a piston, which in turn sits in a tube filled with hydraulic fluid. The inner tube is known as the pressure tube, and the outer tube is known as the reserve tube. The reserve tube stores excess hydraulic fluid.

When the car wheel encounters a bump in the road and causes the spring to coil and uncoil, the energy of the spring is transferred to the shock absorber through the upper mount, down through the piston rod and into the piston. Holes perforate the piston and allow fluid to leak through as the piston moves up and down in the pressure tube. Because the holes are relatively tiny, only a small amount of fluid, under great pressure, passes through. This slows down the piston, which in turn slows down the spring.

Shock absorbers work in two cycles — the **compression cycle** and the **extension cycle**. The compression cycle occurs as the piston moves downward, compressing the hydraulic fluid in the chamber below the piston. The extension cycle occurs as the piston moves toward the top of the pressure tube, compressing the fluid in the chamber above the piston. A typical car or light truck will have more resistance during its extension cycle than its compression cycle. With that in mind, the compression cycle controls the motion of the vehicle's unsprung weight, while extension controls the heavier, sprung weight.

All modern shock absorbers are **velocity-sensitive** — the faster the suspension moves, the more resistance the shock absorber provides. This enables shocks to adjust to road conditions and to control all of the unwanted motions that can occur in a moving vehicle, including bounce, sway, brake dive and acceleration squat.

Dampers: Struts and Sway Bars



This illustration shows common strut design.

Another common dampening structure is the **strut** — basically a shock absorber mounted inside a coil spring. Struts perform two jobs: They provide a **dampening** function like shock absorbers, and they provide **structural support** for the vehicle suspension. That means struts deliver a bit more than shock absorbers, which don't support vehicle weight — they only control the speed at which weight is transferred in a car, not the weight itself.

Because shocks and struts have so much to do with the handling of a car, they can be considered critical safety features. Worn shocks and struts can allow excessive vehicle-weight transfer from side to side and front to back. This reduces the tire's ability to grip the road, as well as handling and braking performance.

Sway Bars

Sway bars (also known as anti-roll bars) are used along with shock absorbers or struts to give a moving automobile additional stability. A sway bar is a metal rod that spans the entire axle and effectively joins each side of the suspension together.

When the suspension at one wheel moves up and down, the sway bar transfers movement to the other wheel. This creates a more level ride and **reduces vehicle sway**. In particular, it combats the roll of a car on its suspension as it corners. For this reason, almost all cars today are fitted with sway bars as standard equipment, although if they're not, kits make it easy to install the bars at any time.

https://auto.howstuffworks.com/car-suspension.htm#pt1