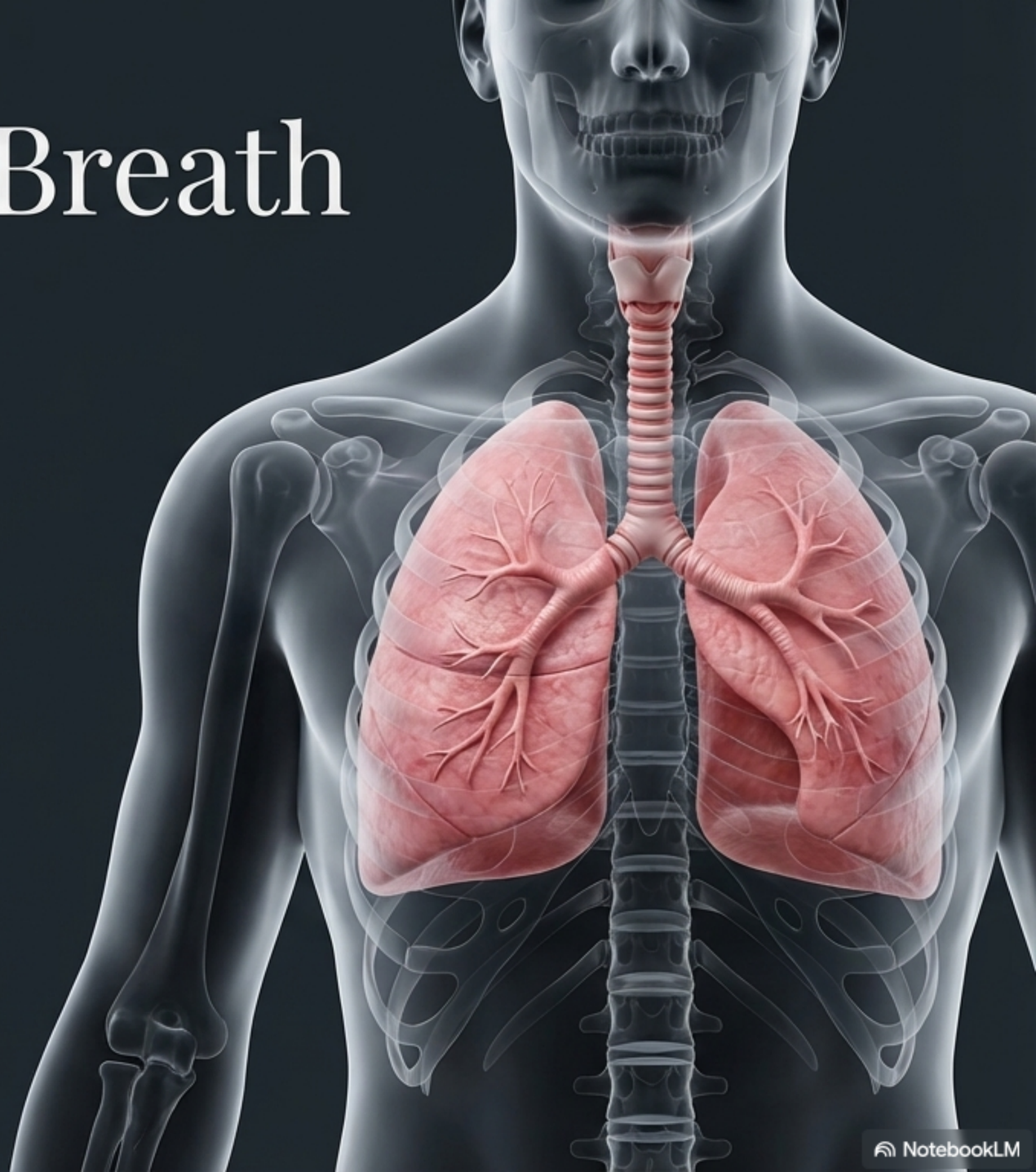
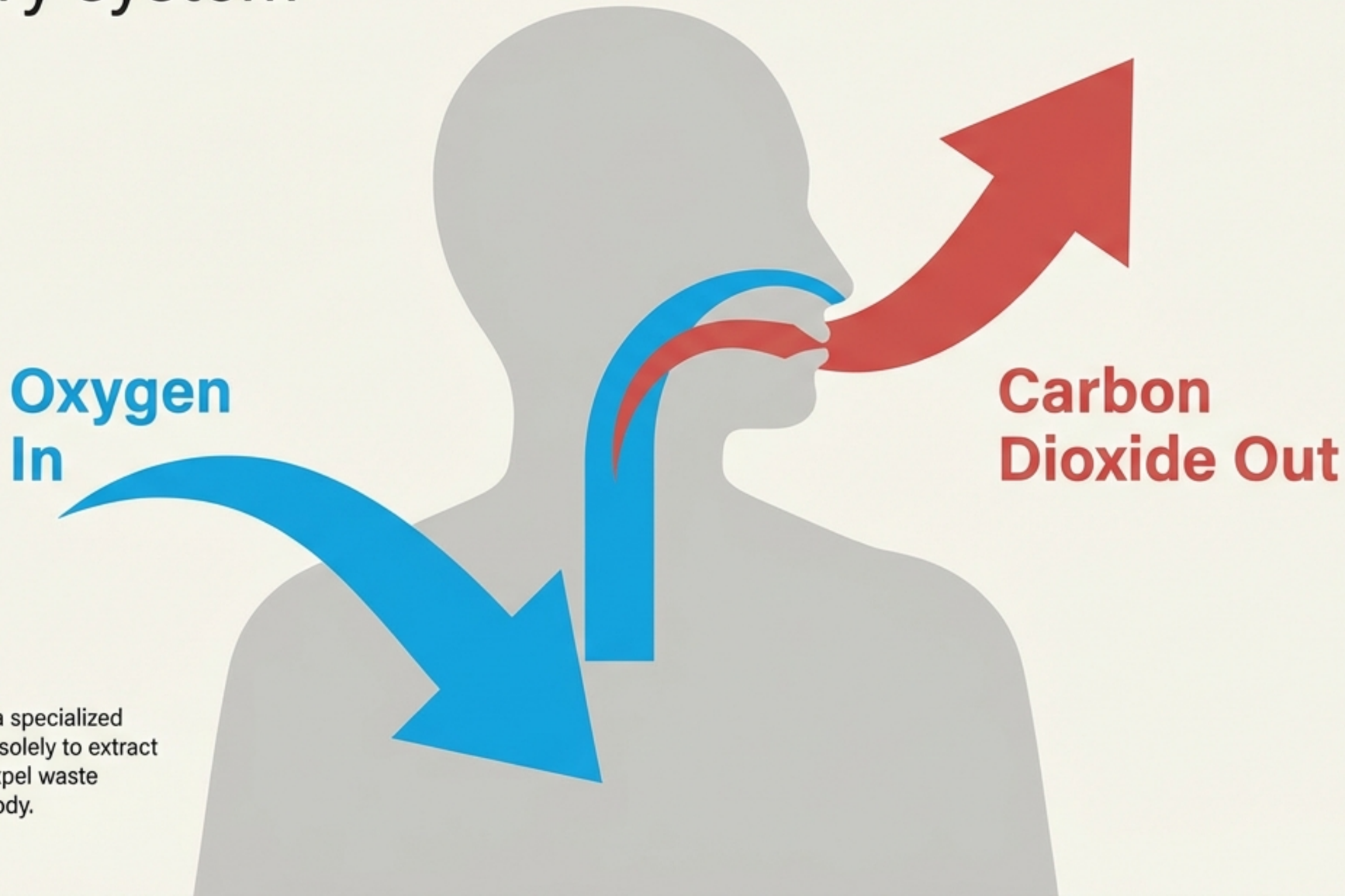
The Journey of a Breath



The primary mission of the respiratory system



The respiratory system is a specialized group of organs designed solely to extract oxygen from the air and expel waste carbon dioxide from the body.

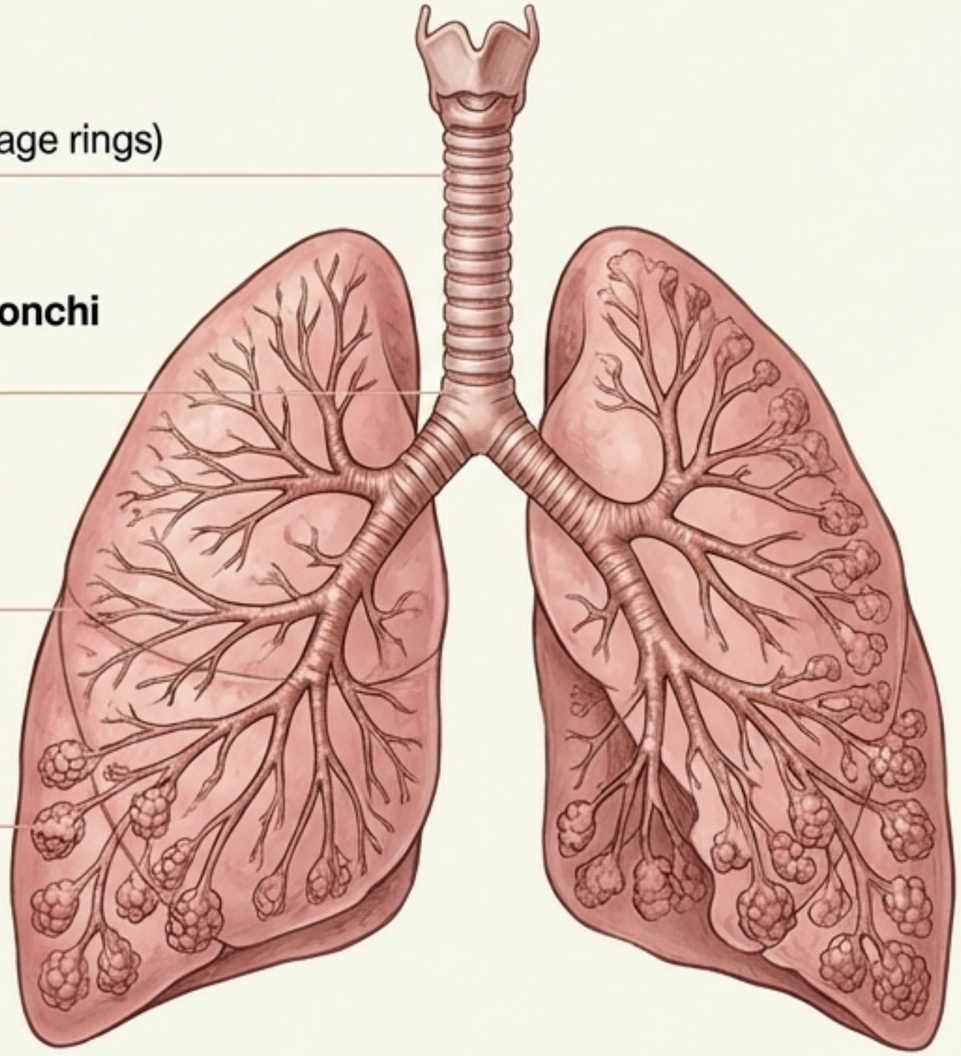
Anatomy of an upside-down tree

The Trunk:
Trachea
(Windpipe protected by cartilage rings)

The Thick Branches: Bronchi
(One for each lung)

The Small Twigs:
Bronchioles

The Leaves:
Air Sacs (Alveoli)

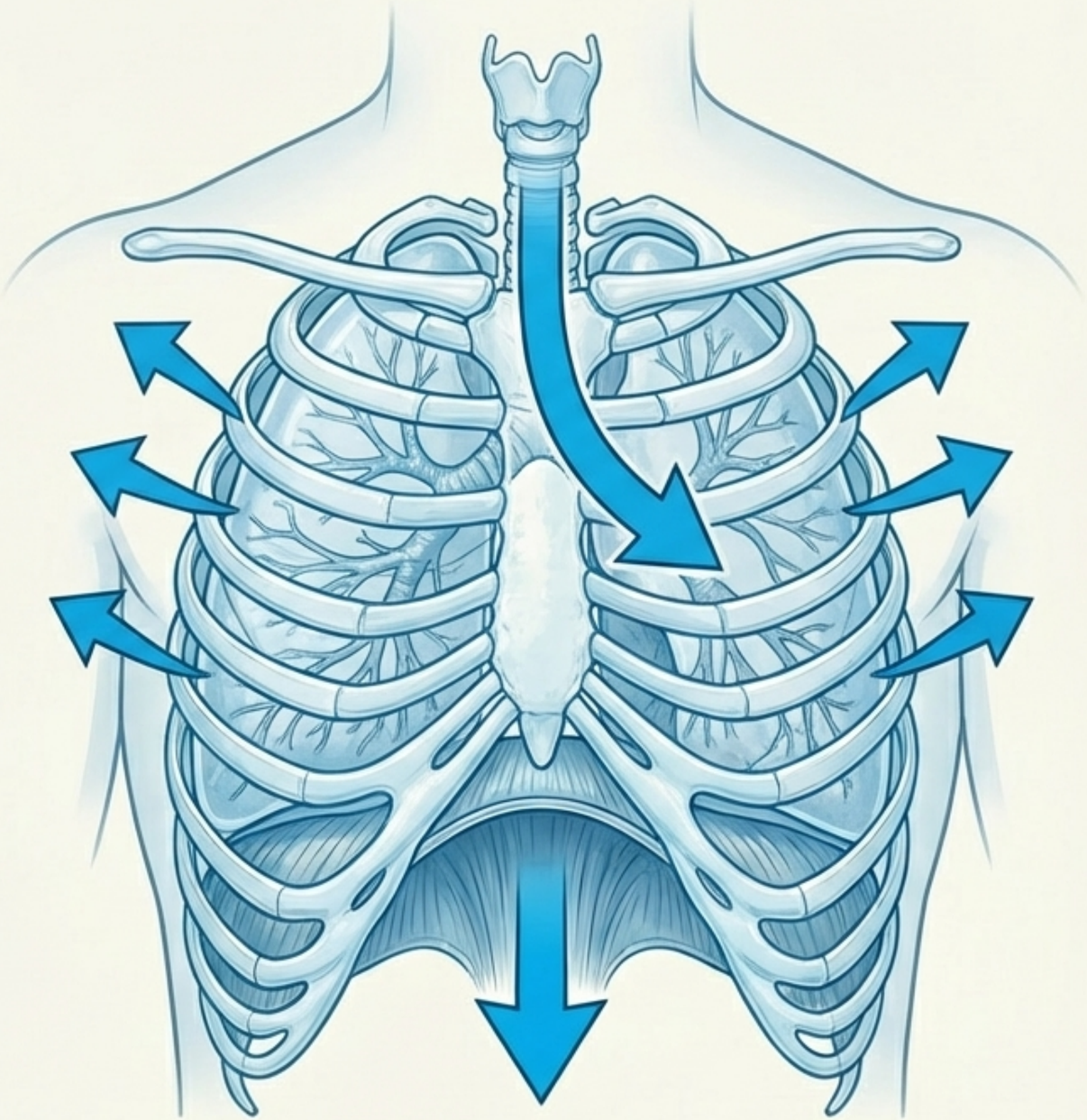


The mechanics of drawing air inward

1. Muscles Contract: Diaphragm pulls downward; intercostal muscles pull ribs upward and outward.

2. Volume & Pressure: Chest cavity volume increases, causing internal air pressure to decrease.

3. The Result: Air rushes down the trachea to fill the empty space.

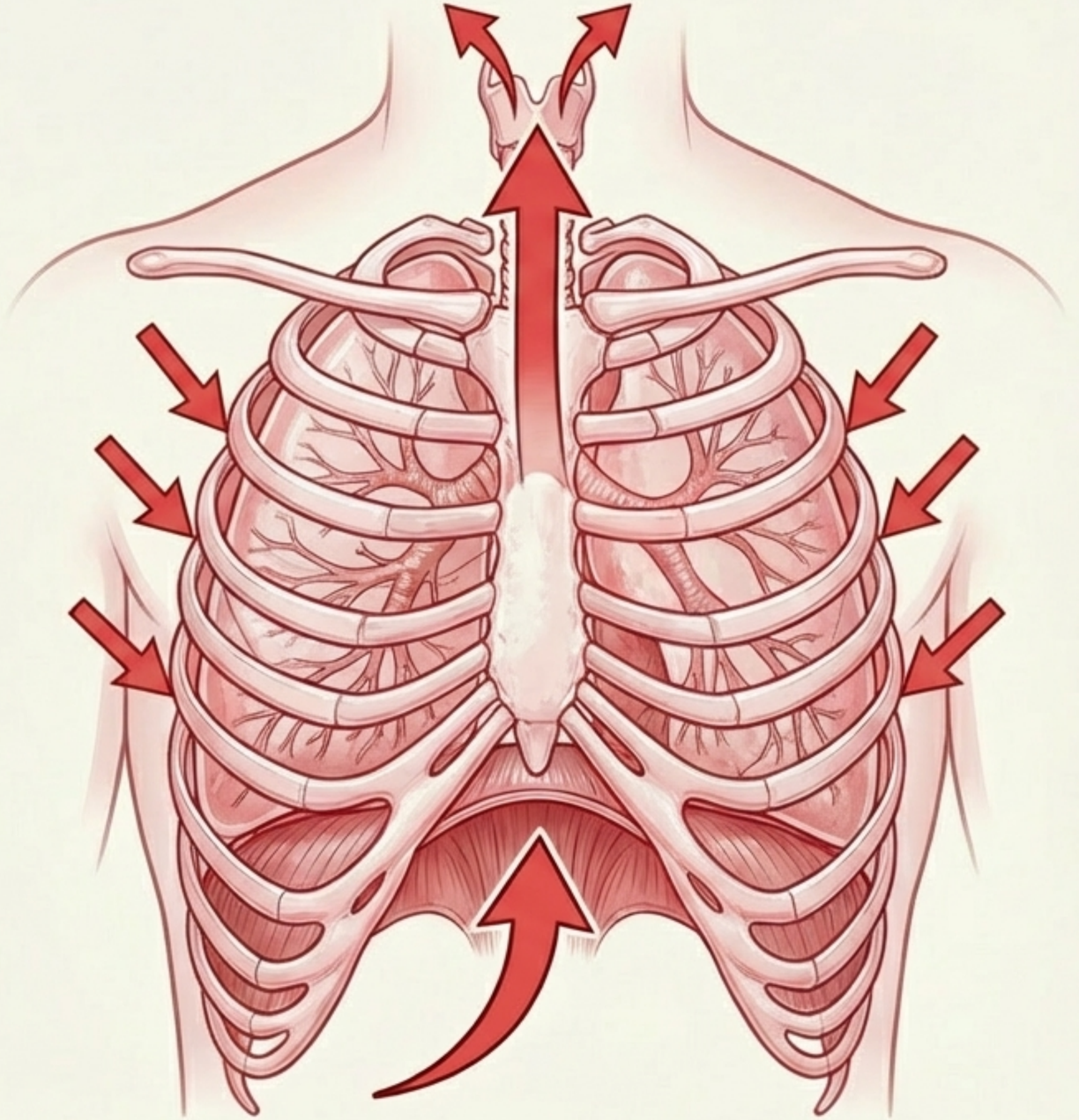


Squeezing the air back out

1. Muscles Relax: Diaphragm returns to a dome shape; intercostal muscles let ribs drop.

2. Volume & Pressure: Chest cavity volume decreases, causing internal air pressure to increase.

3. The Result: Air is physically squeezed out of the lungs.



The Great Misconception

Breathing

The physical, mechanical movement of air in and out of the lungs (ventilation).

Respiration

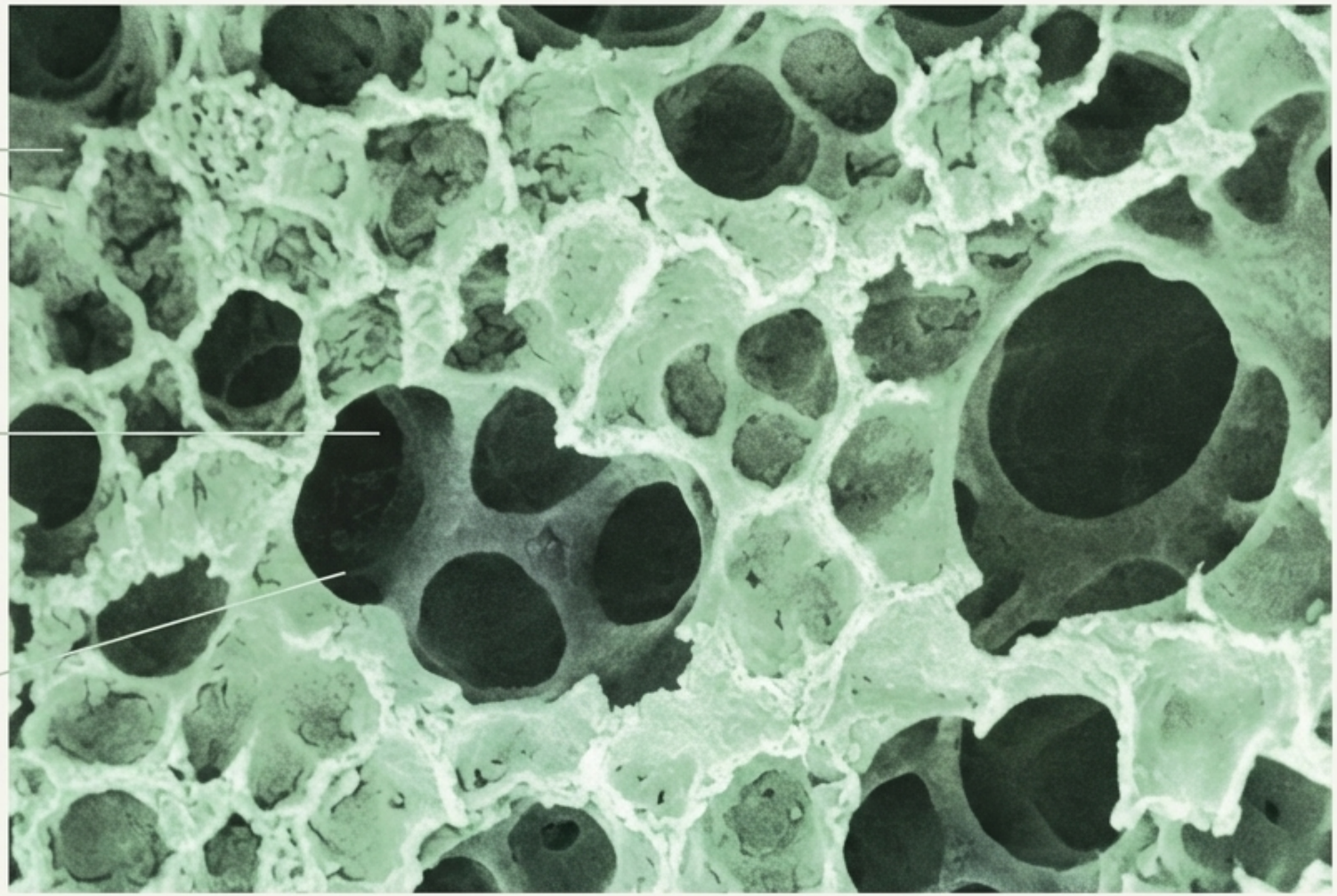
The chemical reaction happening completely inside your cells to release energy.

Zooming in on the gas exchange zone

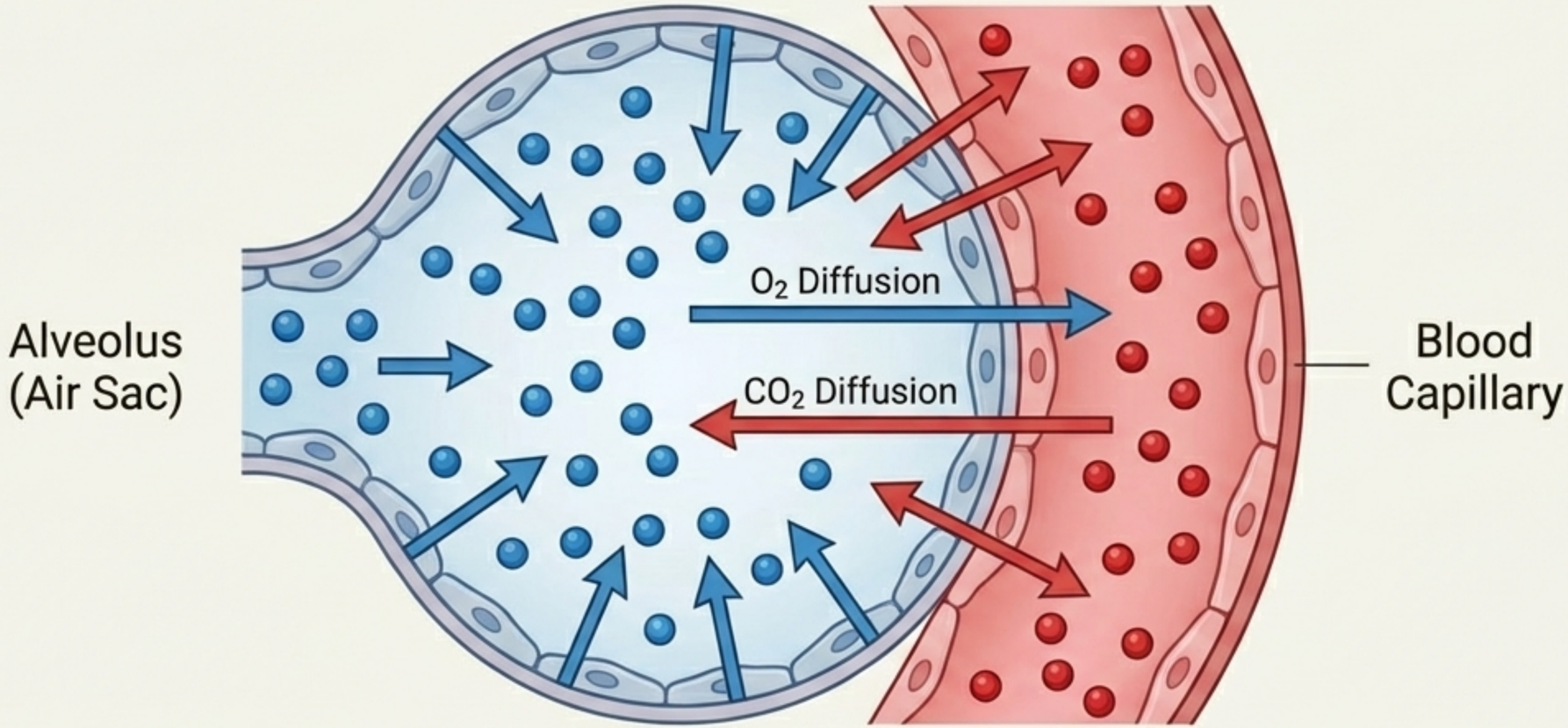
Mammals have millions of these tiny sacs.

They create a massive total surface area for rapid gas exchange.

The walls of the alveoli are incredibly thin—only one cell thick.



Diffusion across the capillary walls

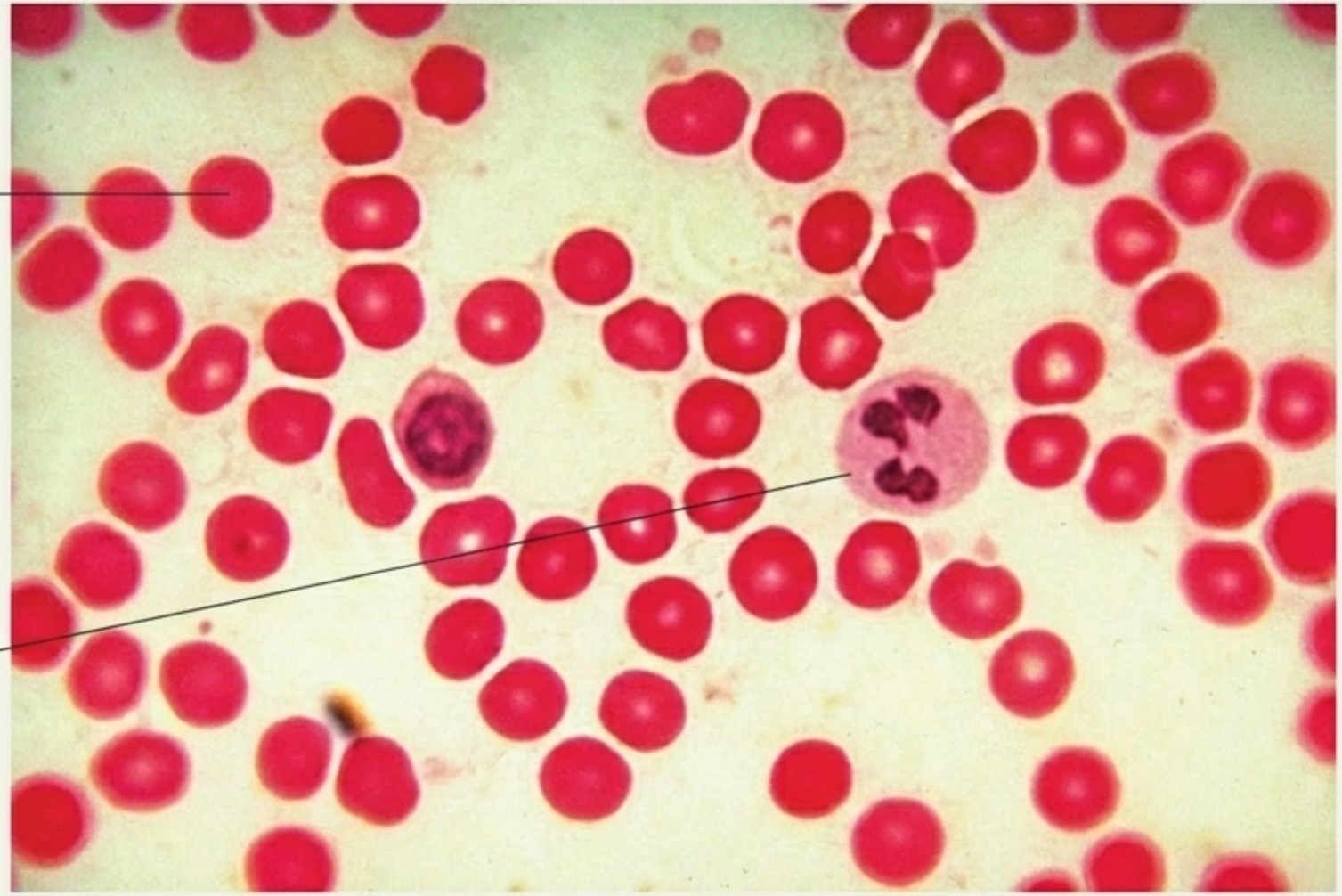


- Oxygen moves freely from high concentration in the air to low concentration in the blood.
- Carbon Dioxide diffuses out of the blood into the lungs to be exhaled.
- There are only two thin cells standing between the air and the blood.

The body’s internal transport network

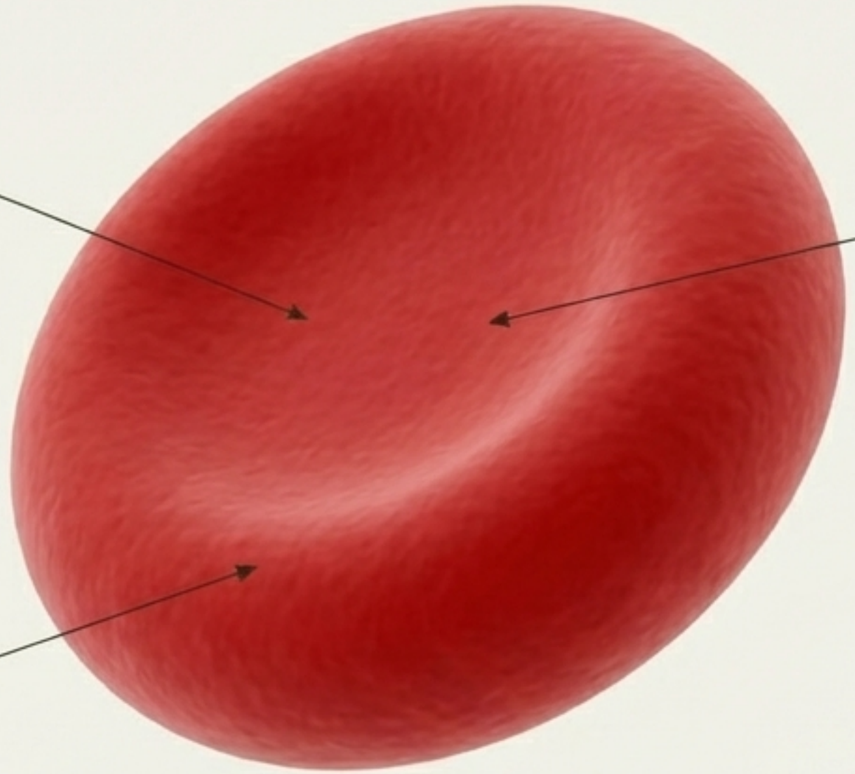
Plasma: The pale yellow liquid ferrying nutrients and dissolved carbon dioxide.

White Blood Cells: The defenders. They protect against pathogens by producing antibodies or directly digesting them.



The perfect oxygen carrier

Packed with haemoglobin (a red pigment that grabs oxygen to form oxyhaemoglobin).



No nucleus (making more physical room to carry haemoglobin).

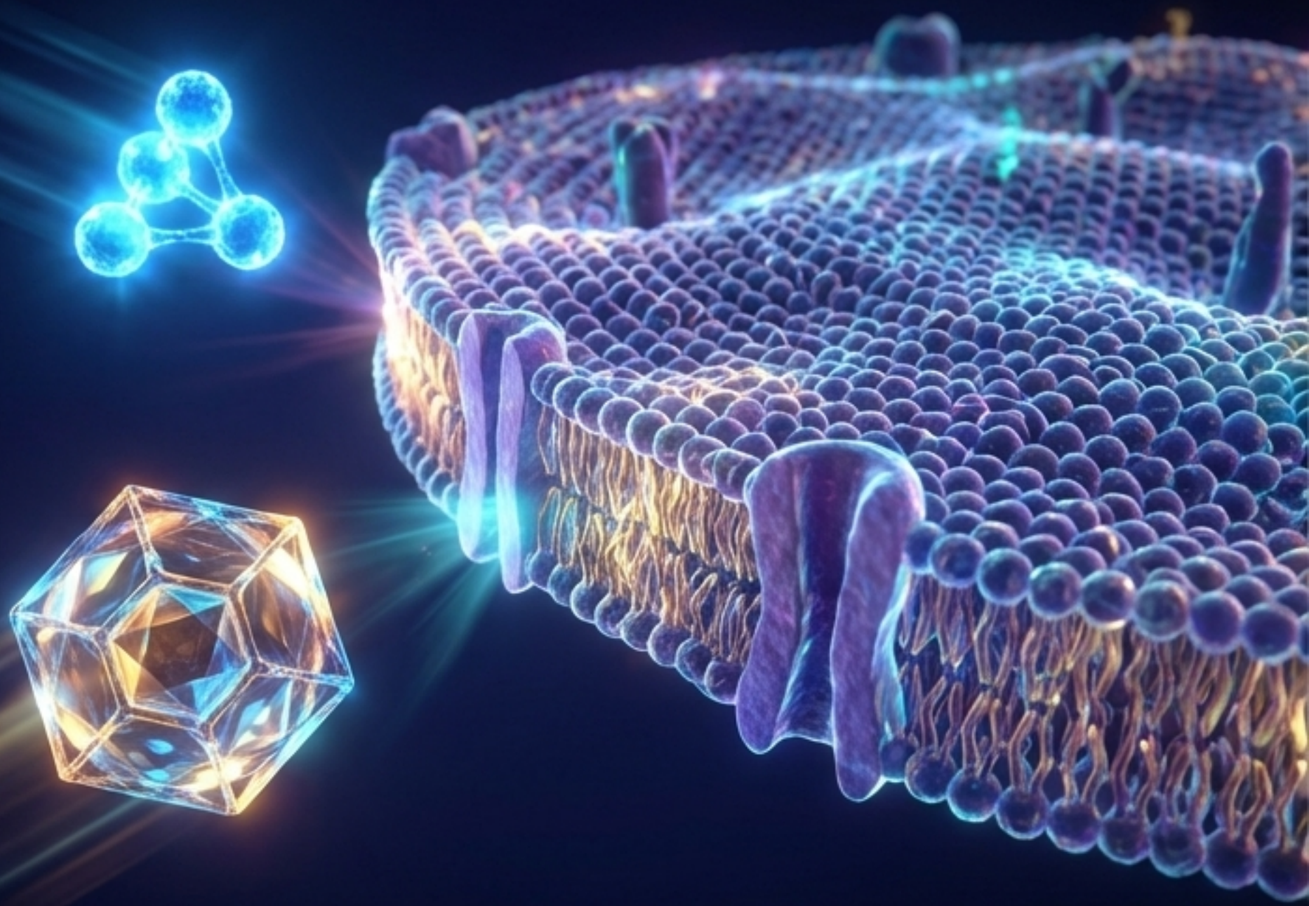
No mitochondria (ensuring the cell transports the oxygen rather than consuming it).

Altitude Adaptation

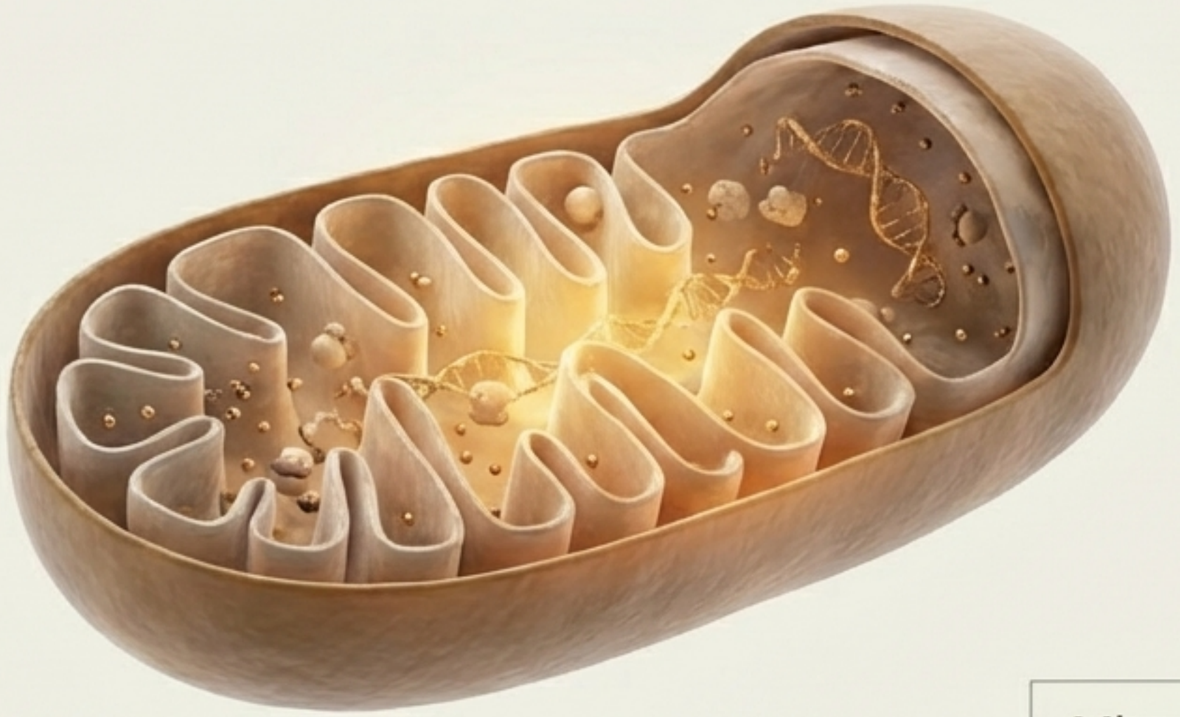
Bodies produce more red blood cells at high altitudes to compensate for thinner air.

Reaching the ultimate destination

- The entire purpose of breathing and circulation is to deliver oxygen to every single living living cell in the body.
- Oxygen meets glucose (sugar broken down from carbohydrates by the digestive system).
- The goal: Unlock the stored energy inside the glucose.



Mitochondria are the engines of the cell



Found inside both plant and animal cells.

This is the exact site of **aerobic respiration** (respiration using oxygen).

Mitochondria provide a **highly controlled release of energy,** unlocking exactly what the cell needs to survive, grow, and move.

The chemistry of aerobic respiration

Glucose + Oxygen → Carbon Dioxide + Water

The Reactants
(Fuel and Air)

The Products
(Waste gas, water, and released energy)

An exothermic reaction that keeps us warm

- Because aerobic respiration transfers stored chemical energy to the cell, some energy is always changed to heat.
- This makes respiration an exothermic reaction.
- This microscopic heat release is exactly what keeps our bodies warm in cold environments.

Final Knowledge Check

Q1: What prevents the trachea from collapsing?

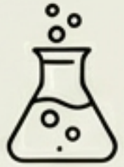
(A: Cartilage rings)

Q2: What is the mechanical movement of air called?

(A: Breathing)

Q3: Why do red blood cells lack mitochondria?

(A: So they don't consume the oxygen they carry)



Q4: What is the word equation for respiration?

(A: Glucose + Oxygen → Carbon Dioxide + Water)