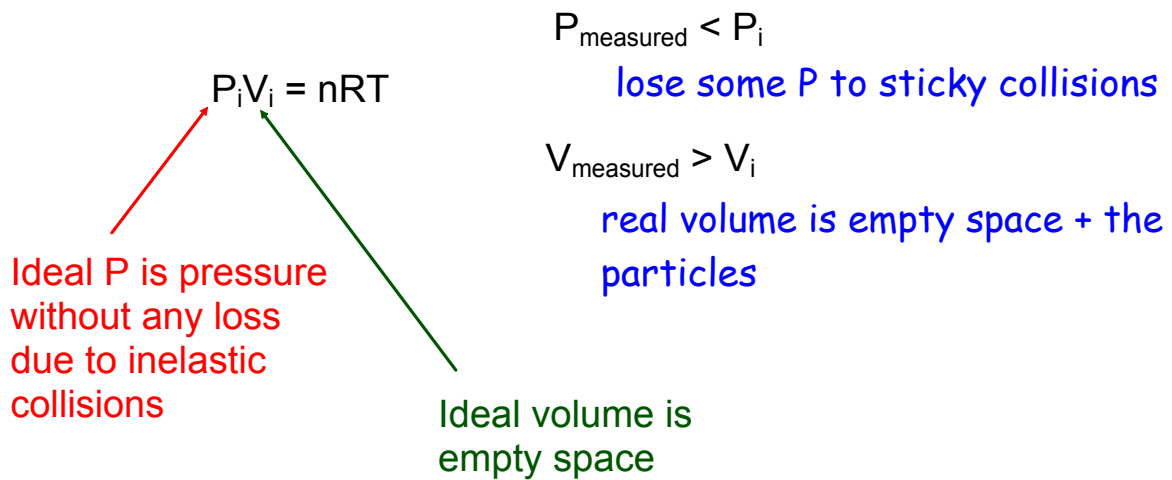


## Non-ideal behavior - the math



van der Waal's equation:  
 $(P_m + a(n/V)^2)(V_m - nb) = nRT$

$a$  = stickiness factor  
 $(n/V)$  = density, density<sup>2</sup> is proportional to # of collisions

$b$  = molar volume of particles, so  $nb$  is volume that the particles take up



drop jaw

$V$  in mouth up,  $P$  in mouth down


$P(\text{straw}) > P(\text{mouth})$ ...so air pushed into mouth

$n(\text{straw})$  down, so  $P(\text{straw})$  down

now  $P(\text{outside}) > P(\text{straw})$ , so...

liquid is pushed up straw from outside

$P_{in} = P_{out}$  (there's a hole)



flip...

F of air down (inside) = F up (outside), so...gravity wins and a SMALL amount of JJ comes out


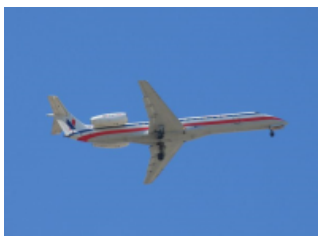
but...

as JJ leaves,  $V_{inside}$  goes up, so  $P_{in}$  goes down, until...


total  $F_{down}$  (air inside + gravity) =  $F_{up}$

however...

If you open another hole at the top... air can move in, so...  $P_{in} = P_{out}$ , and gravity is again the unbalanced force... JJ comes out.

+



good idea?  
bad idea?

If a hole is blown in the side of the plane (or, less violently) someone opens a door...

people do NOT get sucked out of the plane!

$P_{in \text{ the plane}} > P_{outside \text{ the plane}}$ , so the air is pushed out and other things (laptops, papers, house cats) can get pushed along with it.

when enough air has left the plane so that the  $P_{in}$  and  $P_{out}$  are equal, there is no overall force in either direction

