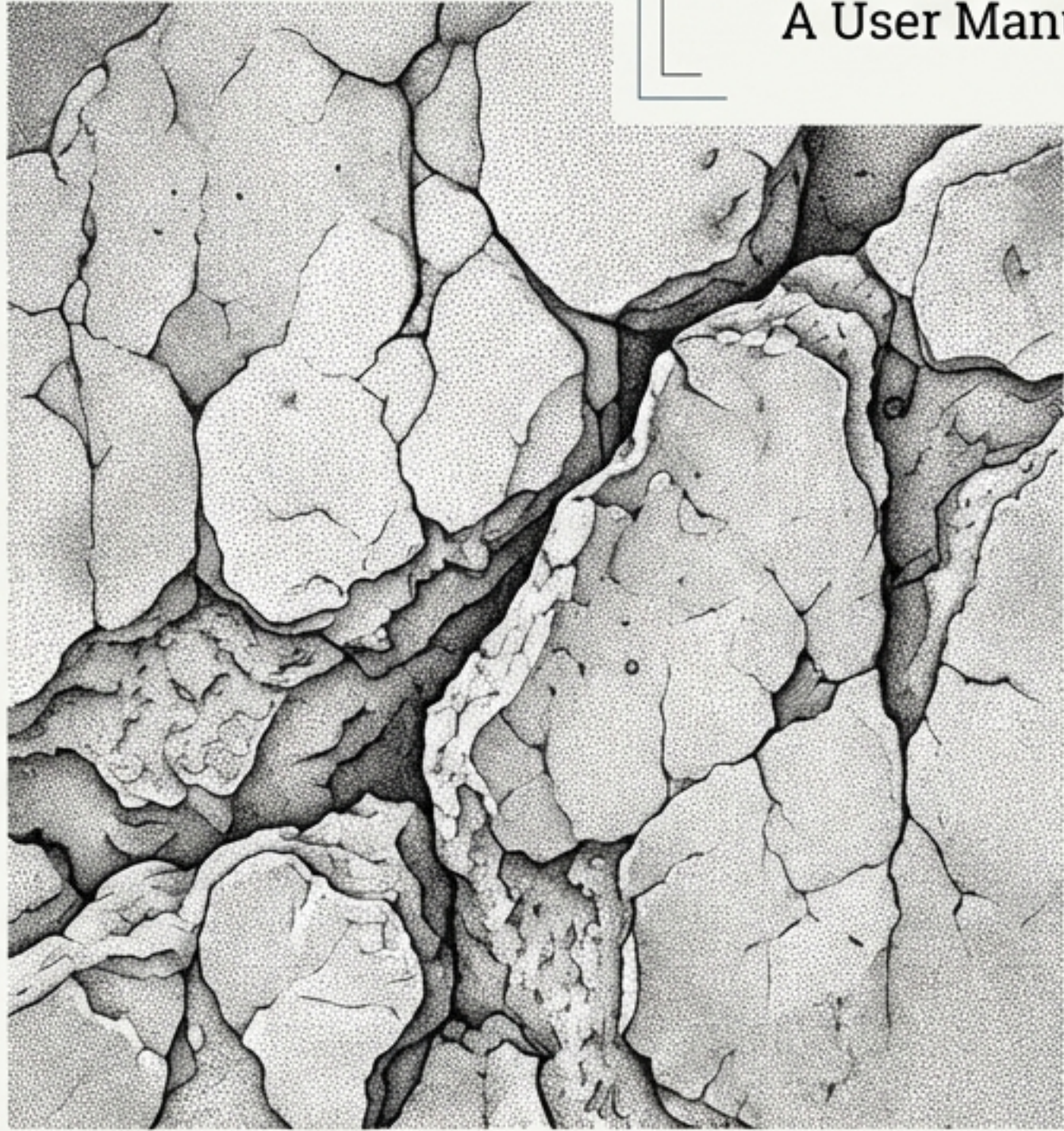
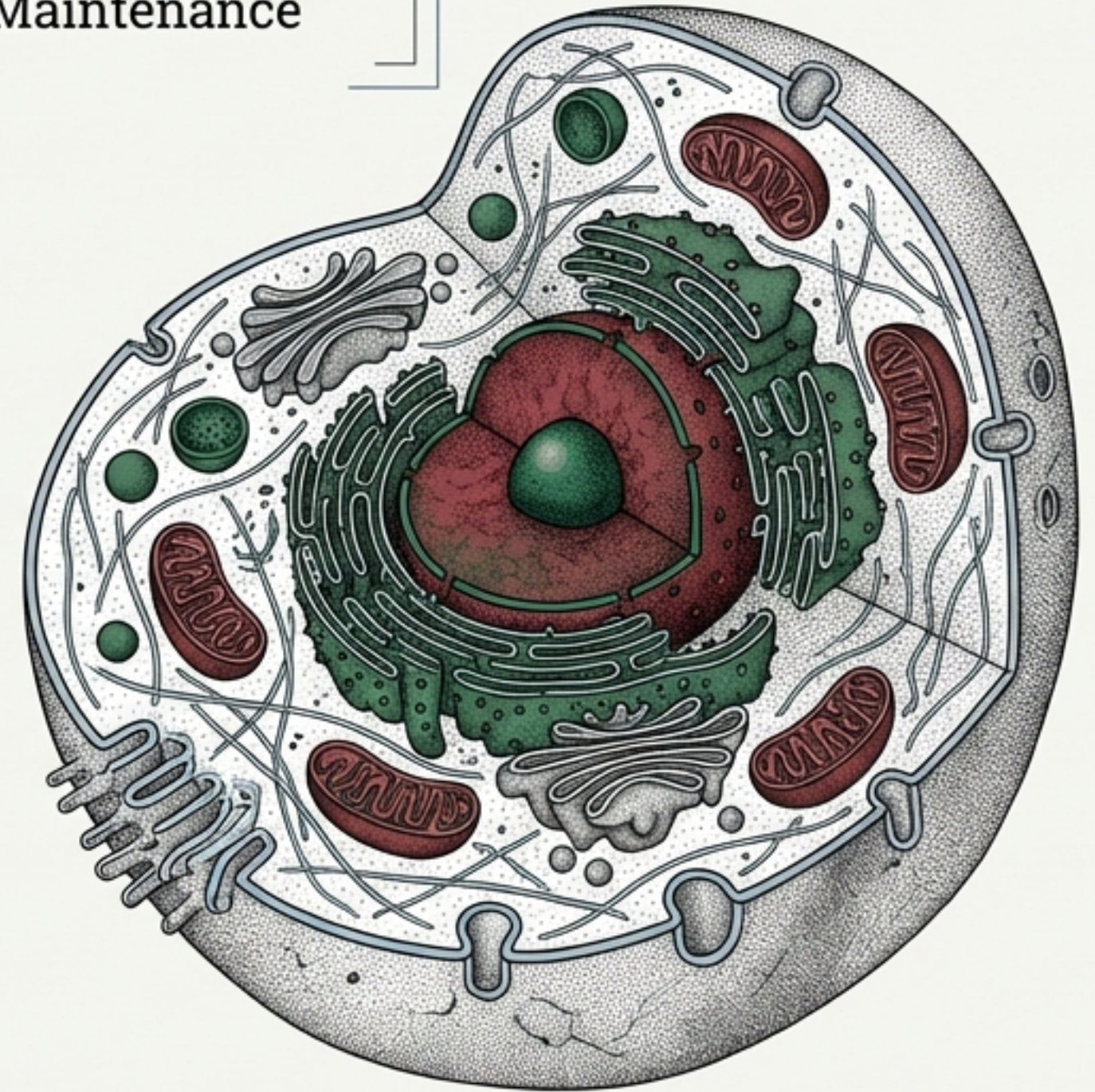


THE MACHINERY OF LIFE

A User Manual for Biological Maintenance



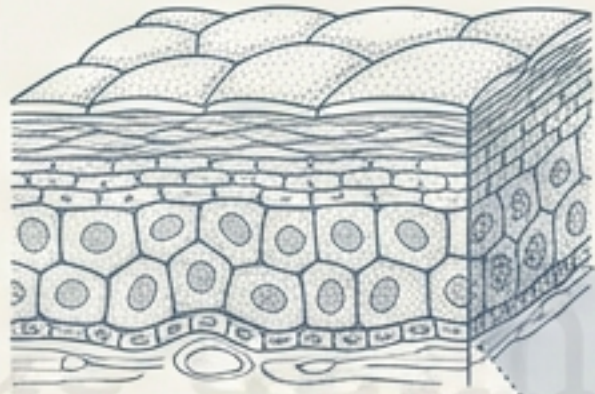
The Problem: Living structures are organized but unstable. Without constant energy input, order breaks down into chaos.



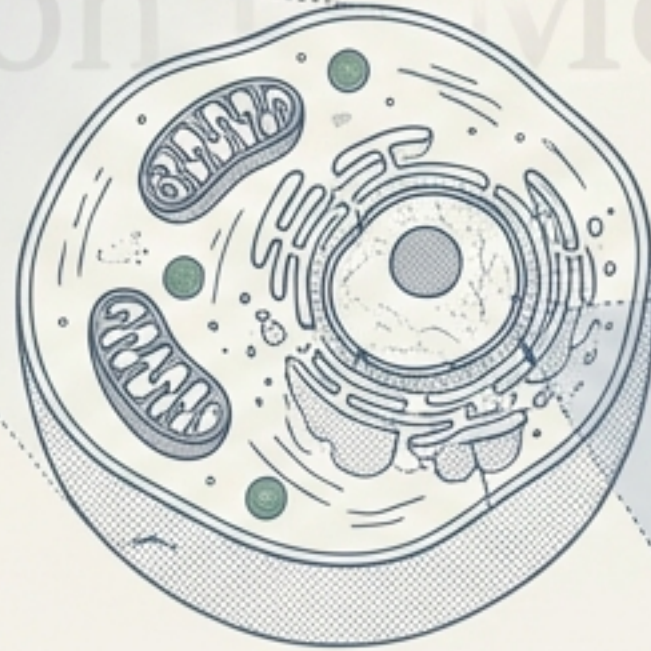
The Solution: A relentless system of repair. Nutrition, Respiration, Transportation, and Excretion.

THE CRITERION FOR LIFE

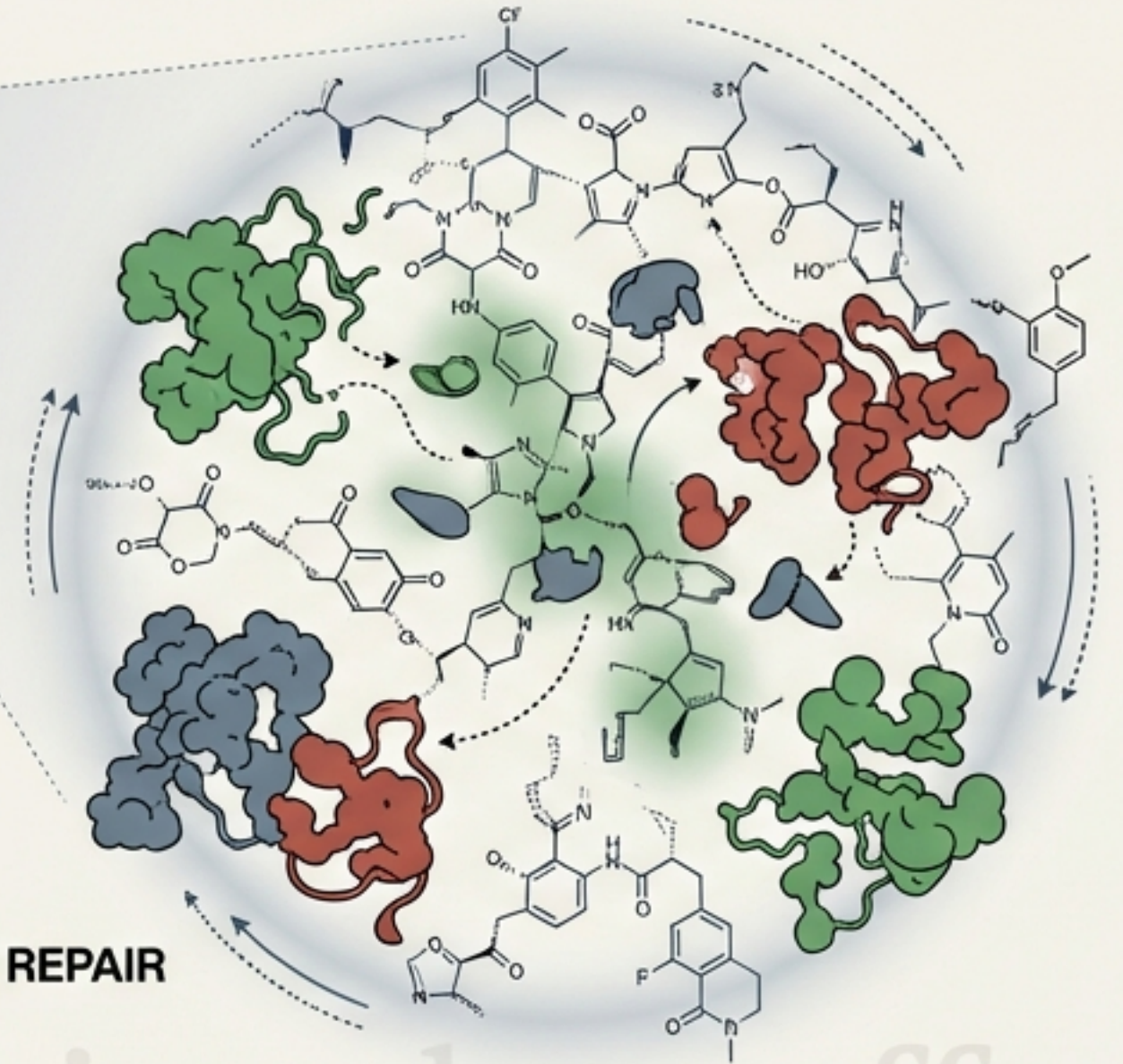
Why visible movement is a false metric.



TISSUE
(Cellular Layers)



CELL
(Zoom Magnitude)



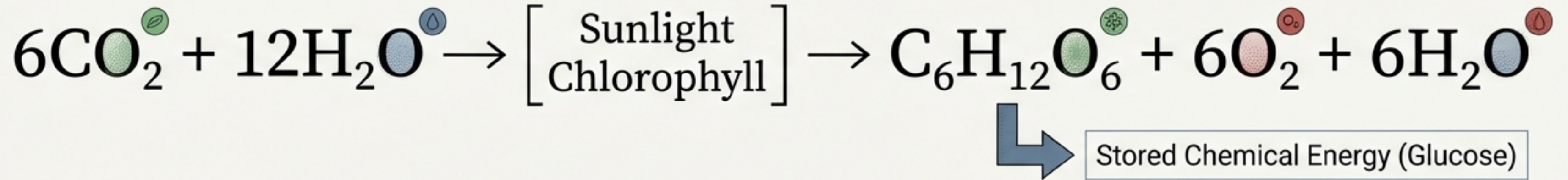
MOLECULAR MOVEMENT & REPAIR
(The Criterion)

- Visible movement (running, chewing) is insufficient; plants don't run, animals sleep.
- The true definition is **Invisible Molecular Movement**.
- Constant repair is required to counteract environmental damage.
- If molecular repair stops, order breaks down → Organism dies.

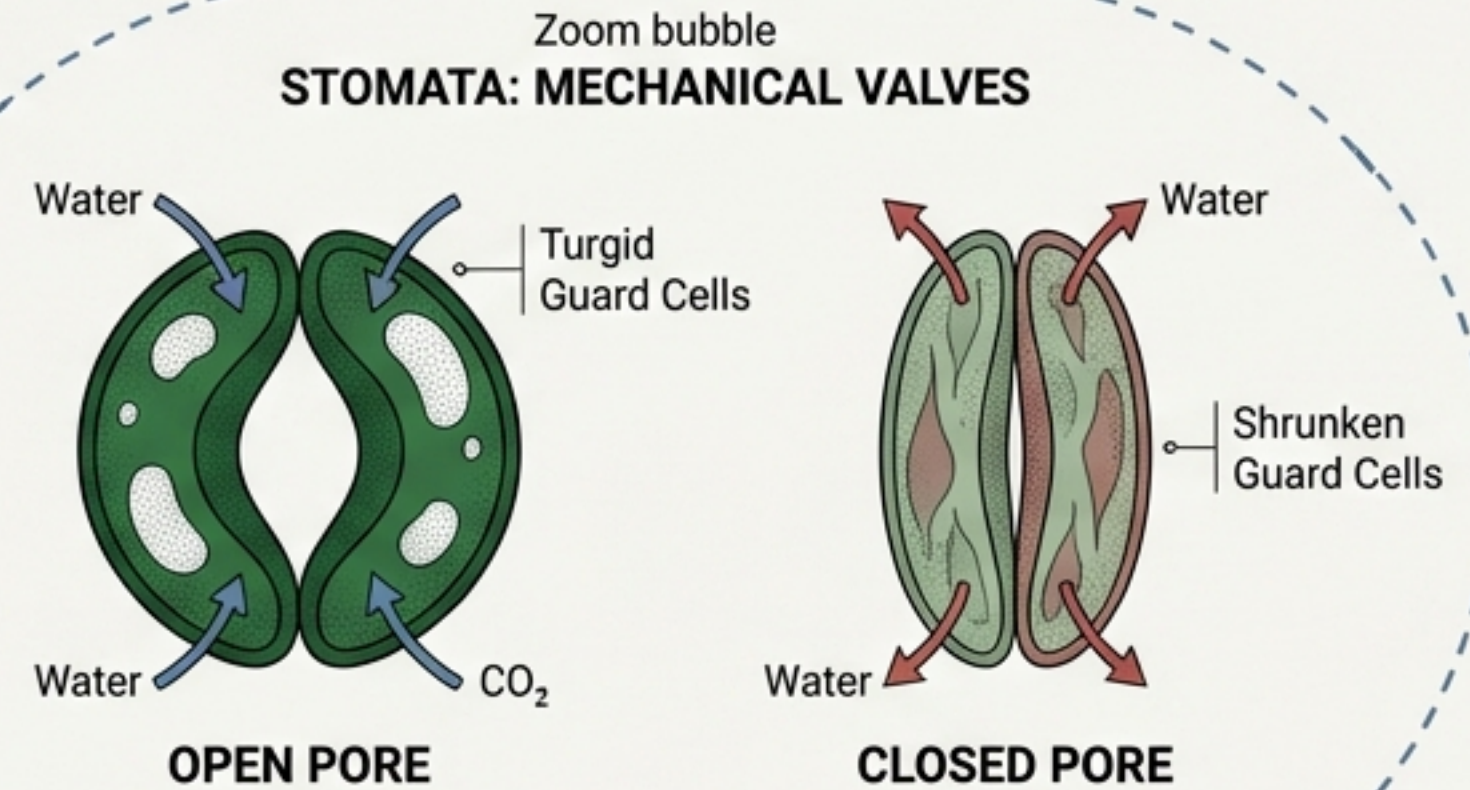
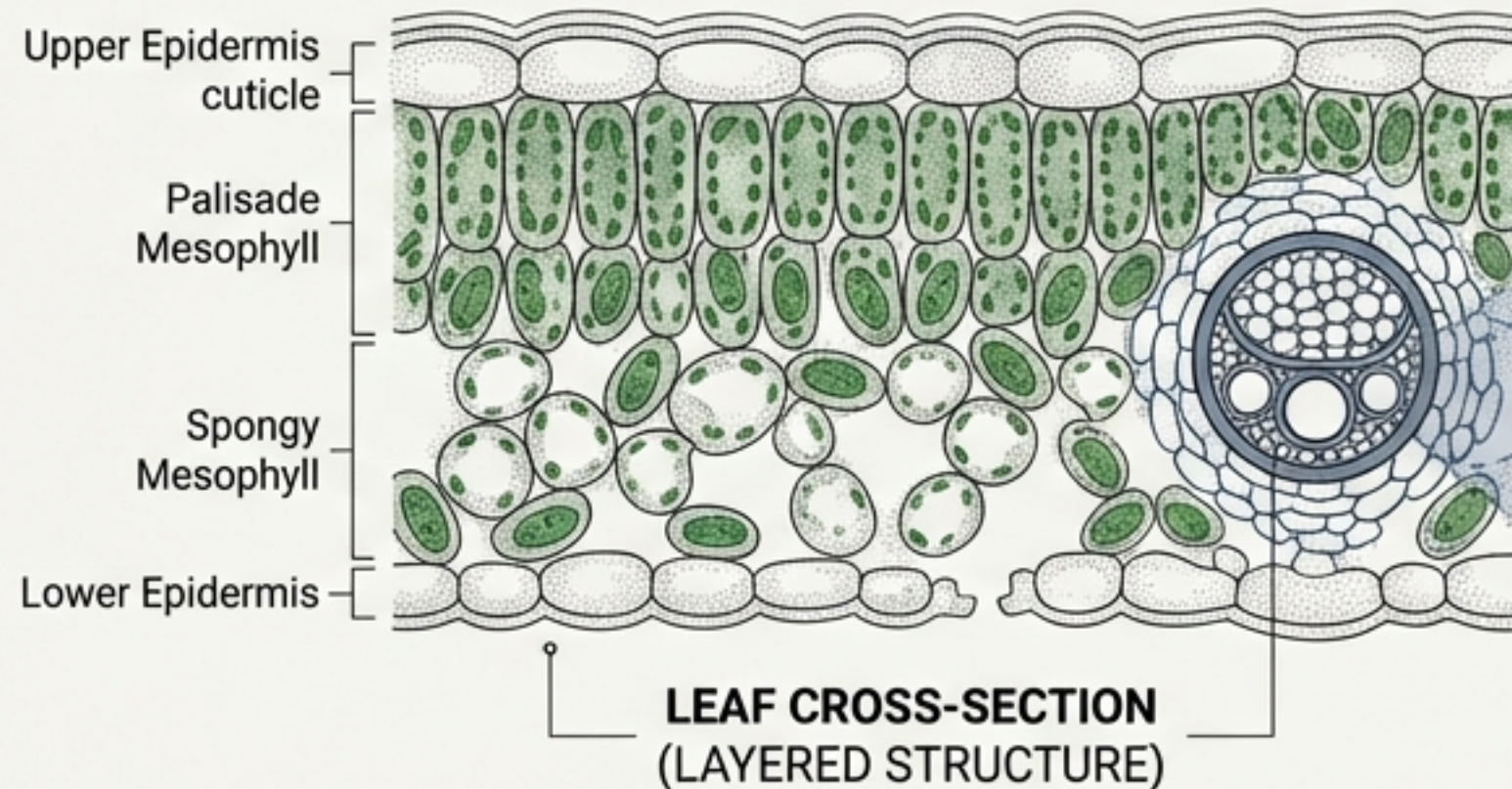
SYSTEM INPUT: THE PRODUCERS

Autotrophic Nutrition & Photosynthesis

THE CHEMICAL RECIPE

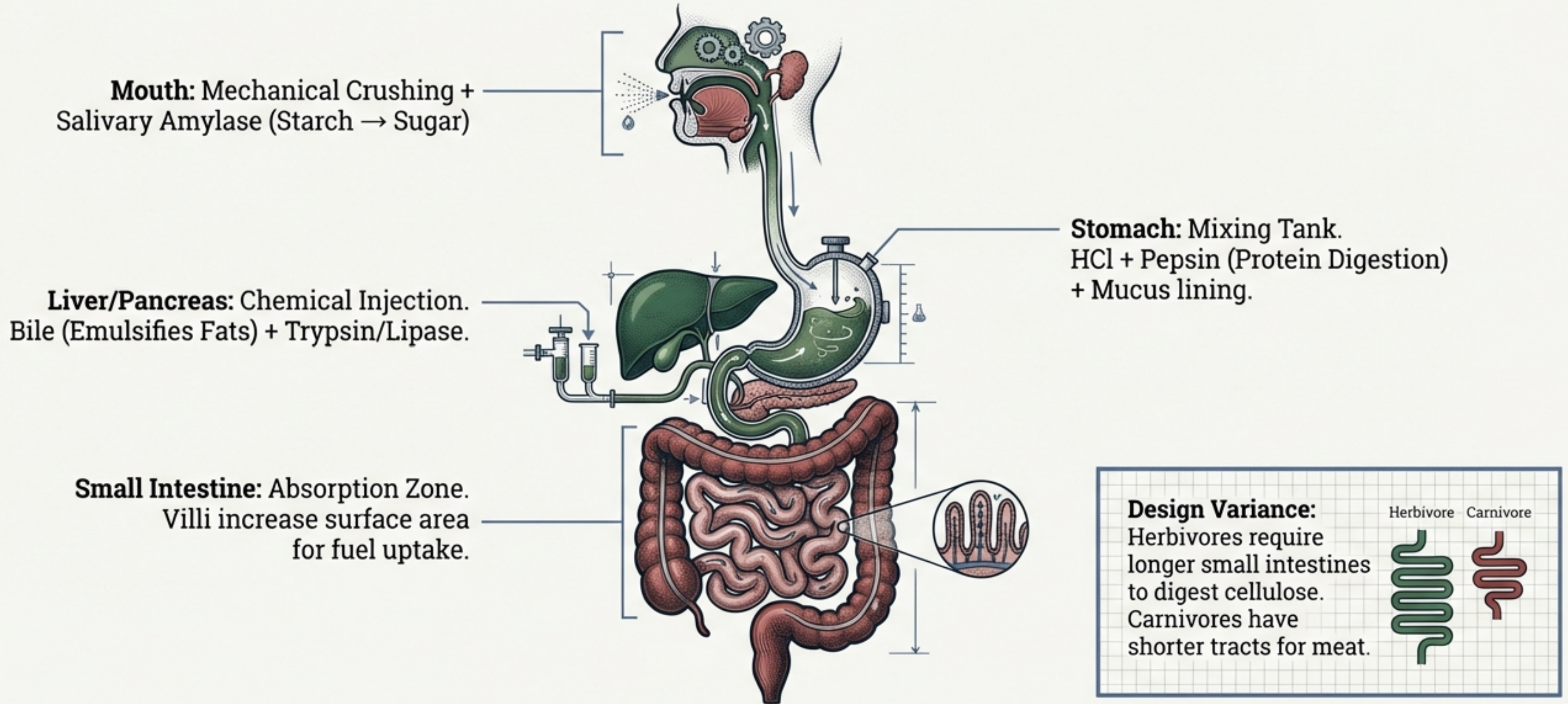


THE HARDWARE



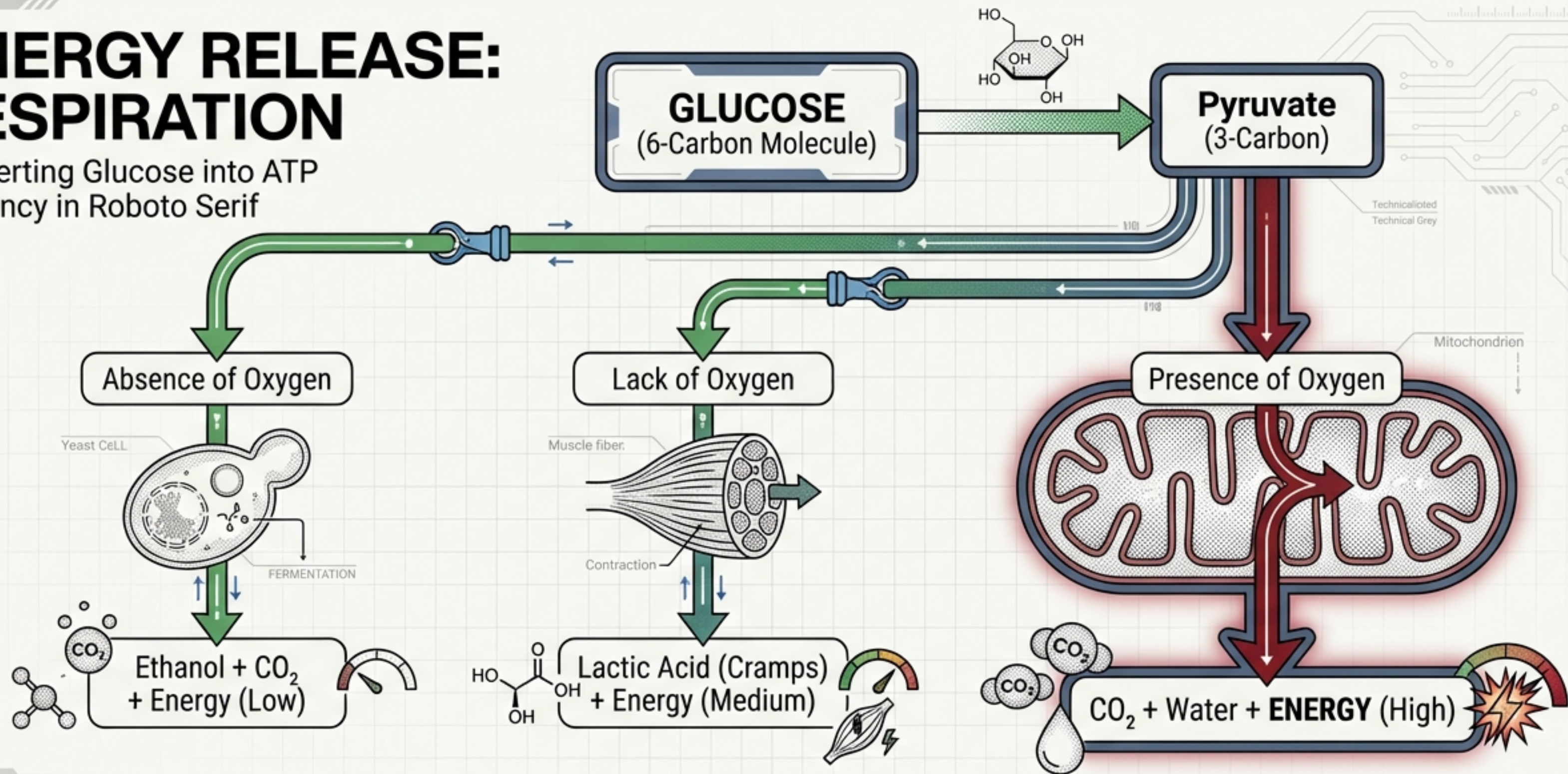
SYSTEM INPUT: THE CONSUMERS

Heterotrophic Nutrition: The Disassembly Line



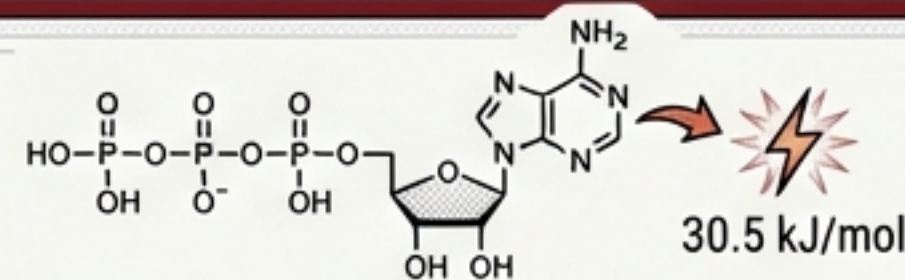
ENERGY RELEASE: RESPIRATION

Converting Glucose into ATP
Currency in Roboto Serif



ATP (Adenosine Triphosphate): The universal battery.

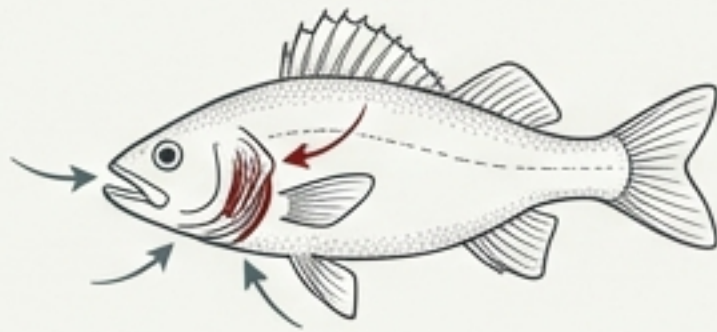
Breaking the phosphate bond releases 30.5 kJ/mol of energy.



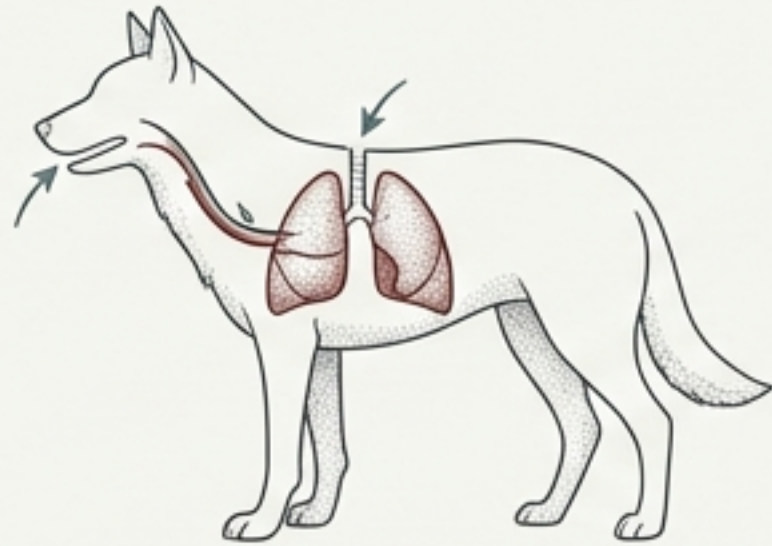
OXIDIZER INTAKE

Engineering for Surface Area

Aquatic vs. Terrestrial

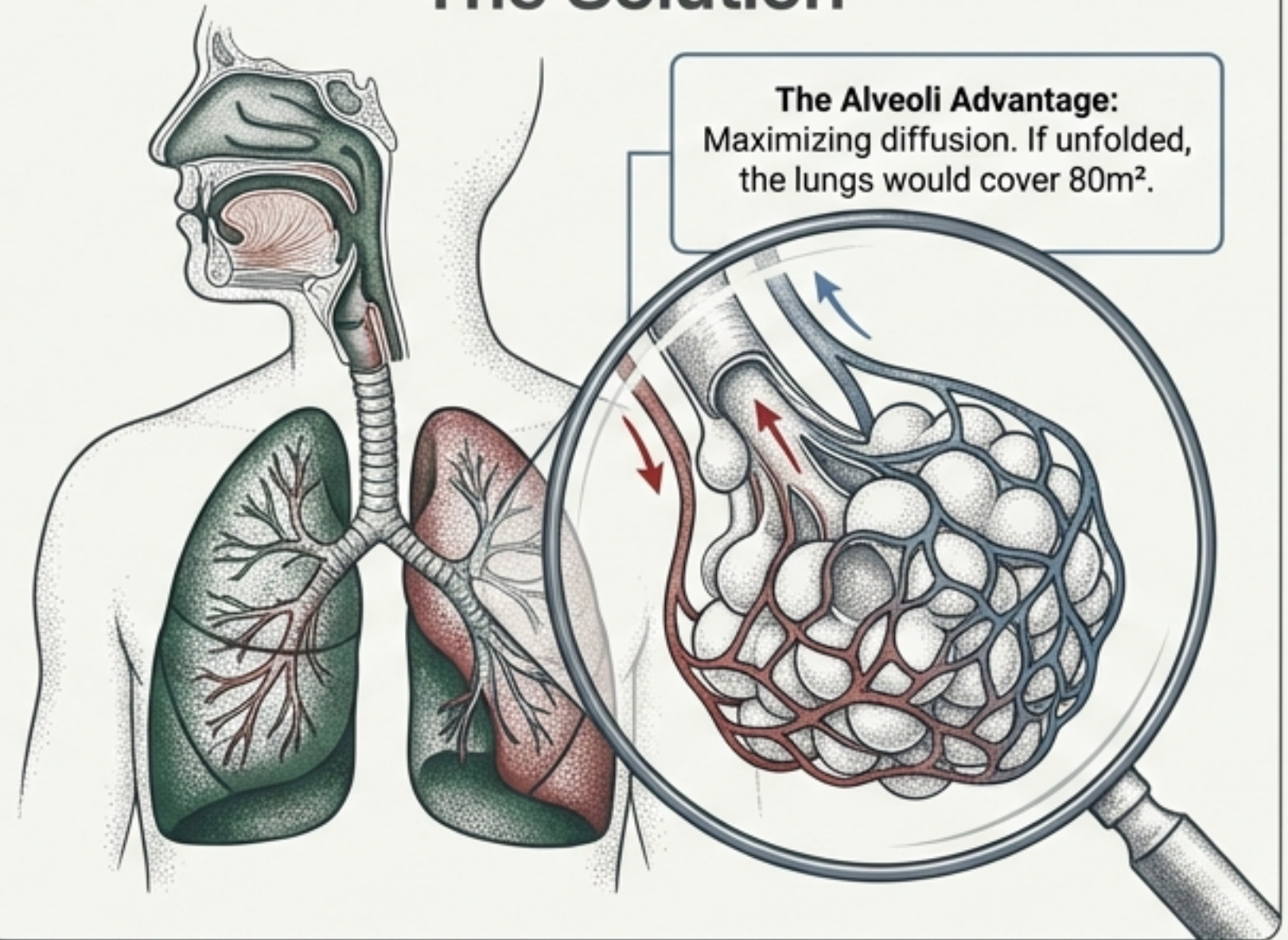


Water has low O_2
→ High flow rate needed
(Gills)



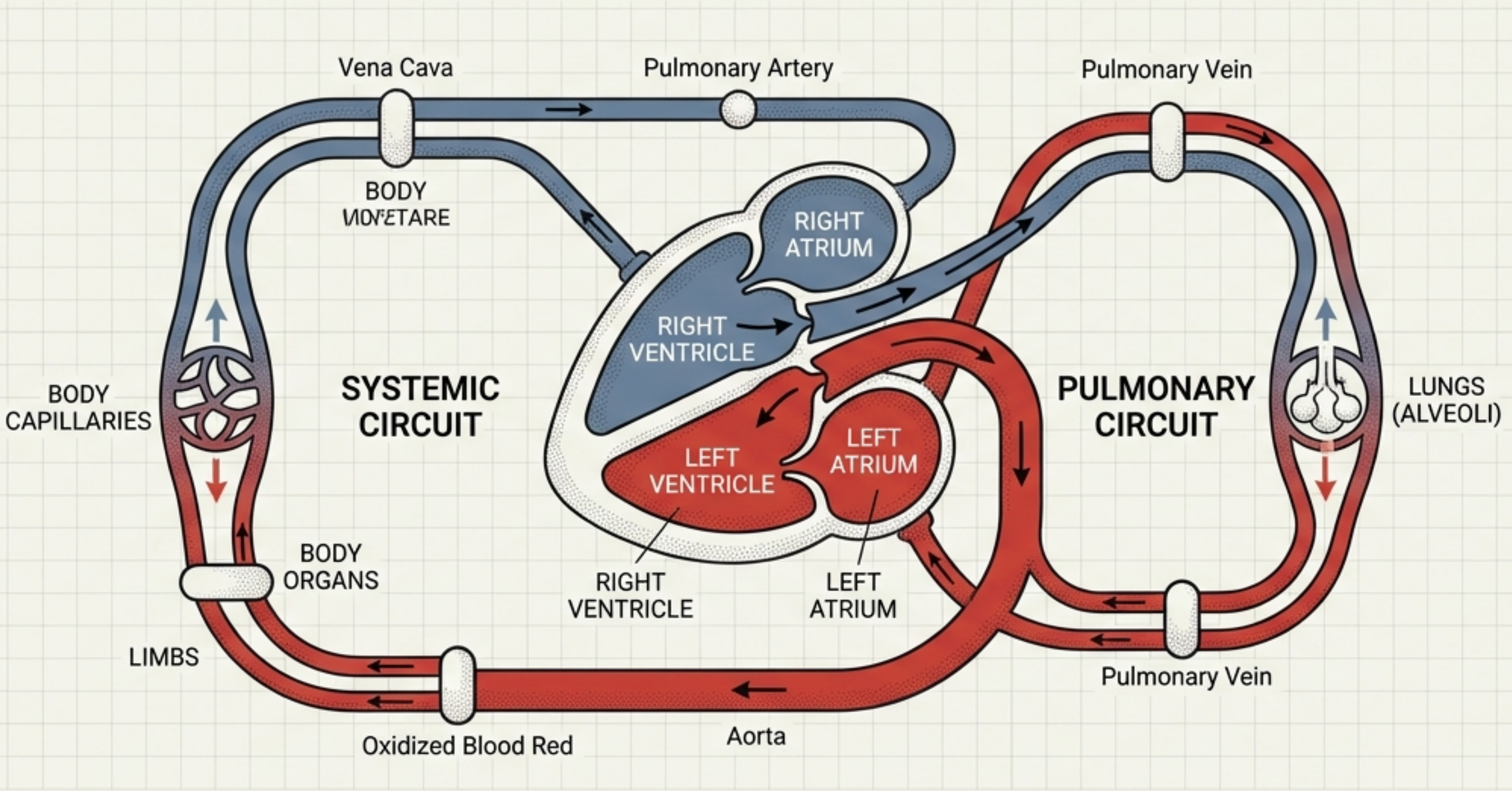
Air has high O_2
→ Internal organs needed
to prevent drying
(Lungs)

The Solution







LOGISTICS: HUMAN CIRCULATION

The Double-Pump System

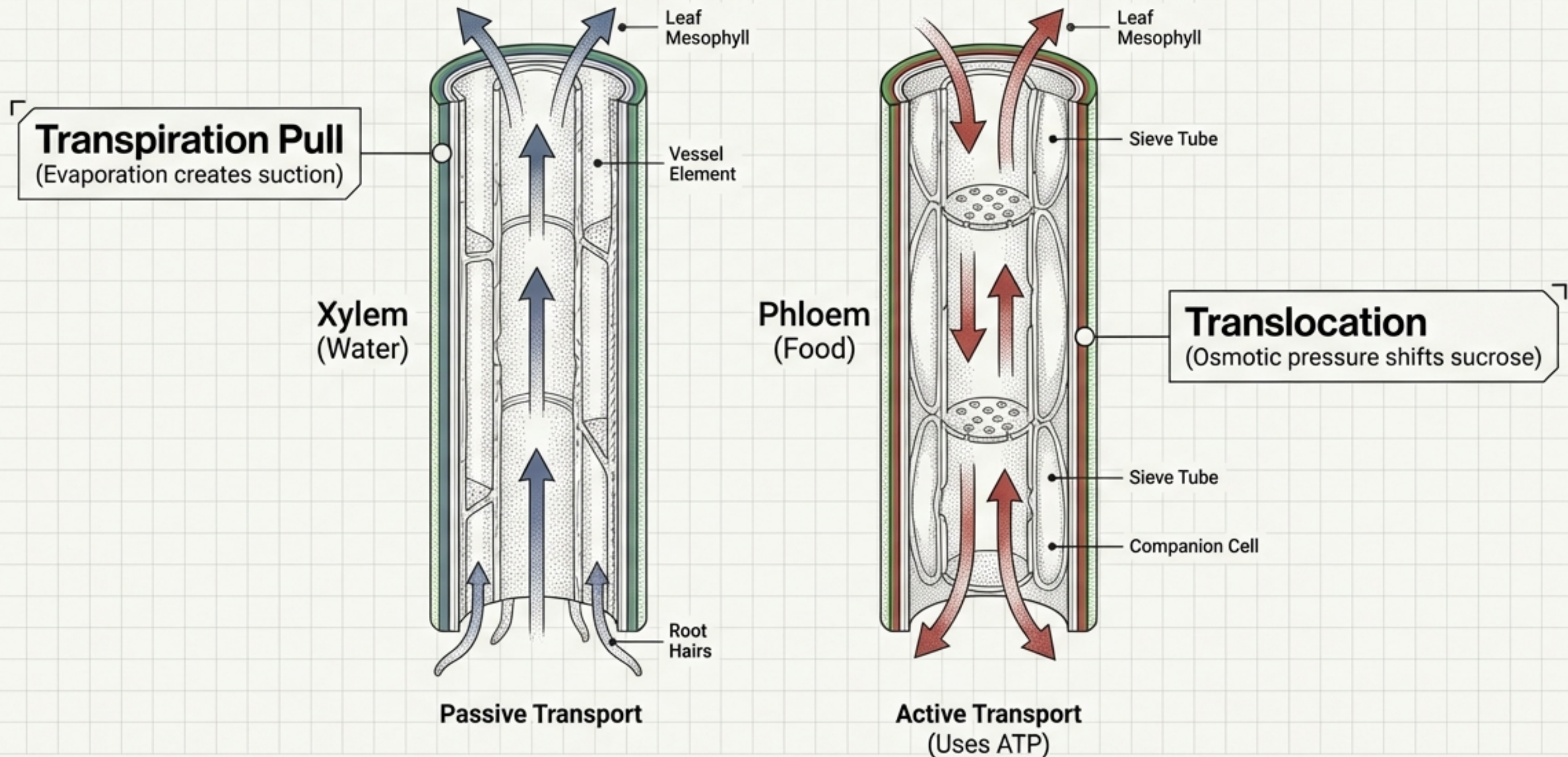


KEY DATA POINTS

-  **Separation:** 4 chambers prevent mixing, essential for high-energy temperature regulation.
-  **Arteries:** Thick walls, high pressure.
-  **Veins:** Valves to prevent backflow.
-  **Platelets:** The maintenance crew for plugging leaks.

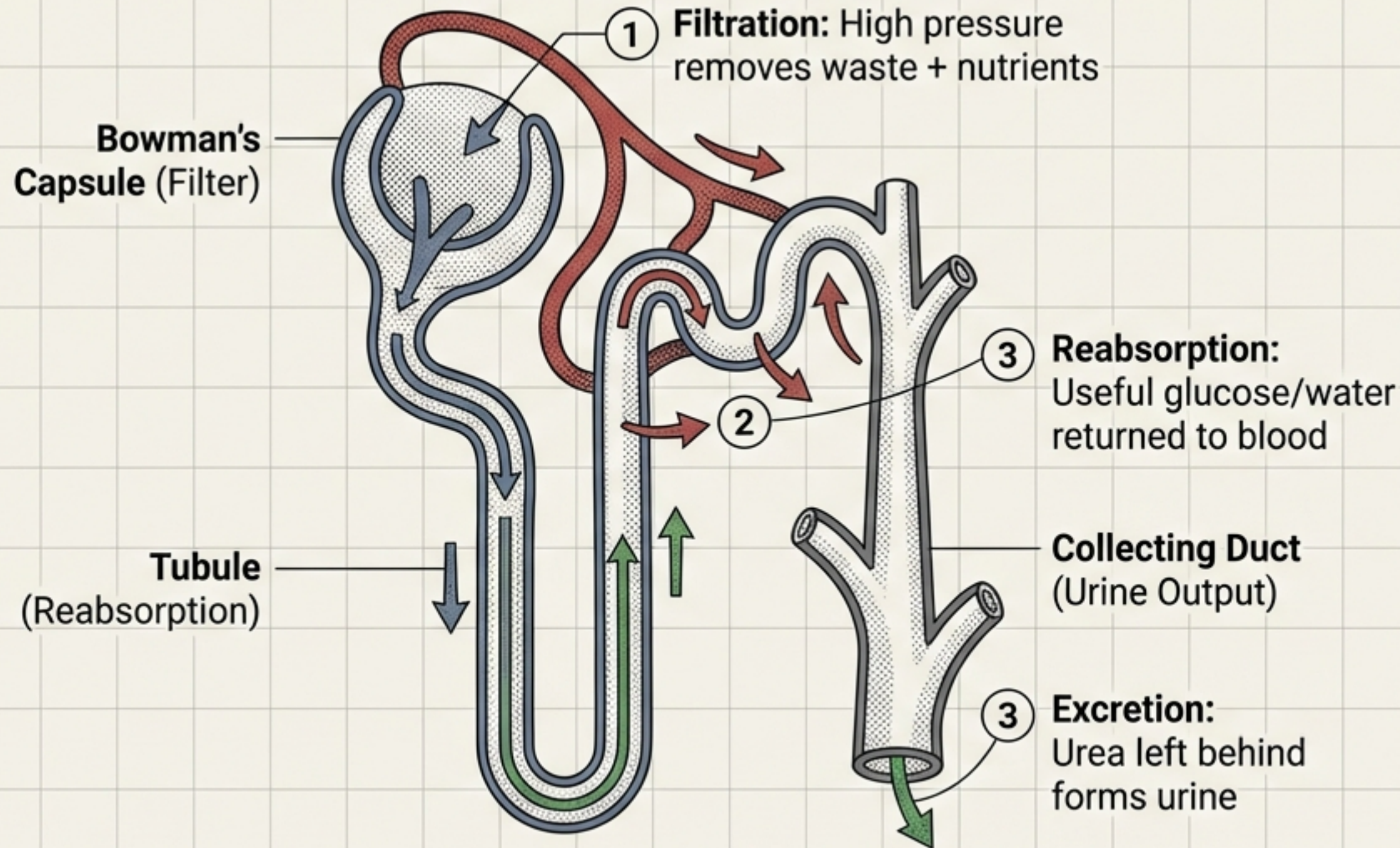
LOGISTICS: PLANT TRANSPORT

Moving materials without a pump.



WASTE MANAGEMENT: EXCRETION

Filtration and Selective Recycling



Plant Strategies

- Gaseous waste (O_2/CO_2) released to air.
- Solid waste stored in falling leaves or old xylem (resins/gums).

THE CYCLE OF MAINTENANCE

