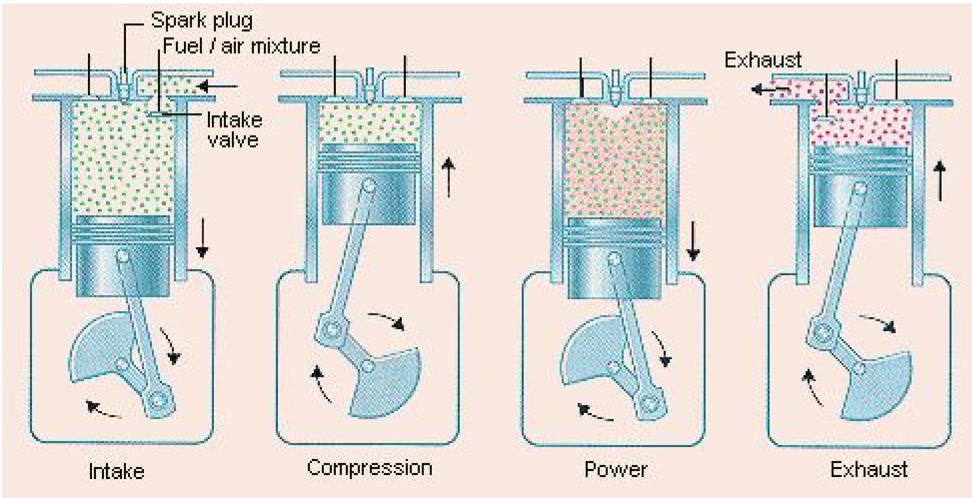
An internal combustion engine provides a good example of the ease with which gases can be compressed. In a typical four-stroke engine, the piston is first pulled out of the cylinder to create a partial vacuum, which draws a mixture of gasoline vapor and air into the cylinder (see figure below). The piston is then pushed into the cylinder, compressing the gasoline/air mixture to a fraction of its original volume.



The operation of a four-stroke engine can be divided into four cycles: intake, compression, power, and exhaust stages.

The ratio of the volume of the gas in the cylinder after the first stroke to its volume after the second stroke is the *compression ratio* of the engine. Modern cars run at compression ratios of about 9:1, which means the gasoline-air mixture in the cylinder is compressed by a factor of nine in the second stroke. After the gasoline/air mixture is compressed, the spark plug at the top of the cylinder fires and the resulting explosion pushes the piston out of the cylinder in the third stroke. Finally, the piston is pushed back into the cylinder in the fourth stroke, clearing out the exhaust gases.
Liquids are much harder to compress than gases. They are so hard to compress that the hydraulic brake systems used in most cars operate on the principle that there is essentially no change in the volume of the brake fluid when pressure is applied to this liquid. Most solids are even harder to compress. The only exceptions belong to a rare class of compounds that includes natural and synthetic rubber. Most rubber balls that seem easy to compress, such as a racquetball, are filled with air, which is compressed when the ball is squeezed.

Because most gases are difficult to observe directly, they are described through the use of four physical properties or macroscopic characteristics: **pressure**, **volume**, number of **particles** (chemists group them by **moles**) and **temperature**.