

How an engine works

YES Electric • a plain-language course for shop helpers and car buyers

First edition (October 2026). Prices and hours in this course are rough numbers for a 2008–2016 sedan and will change by car and by year. Treat them as a guide for deciding, not a quote.

An engine is a metal box that makes thousands of tiny explosions a minute and uses the push from each one to spin a shaft. Here is how, piece by piece.

The box and the holes. Picture a heavy block of metal with four round holes drilled down into it, like four coffee cans standing side by side. Those holes are the cylinders. Most cars have four, trucks have six or eight.

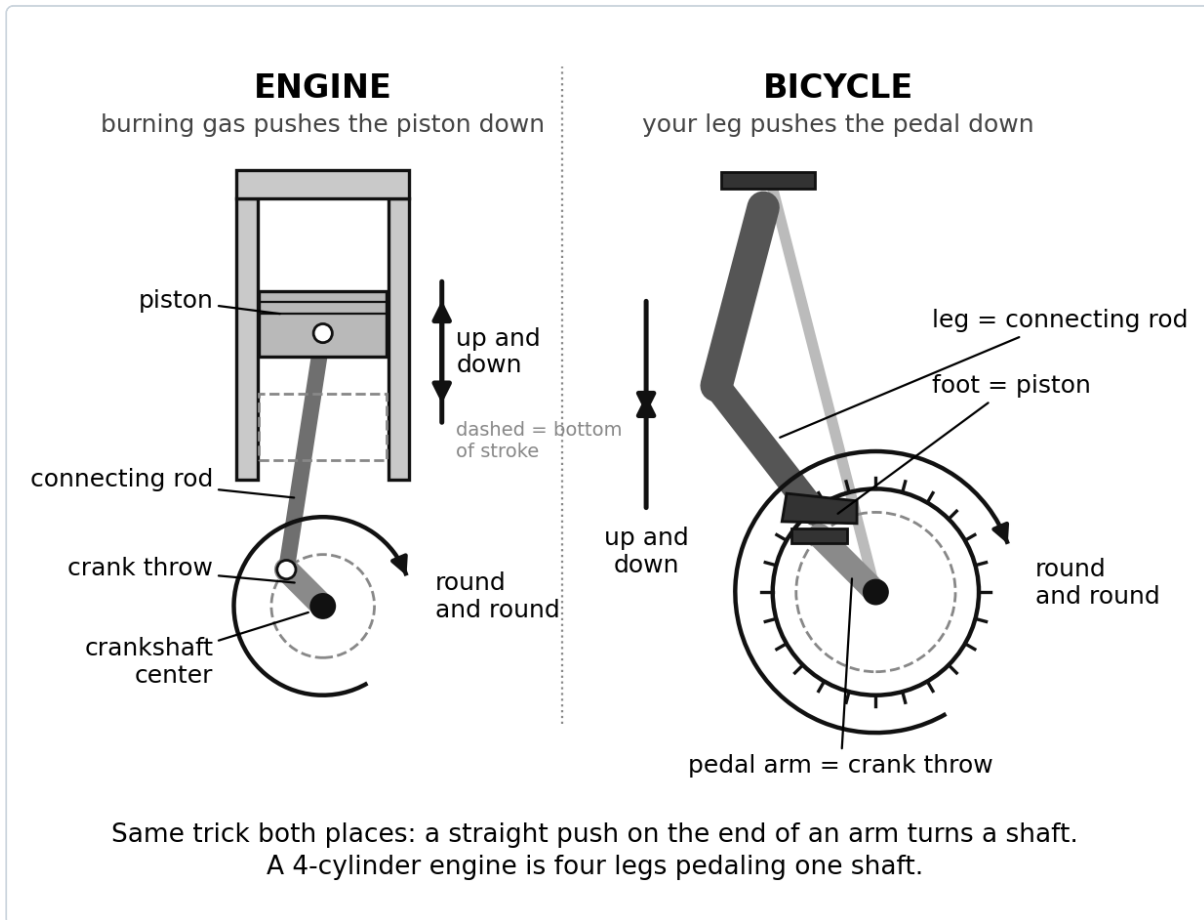
The pistons. In each hole sits a metal plug that fits snug, called a piston. It can slide up and down inside the hole, like a plunger in a syringe. Rings around its edge keep it sealed tight against the wall so nothing leaks past.



A new engine piston. The three thin grooves near the top hold the piston rings, which seal against the cylinder wall and scrape oil. The hole through the side is where the wrist pin goes to attach the connecting rod.

Photo: File:Nüral piston H268X -3985.jpg by Raimond Spekking, CC BY-SA 4.0.

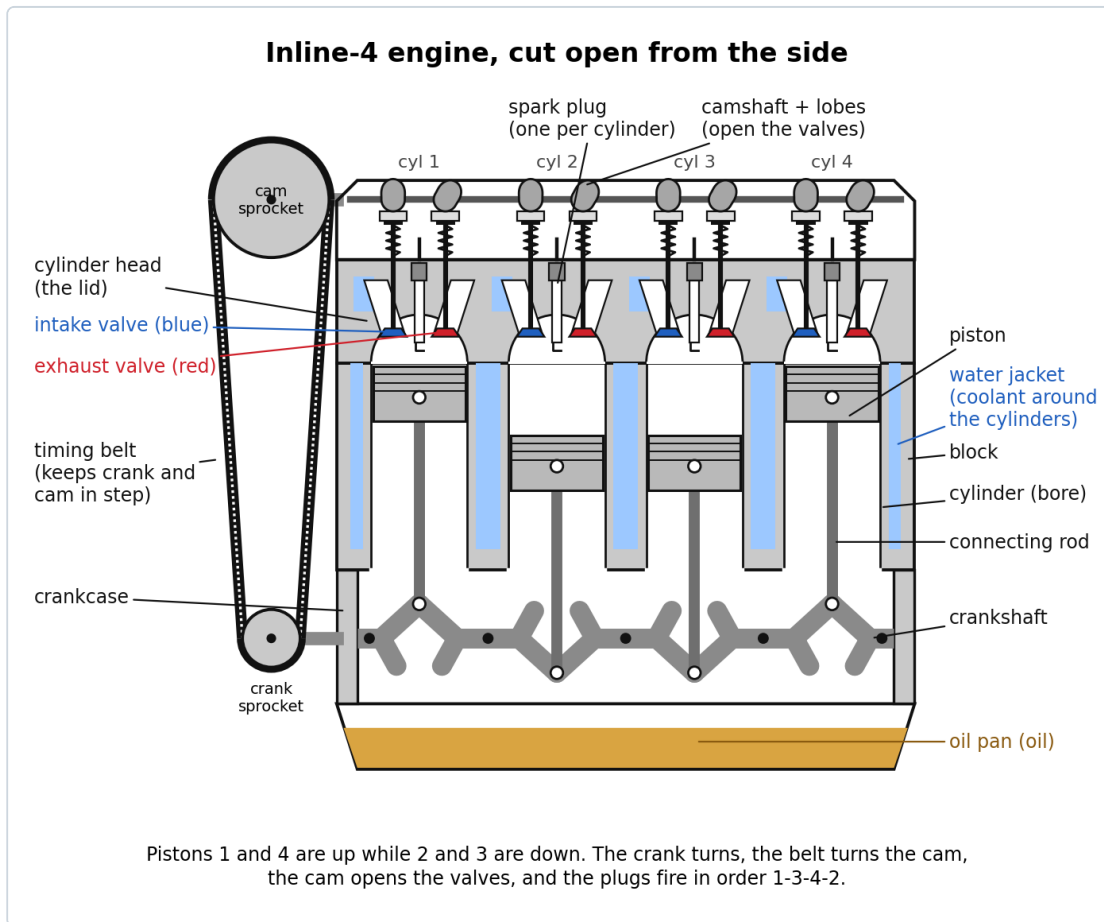
The crankshaft. Each piston has a rod hanging off the bottom of it, and that rod hooks onto a bent shaft lying across the bottom of the engine. Think of a bicycle. Your legs go up and down, but because they push on a bent pedal arm, the pedals go round and round. The crankshaft is the bent pedal arm. When a piston shoves down, it turns the crank. When the crank keeps turning, it pushes the piston back up.



A piston on a crank throw next to a leg on a bicycle pedal. In both, a straight up-and-down push on the end of an arm turns a shaft round and round.

Drawing made for this course.

The lid. On top of the block is another chunk of metal called the head. It caps every cylinder. In the head over each cylinder are two or four little doors called valves, and one spark plug. One door lets stuff in, the other lets stuff out. A thin seal between the block and the head, the head gasket, keeps everything inside.



An inline-4 engine cut open from the side: four pistons on one crankshaft, the head with its valves, cam and spark plugs on top, oil in the pan at the bottom, and the timing belt on the end linking crank to cam. Blue strips are the water jacket.

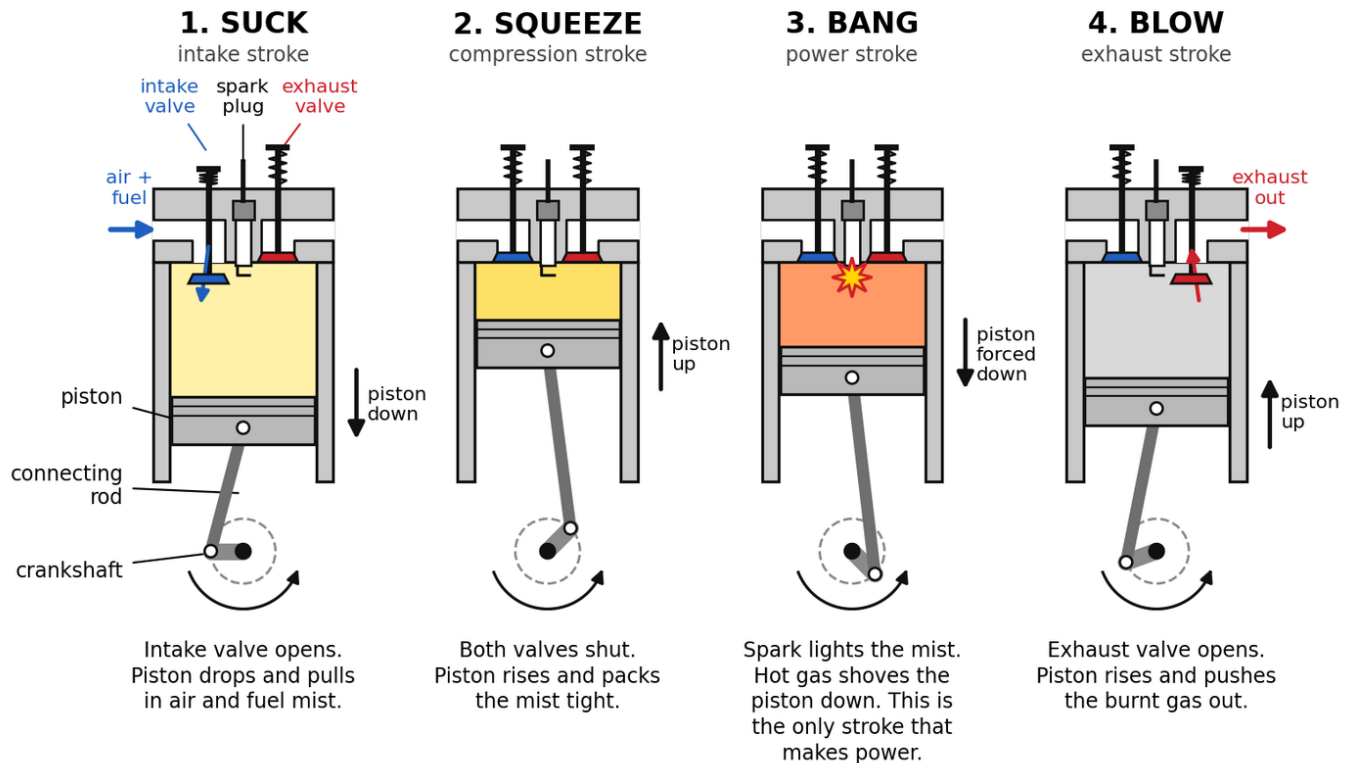
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The four steps. Every cylinder repeats the same four moves, over and over. Mechanics call it suck, squeeze, bang, blow.

1. **Suck.** The piston slides down. The "in" door opens, and the piston pulls in a mist of air mixed with a tiny bit of gas, like pulling back a syringe.
2. **Squeeze.** The door shuts. The piston slides up and crushes that mist into a space about one-tenth the size. Squeezing it makes it hot and packed tight, ready to burn fast.
3. **Bang.** At the very top, the spark plug makes a spark. The mist explodes. The explosion shoves the piston down hard. This is the only step that makes power. The other three are just setup.
4. **Blow.** The "out" door opens. The piston slides back up and pushes the burned smoke out into the exhaust pipe. Then the door shuts and it starts over with suck.

The piston goes down, up, down, up. The crankshaft turns twice for every one bang in a cylinder.

One cylinder, four strokes. The crank turns twice to do all four.

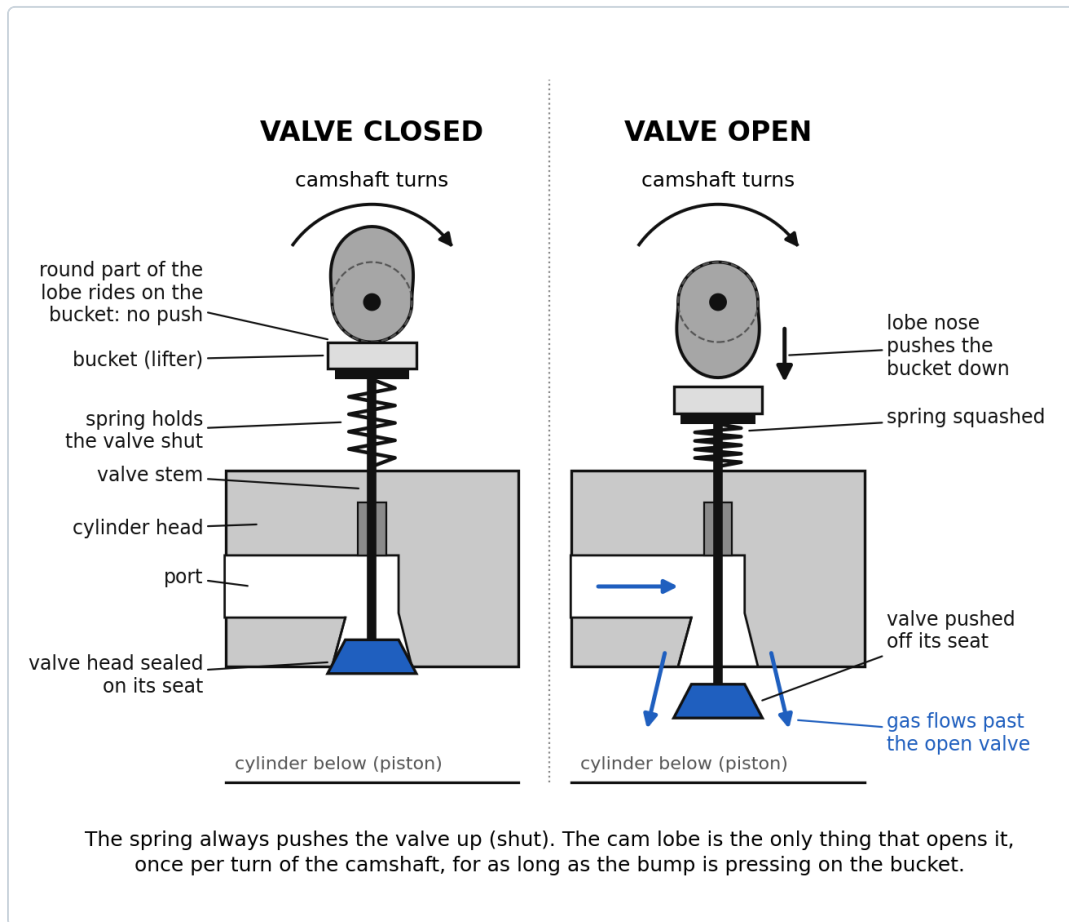


The four strokes of one cylinder: suck (intake valve open, piston down), squeeze (both valves shut, piston up), bang (spark fires, piston forced down) and blow (exhaust valve open, piston up). Only the bang stroke makes power.

Drawing made for this course.

Why it runs smooth. With four cylinders, they take turns. While one is on bang, another is on suck, another on squeeze, another on blow. There is always one pushing, so the crankshaft never stops spinning. At idle it spins about 700 times a minute. On the highway, about 2,500. A heavy metal wheel on the end of the crank, the flywheel, keeps it coasting between pushes, like a spinning top.

The doors need a clock. The valves have to open at exactly the right moment. A second shaft up in the head, the camshaft, has bumps on it. As it turns, each bump pushes a valve open and lets it snap shut. The camshaft is tied to the crankshaft by the timing belt or chain, so they always stay in step, like two gears on a clock. If the belt breaks, the doors are open when the piston comes up, and the piston hits them. That ruins the engine.



A camshaft lobe and a valve, shown closed and open. The spring keeps the valve shut; the lobe's bump pushes the bucket and valve down once per turn, and gas flows past the open valve head.

Drawing made for this course.



Two engine valves bent after a timing chain broke. With the chain gone, the pistons came up and hit the open valves, bending their stems. The valve on the right shows the bend clearly.

Photo: File:Ventile nach Kettenriss.JPG by KarleHorn, CC BY-SA 4.0.

Getting the gas in. The fuel pump in the tank pushes gas to the engine. Little nozzles called injectors, one per cylinder, squirt a fine mist right as the piston sucks. The computer decides how much, based on how hard you push the pedal and what the sensors say.

Making the spark. The battery gives low power. The coil turns it into a very high jolt, and the spark plug is where that jolt jumps a tiny gap, making a spark like static electricity but much hotter. The computer fires it at the exact instant the piston reaches the top, using the crank sensor to know where the piston is.

Keeping it from melting. Thousands of explosions a minute make heat that would melt the metal. Water passages run all through the block and head. The water pump keeps water flowing through them, out to the radiator at the front where the wind cools it, and back. The thermostat holds the water inside until the engine warms up, then opens.

Keeping it from grinding. Every moving part has metal sliding on metal. The oil pan at the bottom holds a few quarts of oil, and the oil pump sprays it everywhere, so the parts slide on a thin film of oil and never actually touch. Run it dry and the parts heat up, swell, and weld themselves together. That is a seized engine, and it is why a \$1,500 car with no oil is worth scrap.

Where the power goes. The crankshaft sticks out the back of the engine into the transmission, which sends the spin to the wheels. The front of the crank has a pulley that spins a belt, and that belt turns the alternator, the water pump, the power steering pump, and the air conditioner.

What the mechanic checks. A compression test screws a gauge into the spark plug hole and cranks the engine. A healthy cylinder squeezes to about 150 to 200 pounds per square inch. If one cylinder reads 0, the squeeze is leaking out, meaning a broken ring, a bent valve, or a hole in the head gasket. That is the test the plan says to do before buying any car, because it tells you whether the explosion box is still sealed.



A compression gauge in use. The hose screws into a spark plug hole, and when the engine is cranked the needle shows how much pressure that cylinder can build. Low or uneven readings point to worn rings, bad valves, or a head gasket leak. This test is on an outboard motor, but the tool and the method are the same on a car.

Photo: File:Compression Testing of a Mercury Verado Outboard Engine During and Engine Survey.jpg by Suenosazules, CC BY-SA 4.0.

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