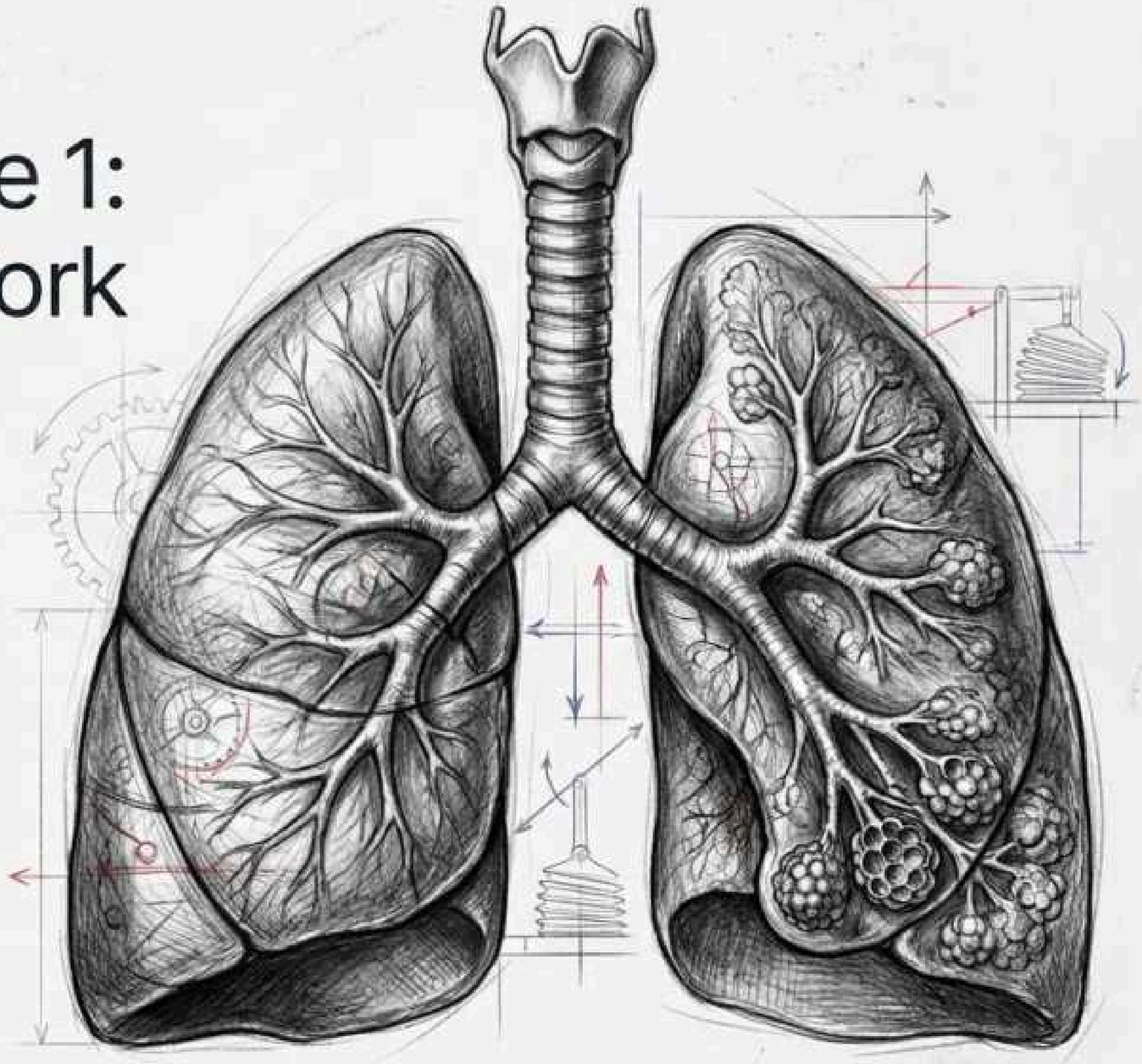
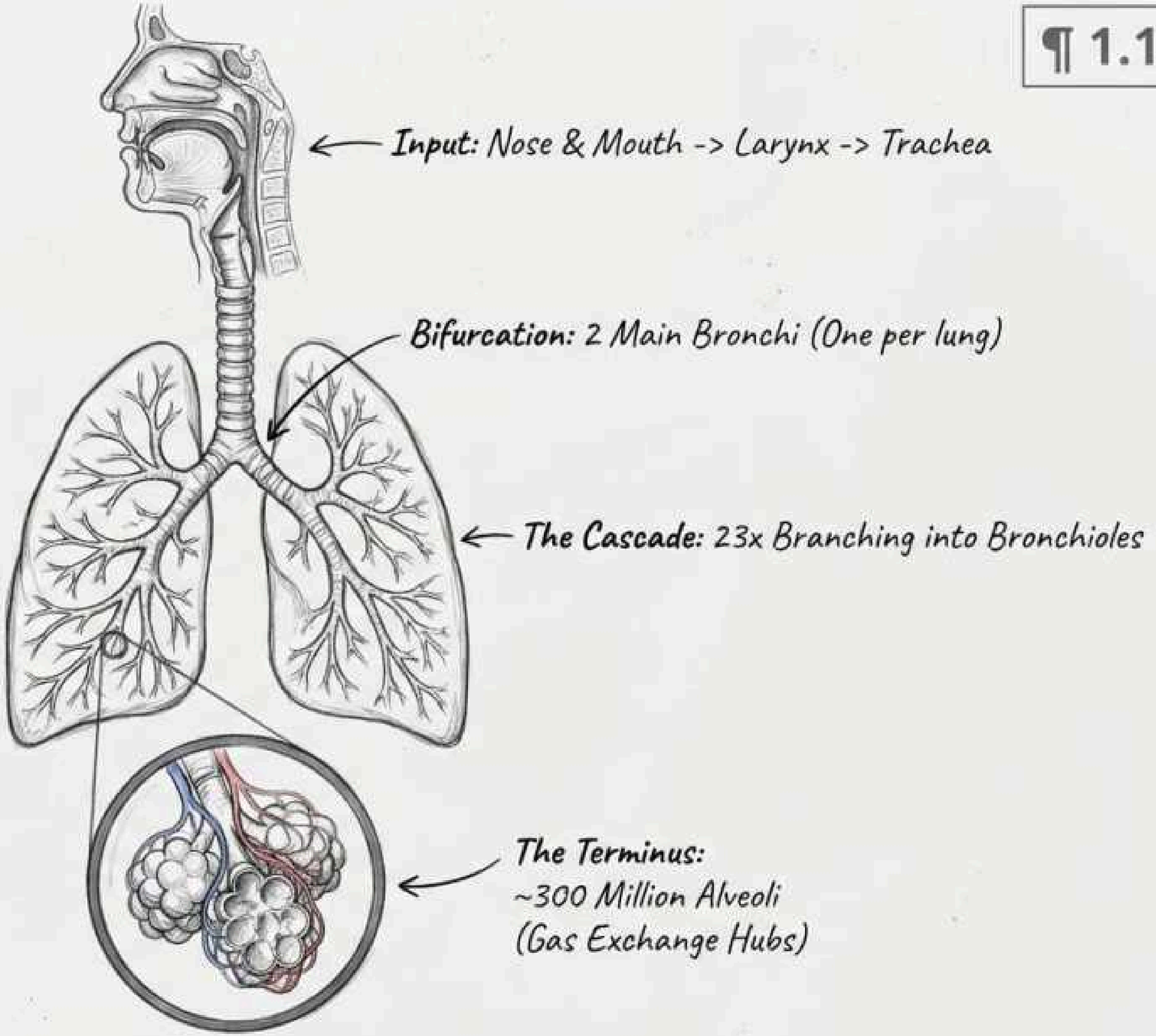
MED 522 B Lecture 1: How the Lungs Work

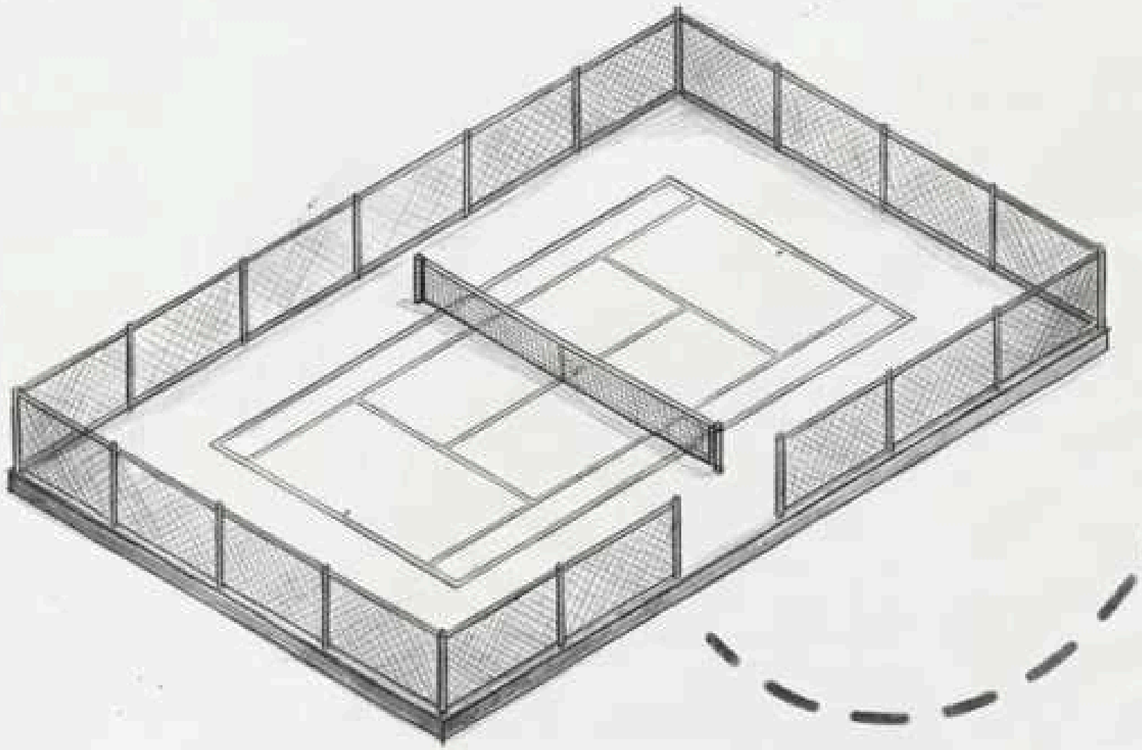
Form, Function, and the Mechanics of Breathing



¶ 1.1

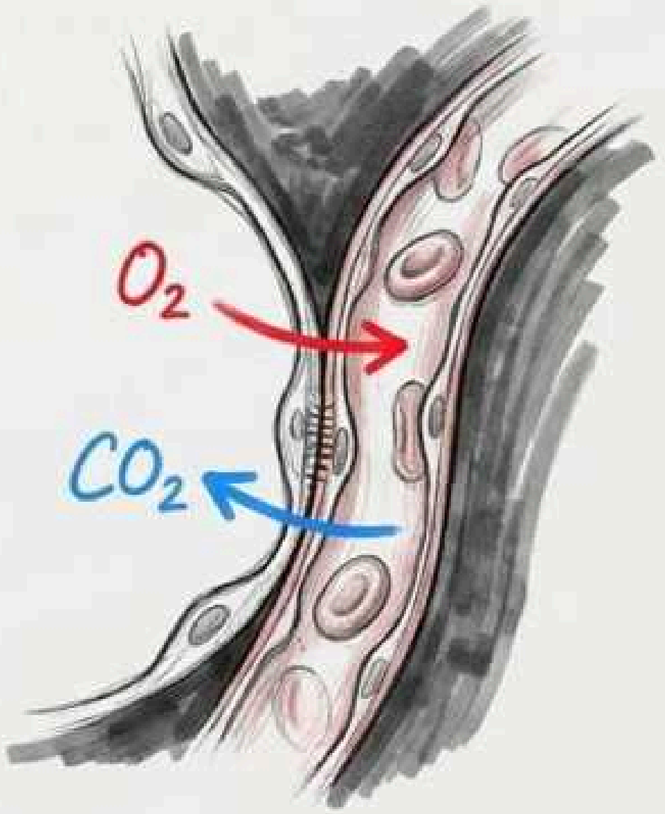

Input: Nose & Mouth -> Larynx -> Trachea
Bifurcation: 2 Main Bronchi (One per lung)
The Cascade: 23x Branching into Bronchioles
The Terminus:
~300 Million Alveoli
(Gas Exchange Hubs)

Macro



Total Surface Area ≈ 1 Tennis Court

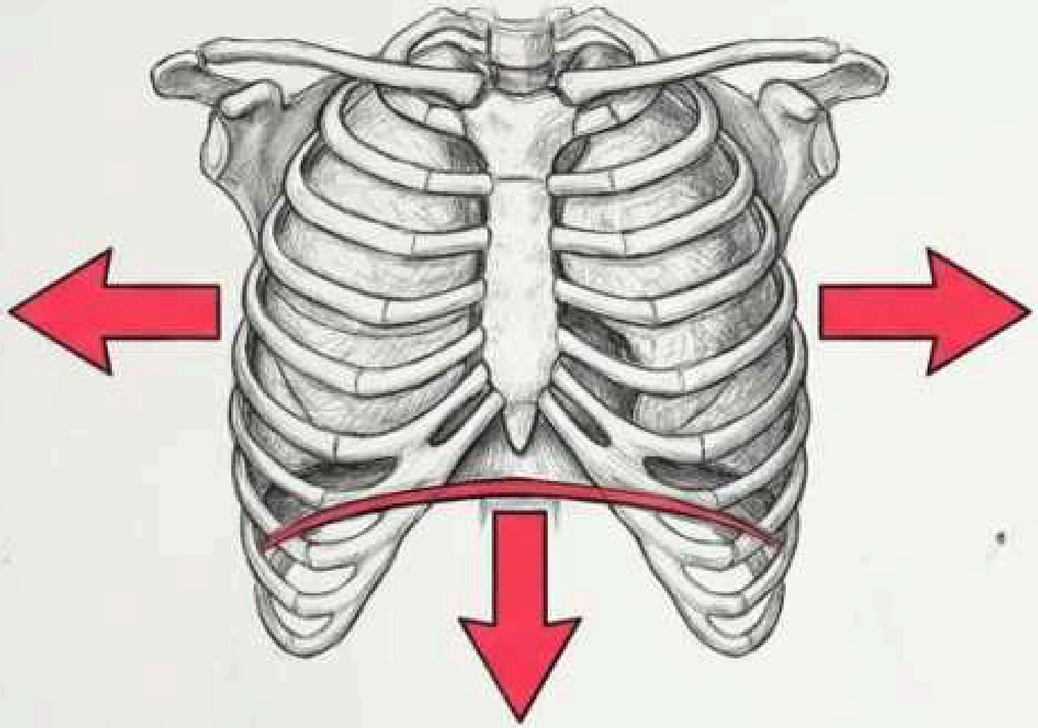
Micro



Barrier Thickness < 0.001 mm

Vast Area + Razor-Thin Barrier = Rapid Gas Diffusion

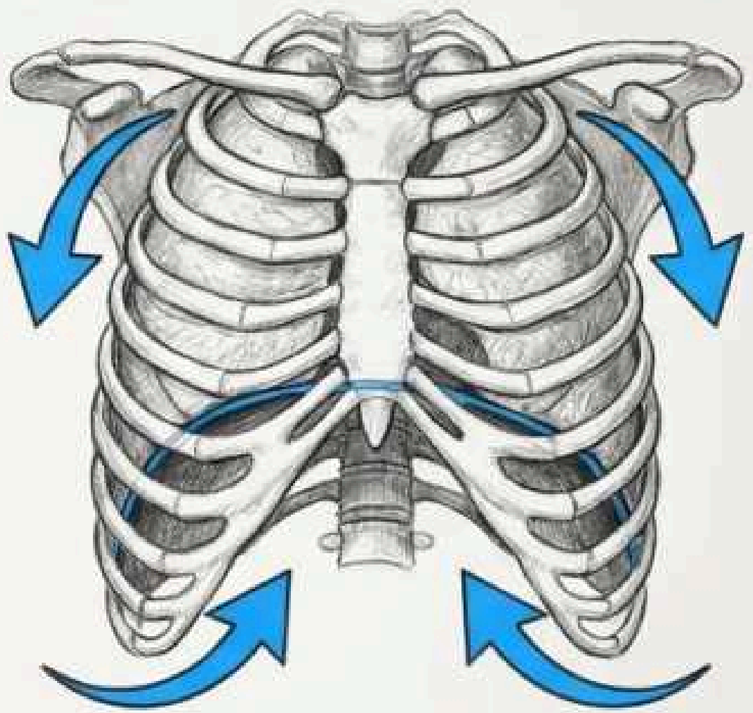
Active Phase



Muscle Contraction.
Volume ↑, Pressure ↓

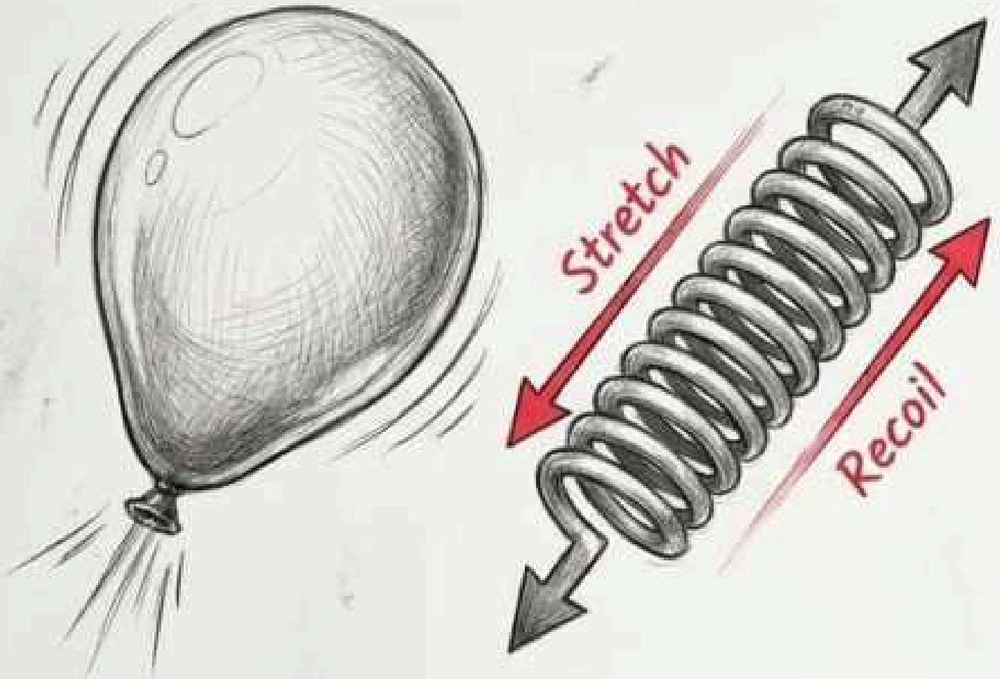
$$P_{int} < P_{ext}$$

Passive Phase
(Quiet breathing)



Elastic Recoil.
Volume ↓, Pressure ↑

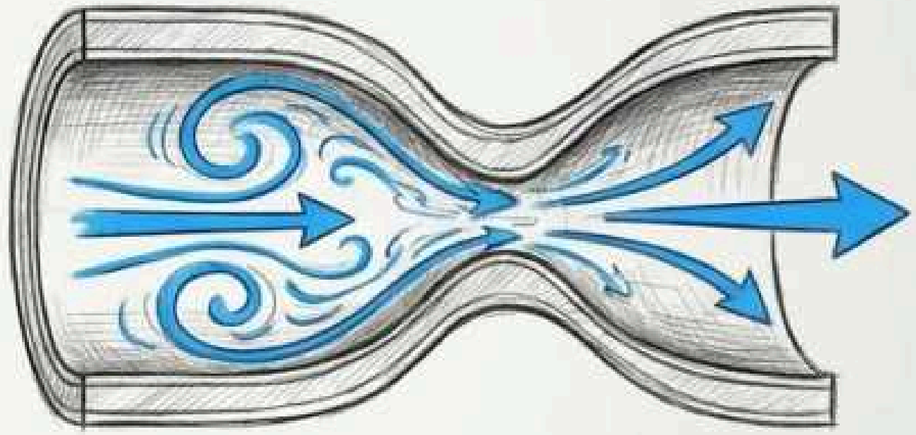
Compliance
(Tissue Stretchability)



Describes how easily lungs stretch.

Clinical Hurdle: Stiff, scarred lungs = Low compliance (requires more effort to fill).

Airway Resistance
(Tube Restriction)

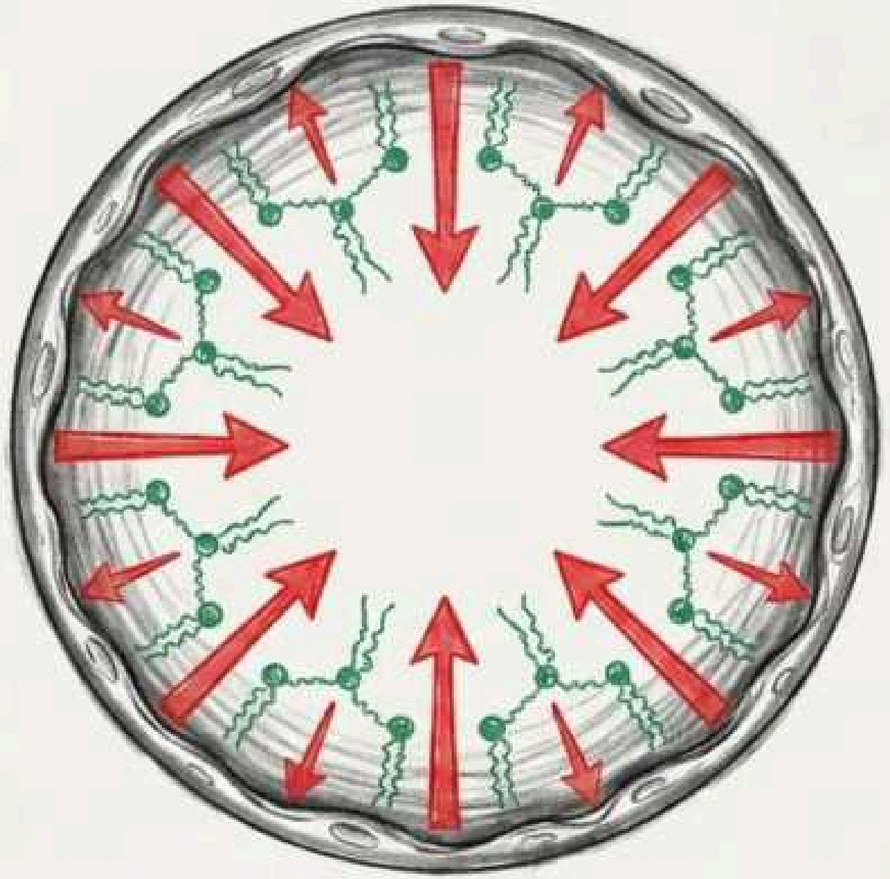


Describes how hard it is to push air through airways.

Physics Analog: Like blood flow, resistance rises sharply as the diameter narrows.

¶ 1.5

$$P = \frac{2T}{r}$$

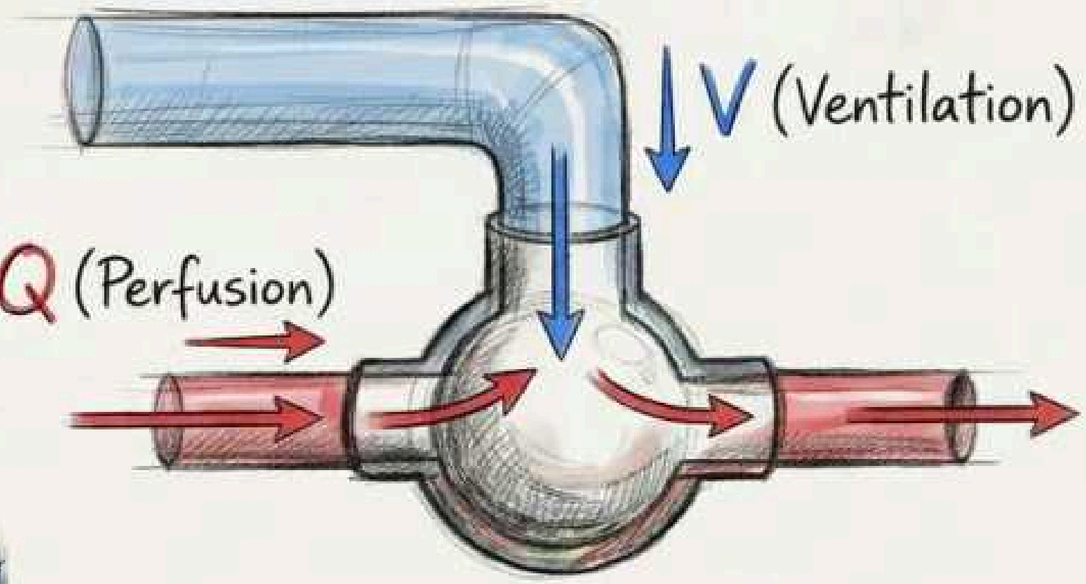


The Solution: Surfactant (produced by alveolar wall cells) reduces surface tension.

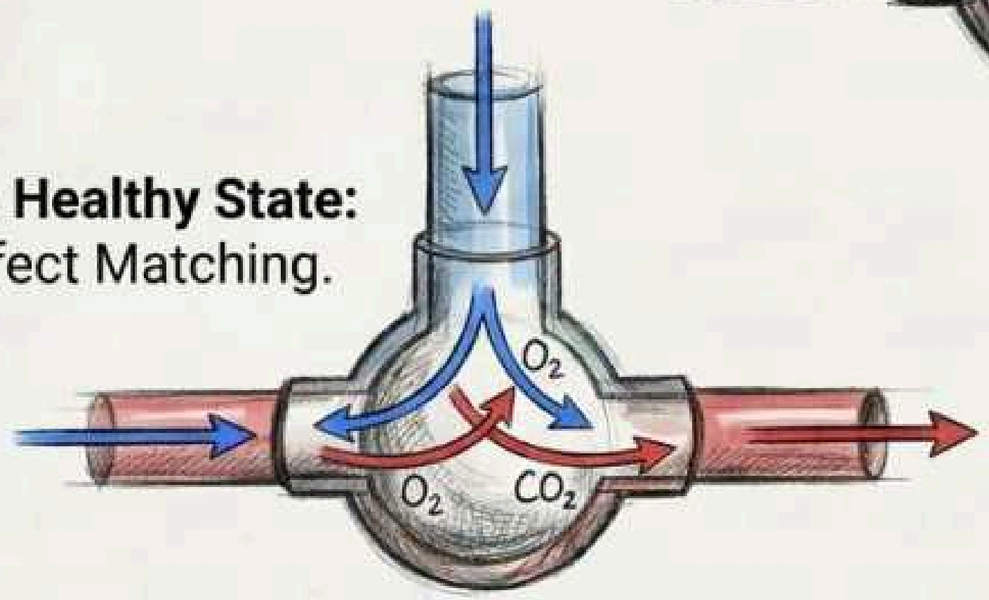
Clinical Application: Premature babies lack sufficient surfactant → severe breathing difficulty → treated with **direct** surfactant instillation.

Ventilation (Air) + Perfusion (Blood) = Gas Exchange

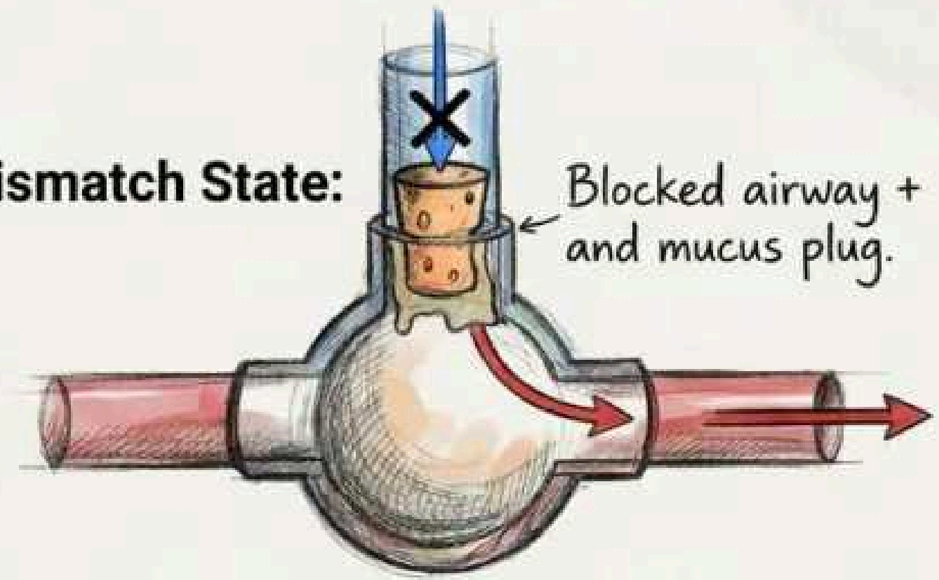
¶ 1.6



The Healthy State:
Perfect Matching.



The Mismatch State:

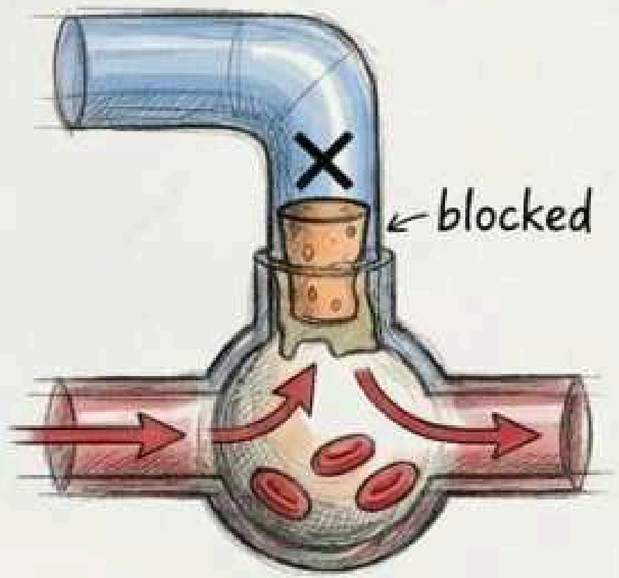


Blocked airway + Continued blood flow
= Blood exits without sufficient oxygen payload.

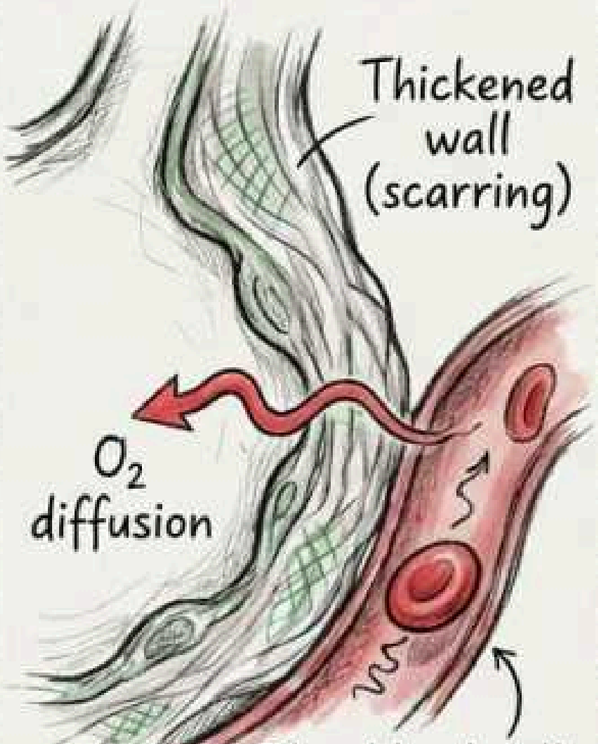
The Diagnostics of Hypoxia (Low Oxygen)

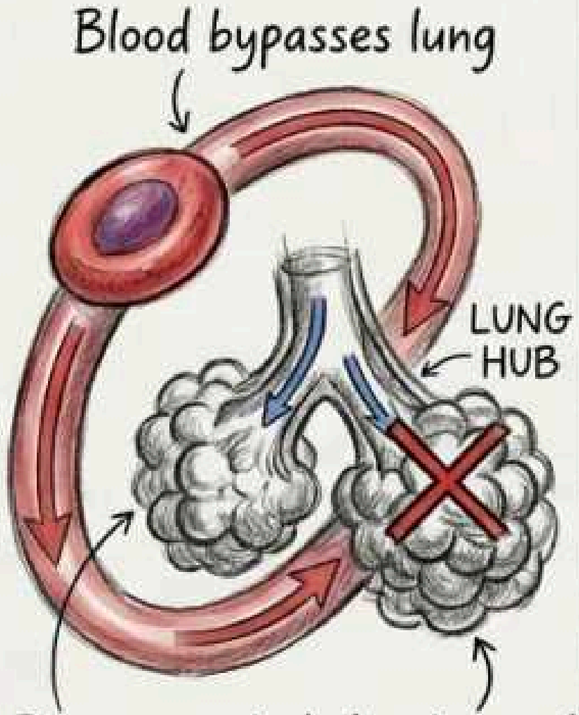
¶ 1.7

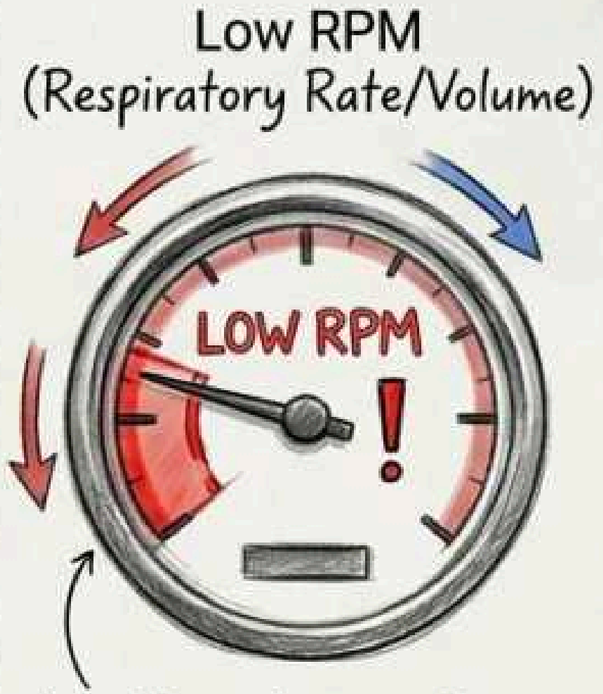
V/Q Mismatch	Thickened Barrier	Shunt	Hypoventilation
Most Common Cause	Slowed Diffusion	Bypassing the Lungs	Not Breathing Enough



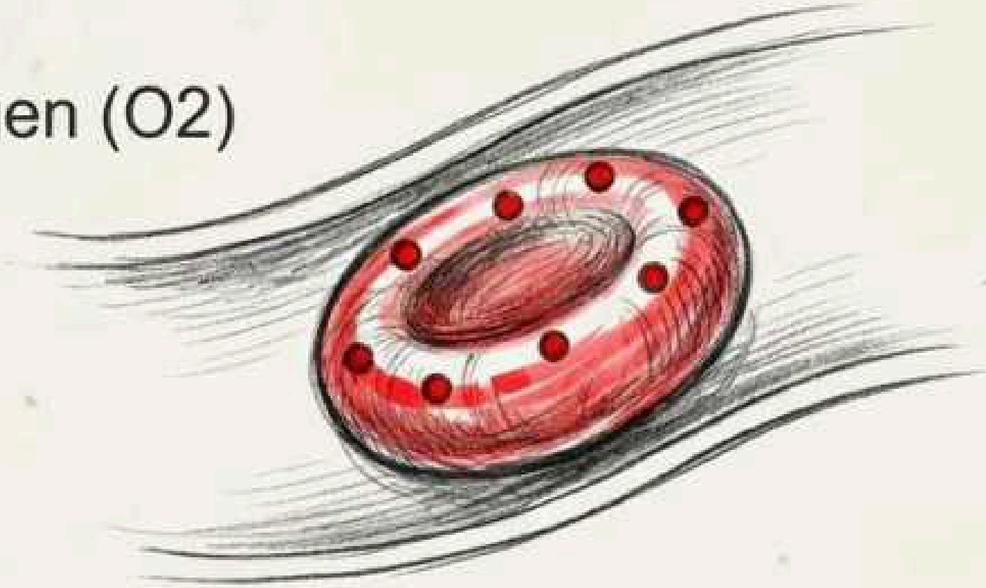
Q (Perfusion)
Blood flow continues, but no air







Oxygen (O2)





Arterial Blood Gas

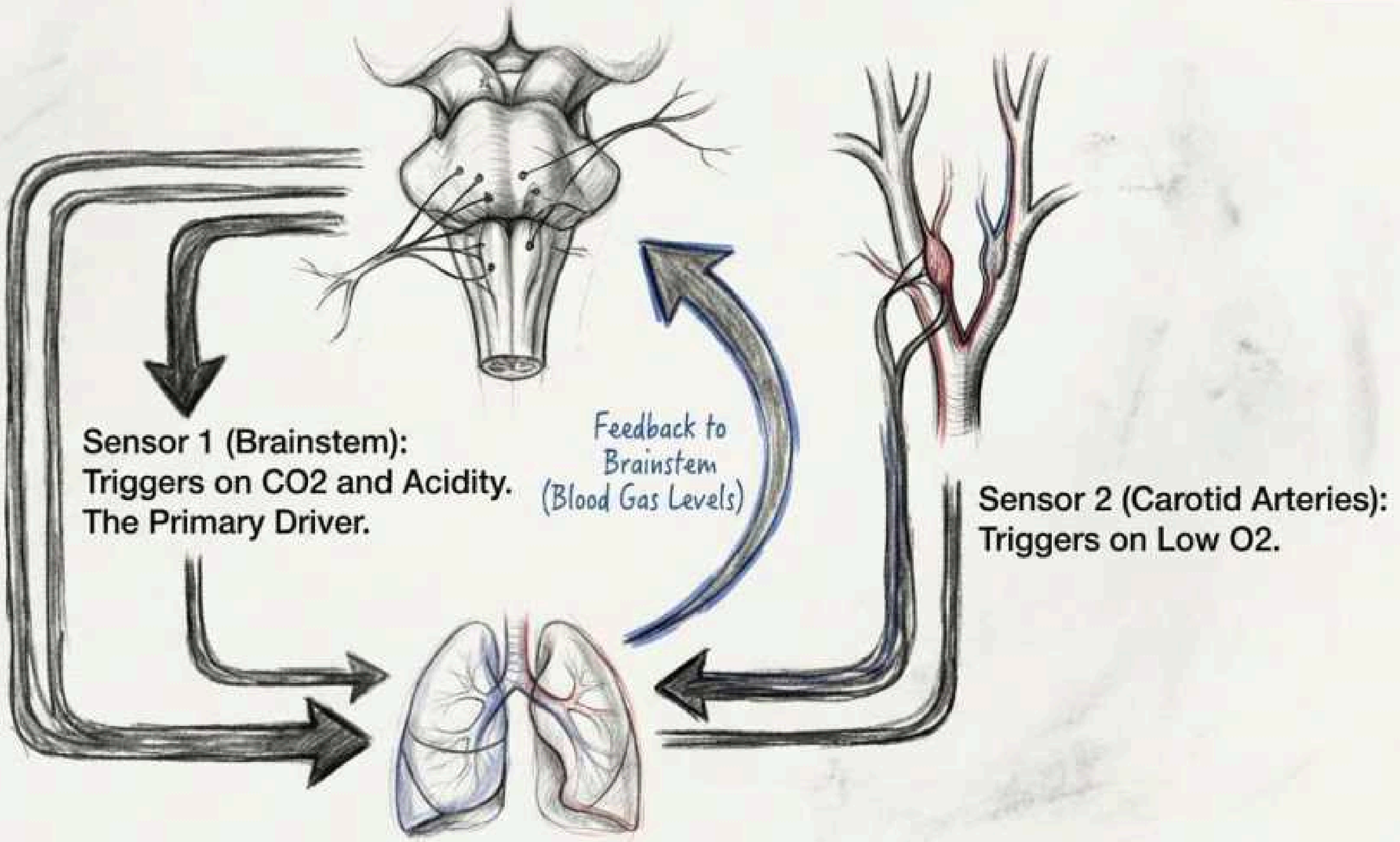
Carbon Dioxide (CO2)



Blowing off CO_2 through breathing is a primary mechanism for controlling blood acidity (pH balance).

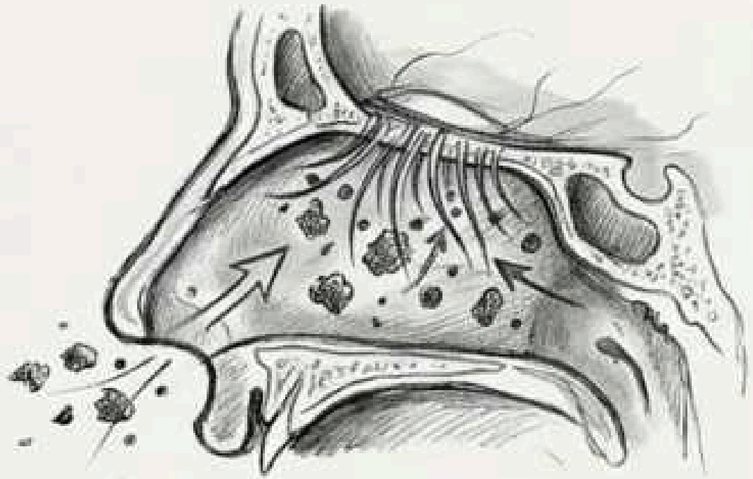
The Automatic Rhythm Pacemaker (Brainstem Centers)

¶ 1.9

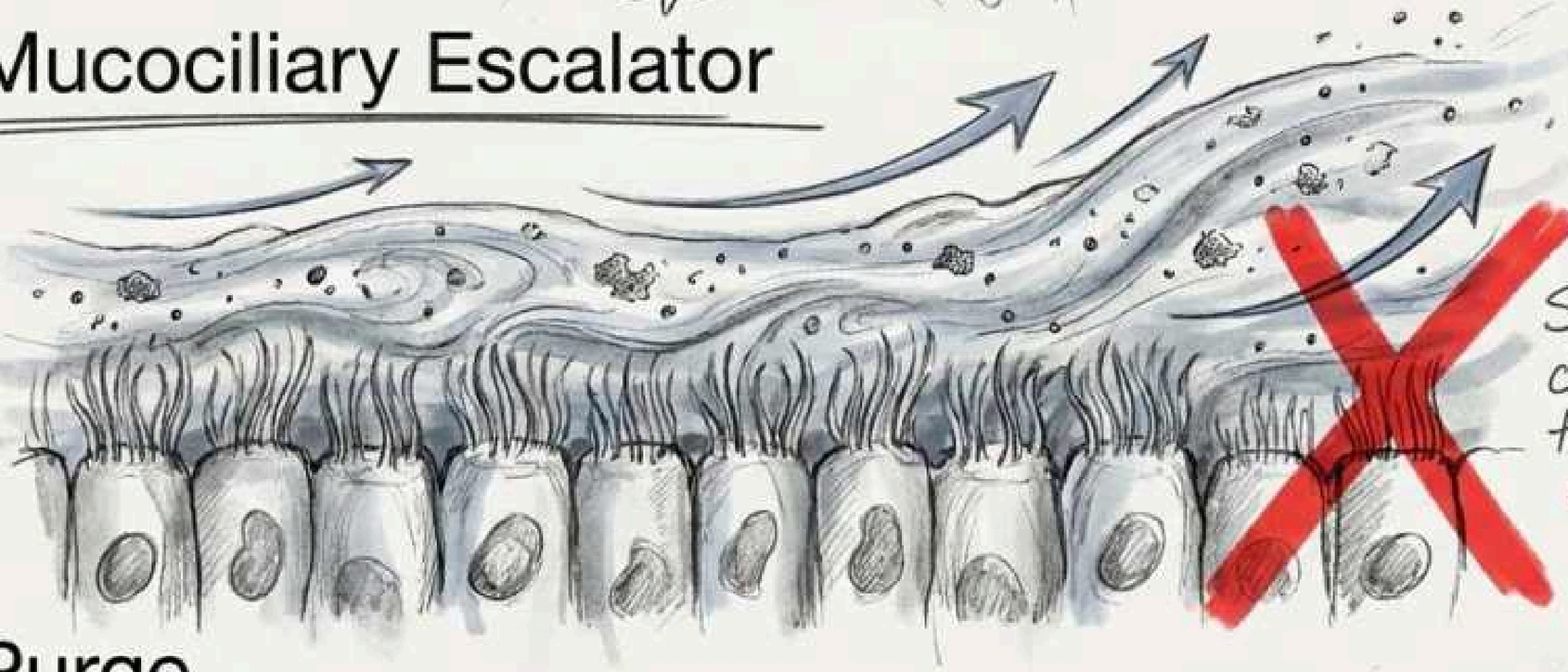


Context Note: Holding your breath becomes unbearable because CO_2 builds up, NOT just because O_2 drops.

The Gates



The Mucociliary Escalator



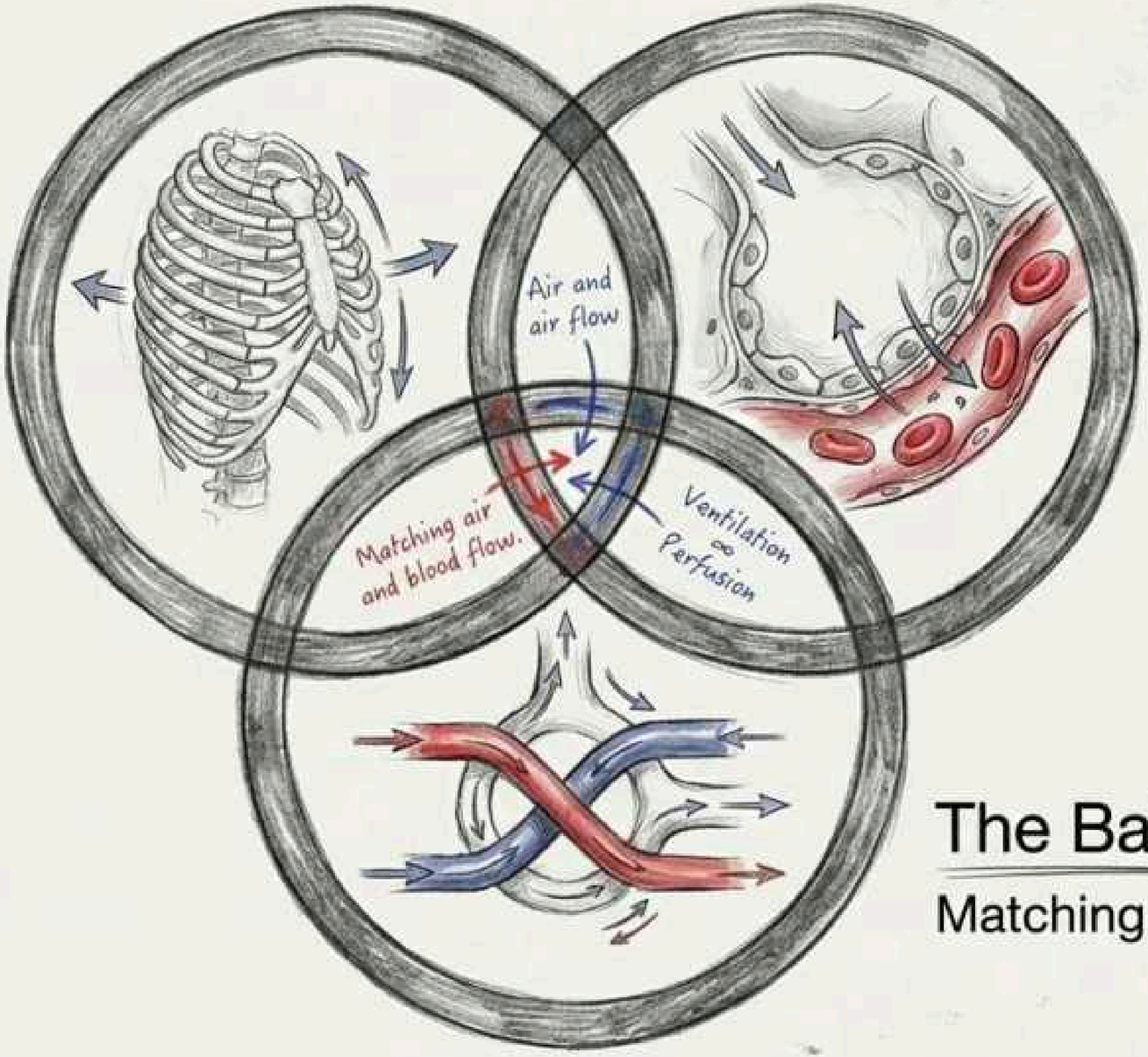
Smoking paralyzes cilia and damages the escalator → chronic cough and chest infections.

The Purge

Coughing clears larger amounts.

The Pump

Moving air by changing chest size.



The Interface

Exchanging gas across a vast, thin surface.

The Balance

Matching air and blood flow.

Next: How doctors measure these functions and recognize patterns of disease.