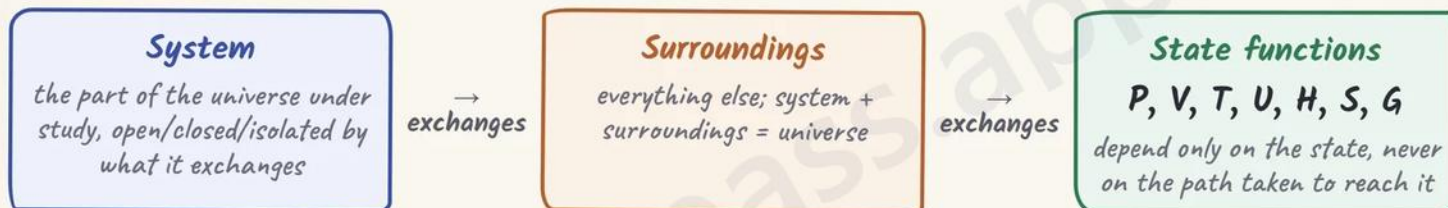
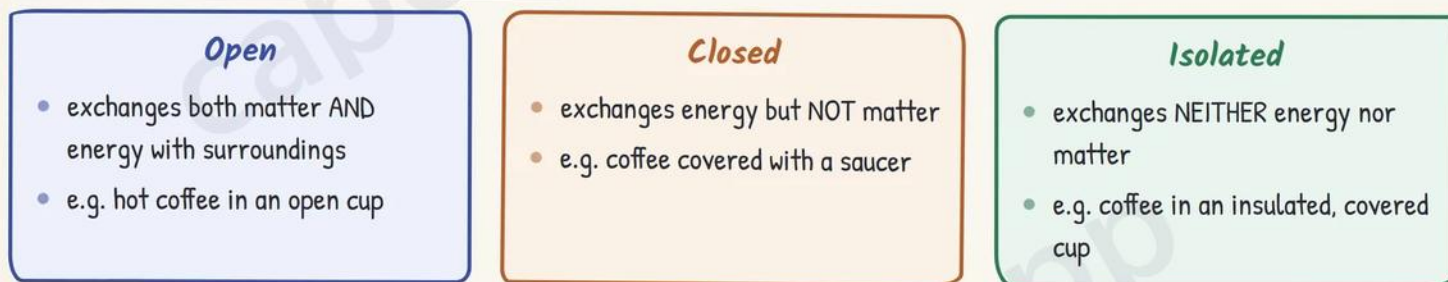


system, surroundings, and the two laws that decide how much energy moves and whether it moves at all



and back: W and Q are PATH functions, not state functions, which is exactly why the first law needs both of them

Open, Closed and Isolated Systems



extensive property depends on the amount of matter present (mass, volume, U, H, S , heat capacity); intensive property doesn't (P, T , density, viscosity, specific heat)

Processes, by What Stays Fixed *

- isothermal: T constant, so $\Delta T=0$ and $\Delta U=0$ for an ideal gas
- isobaric: P constant, $\Delta P=0$; most lab reactions in open vessels are isobaric
- isochoric: V constant, $\Delta V=0$; a reaction in a sealed closed container
- adiabatic: no heat exchange, $Q=0$; the system is fully insulated
- reversible: driving force P exceeds opposing P_{ext} by an infinitesimal amount always
- proceeds in infinite tiny steps, reverses on an infinitesimal change of conditions
- a real process is irreversible (spontaneous) by comparison

Pressure-Volume Work

work against a constant external pressure $W = -P_{\text{ext}}\Delta V = -P_{\text{ext}}(V_2 - V_1)$

free expansion: expansion against zero opposing force, e.g. into vacuum $P_{\text{ext}}=0 \Rightarrow W=0$

unit conversion $1 \text{ dm}^3 \text{ bar} = 100 \text{ J}$

sign convention: $+Q$ heat absorbed by system, $-Q$ heat released; $+W$ work done ON the system by surroundings, $-W$ work done BY the system. On expansion ($V_2 > V_1$) the system does work so W is negative; on compression W is positive

