

temperature is nothing but molecules moving faster, pressure is nothing but them hitting the wall

The molecular picture of matter

- matter is made of atoms and molecules in **constant, random motion**, never actually at rest
- ideal gas model: molecules are point-sized, exert no force except during a collision
- every collision is taken as **perfectly elastic**, the simplification the whole chapter rests on

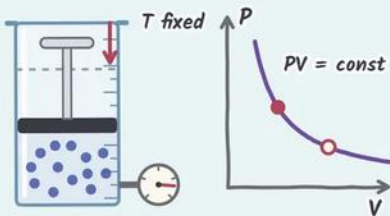
The ideal gas equation, n moles

$$PV = nRT$$

T fixed (Boyle's law)	→ pressure and volume trade off	$PV = \text{constant}$
P fixed (Charles' law)	→ volume tracks temperature	$\frac{V}{T} = \text{constant}$
V fixed (Gay-Lussac's law)	→ pressure tracks temperature	$\frac{P}{T} = \text{constant}$

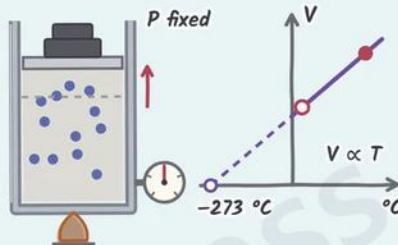
each named gas law is just this equation with **one variable held fixed**

The three gas laws in a cylinder

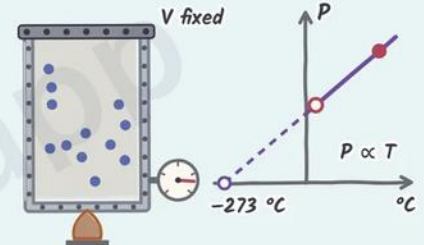


glass syringe

Boyle, T fixed, in a glass syringe: pushed in, the gauge rises; along the curve PV stays constant



Charles, P fixed by a loaded free piston in a steel cylinder: heated, the piston rises; $V \propto T$



Gay-Lussac, V fixed in a sealed, riveted steel vessel: heated, the gauge rises; $P \propto T$

T fixed: the molecules keep their speed, but squeezed into less room they reach a wall more often, so P rises. P fixed: heated molecules hit harder, so the loaded piston rises until P is back to its value. V fixed: hotter molecules hit harder and more often, so P rises. Run either straight line back and it reaches zero at **absolute zero**, -273.15°C