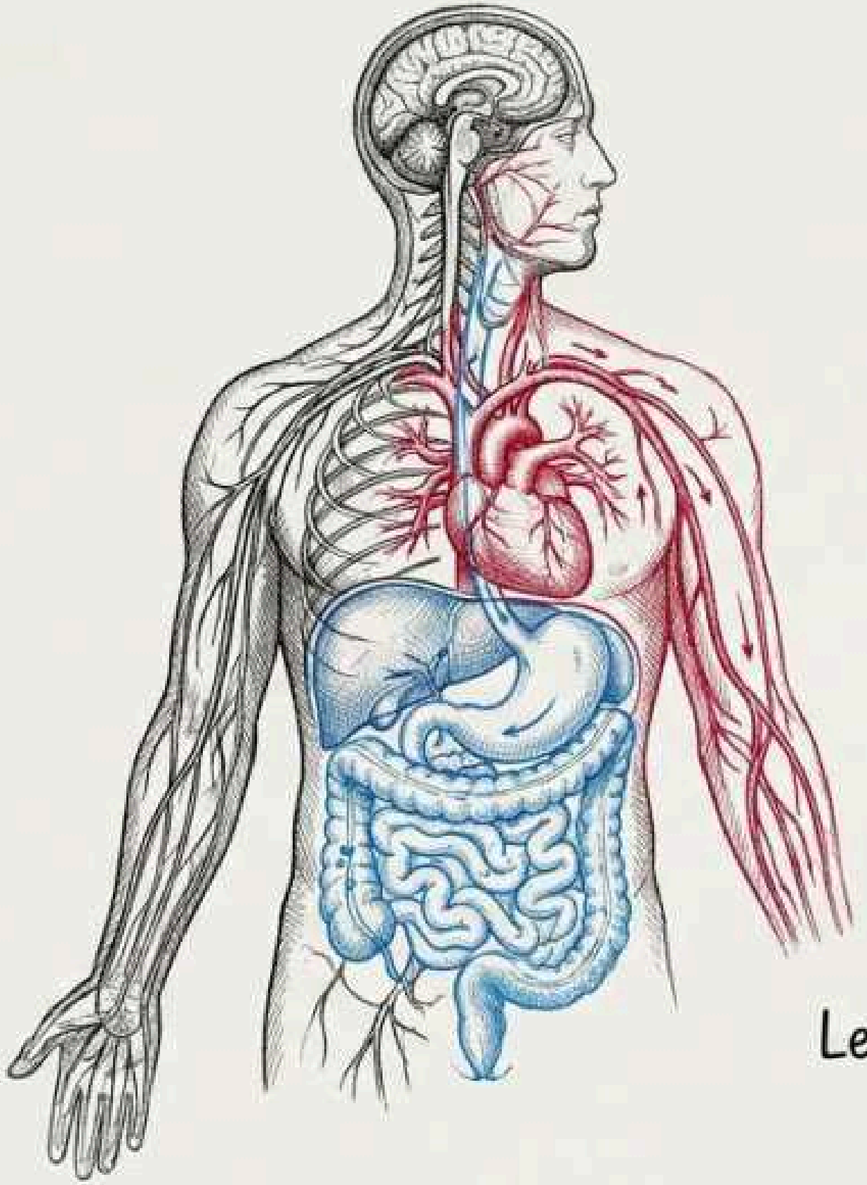
¶ 1.1

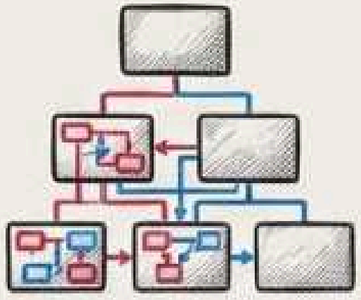
Homeostasis and the Organization of the Body



Lecture 1: The foundational mechanics of human physiology.

¶ 1.2

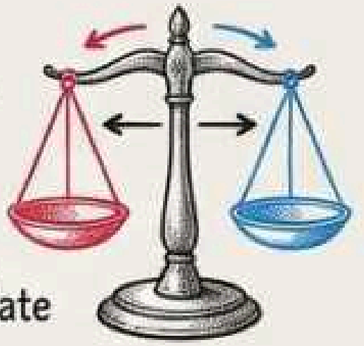
Framework of the Human Machine



Levels of Organization

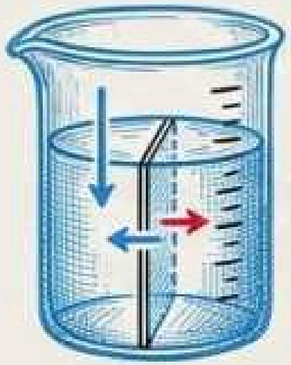
Building from molecules up to the whole person.

Homeostasis



The steady internal state keeping cells alive.

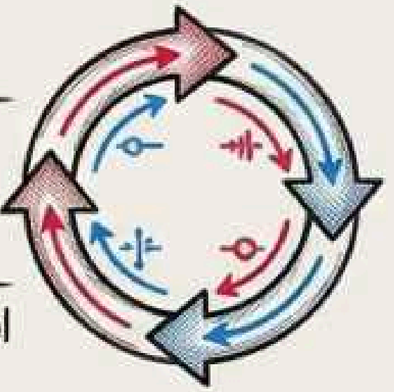
The Body



Water Compartments

Mapping the fluid divisions.

Feedback Loops



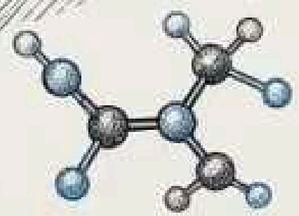
The body's control systems.

¶ 1.3

The Hierarchy of Biological Assembly

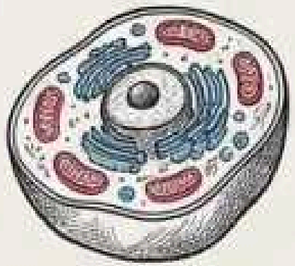
Emergent Properties: Each level achieves **functions** the level below cannot.

Atoms → Molecules

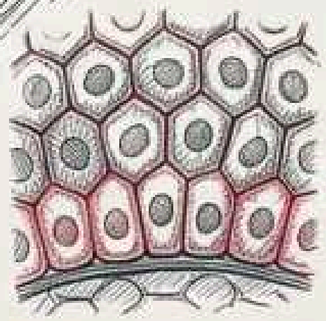


Cells

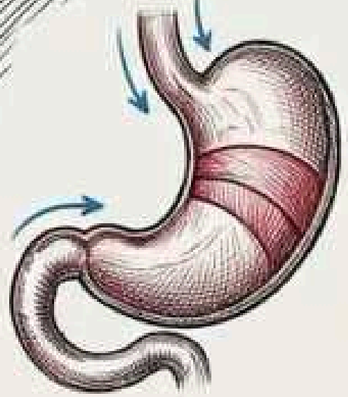
the smallest units of life



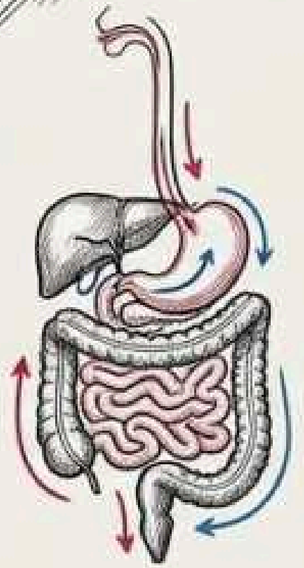
Tissues



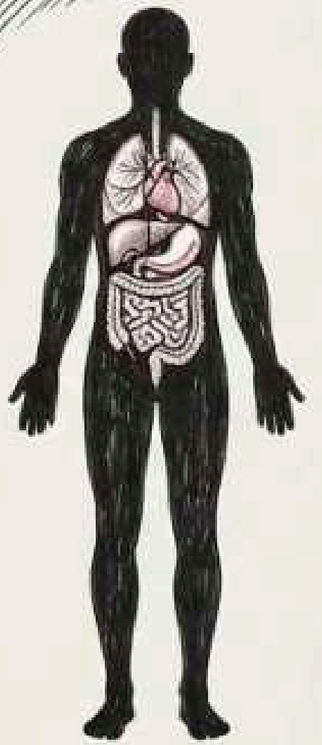
Organs



Organ Systems



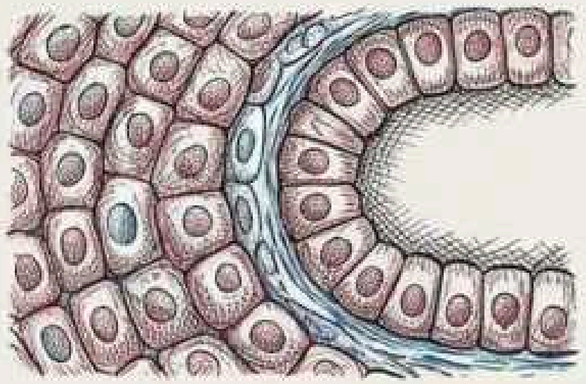
Organism



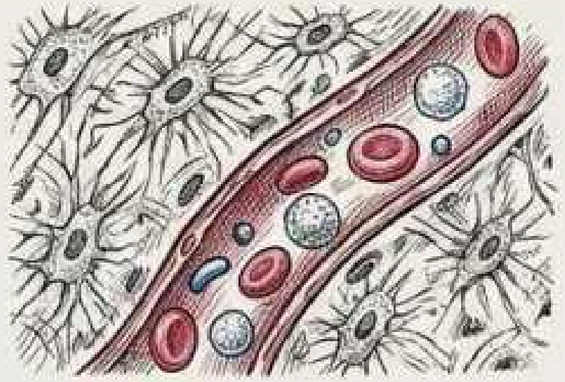
¶ 1.4

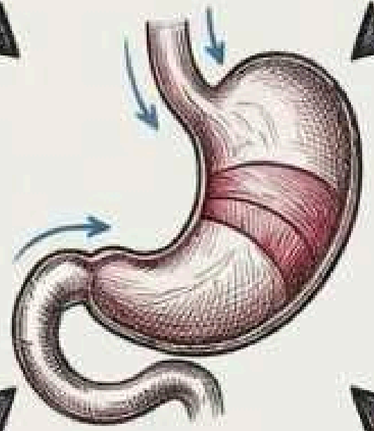
Four Fundamental Tissues Build Every Organ

Epithelial: Covers surfaces & lines cavities.

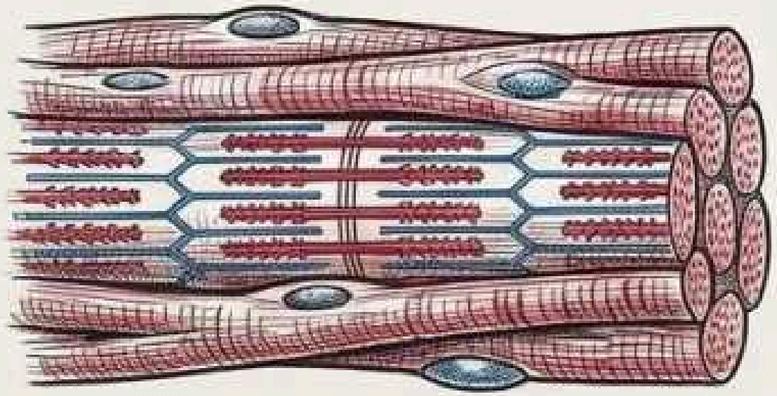


Connective: Supports & joins.

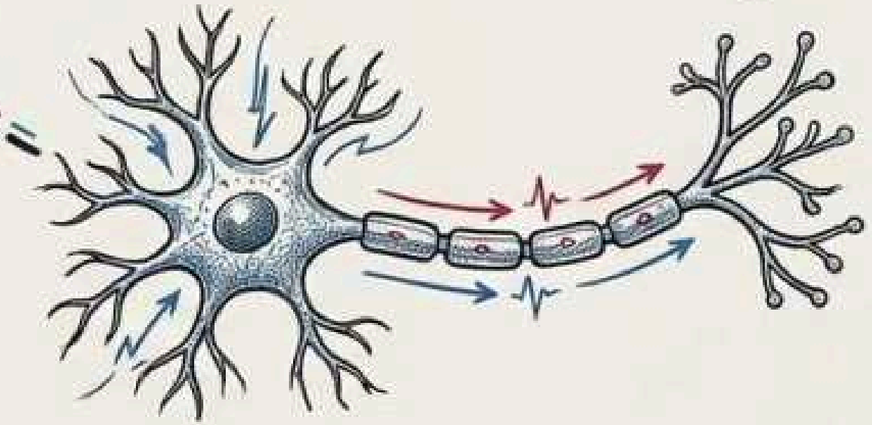




Muscle: Contracts for force.



Nervous: Carries electrical signals.



The Necessity of a Protected Inner World

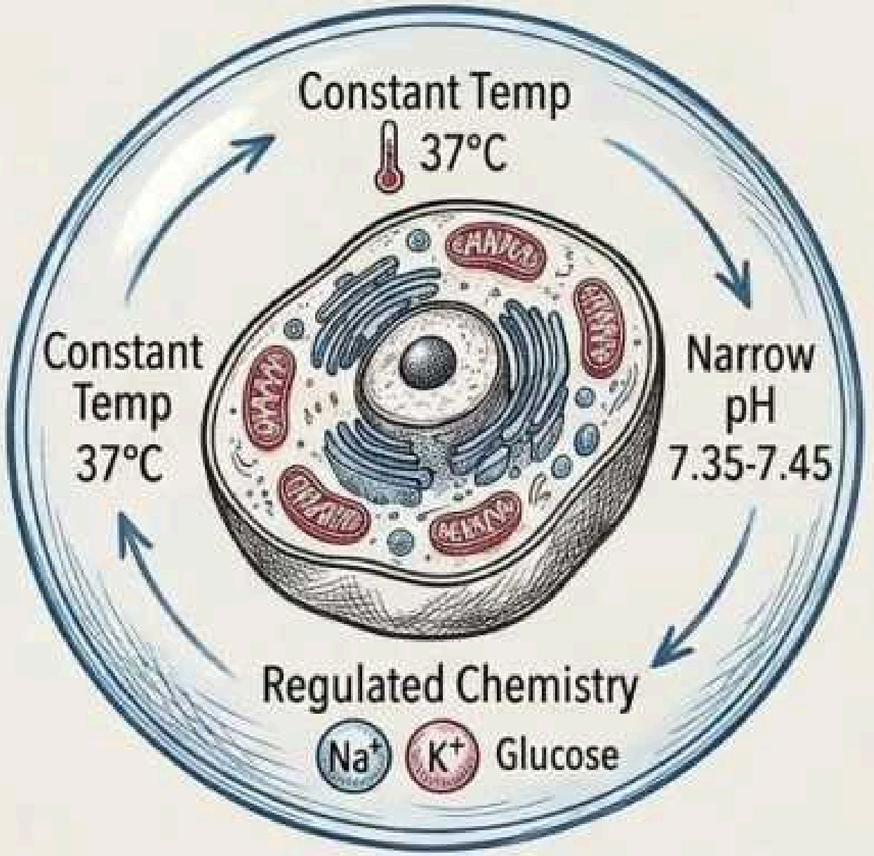
¶ 1.5

The Harsh Outdoors



Hostile, unpredictable, fatal to fragile biology.

The Stable Inner World



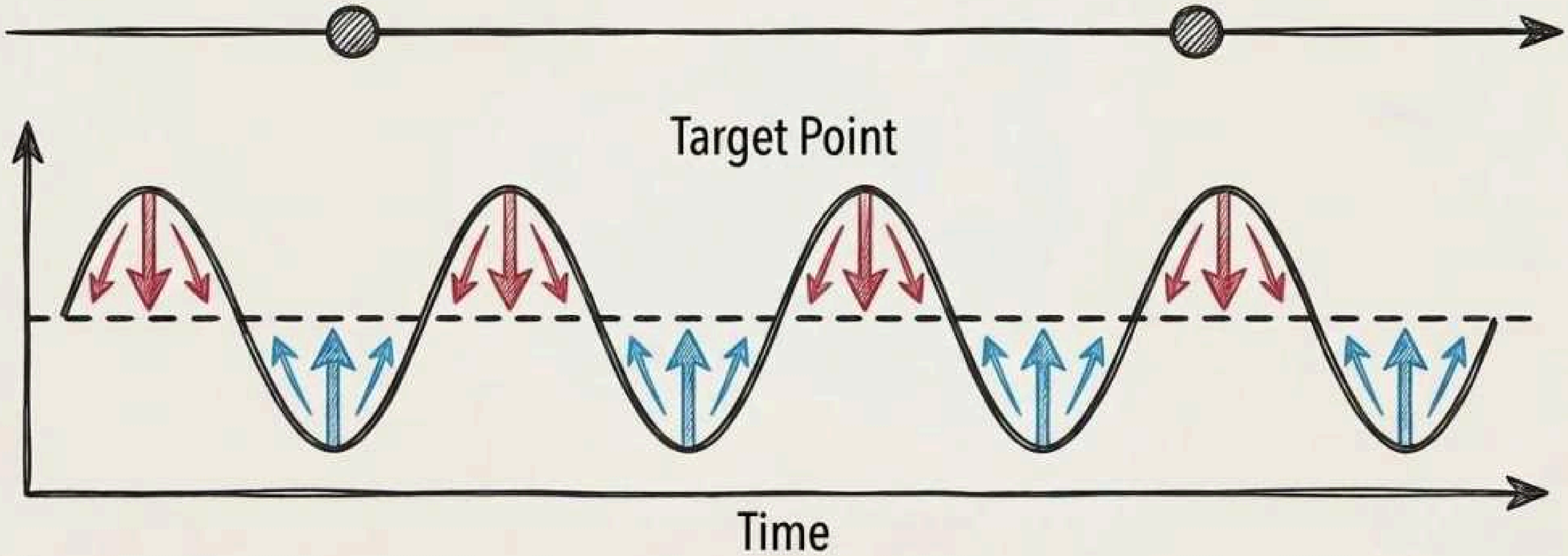
Cells only survive within extremely narrow environmental limits.

¶ 1.6

Dynamic Equilibrium: The History of Homeostasis

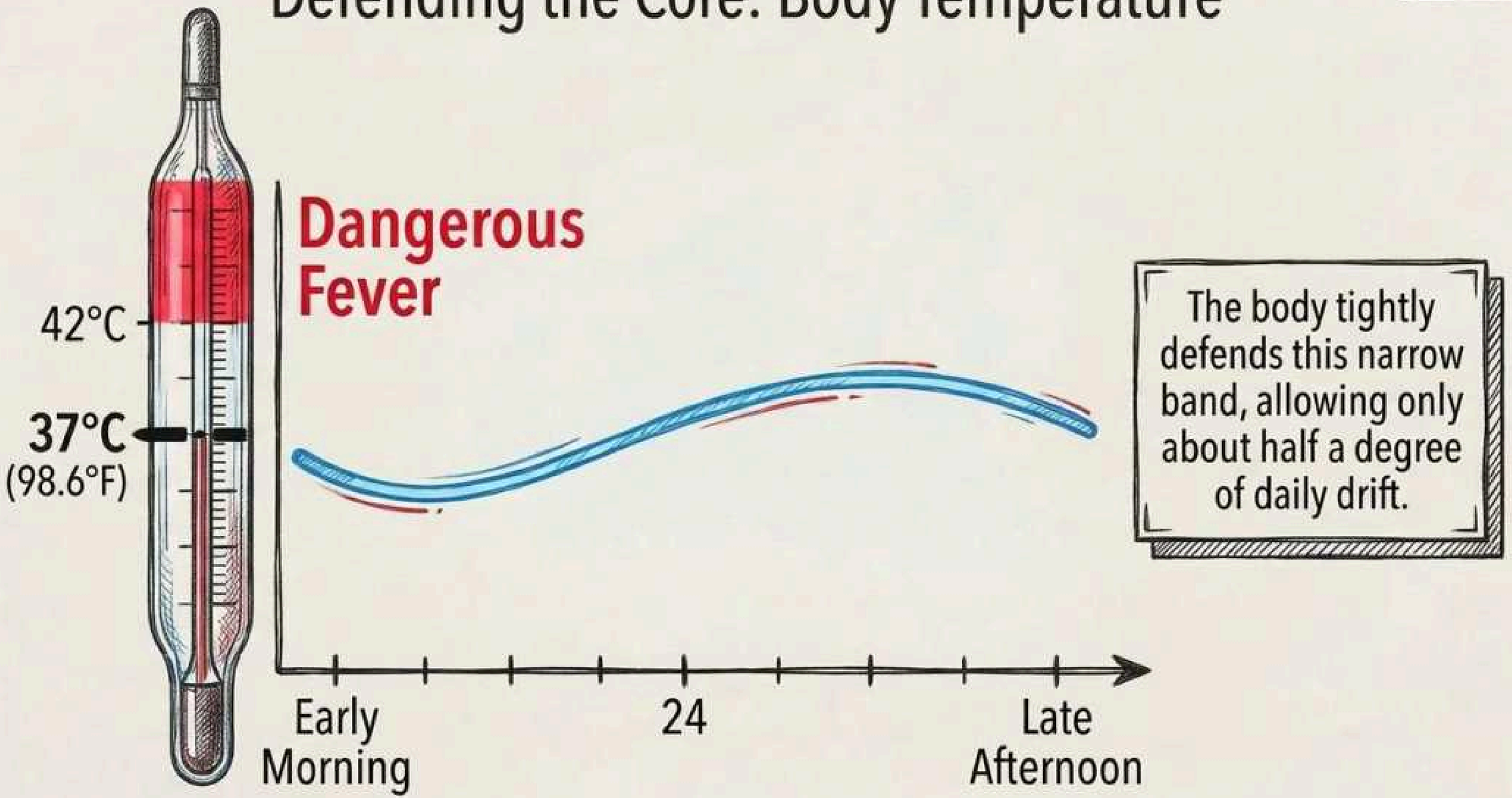
19th Century: Claude Bernard defines the "Internal Environment"

20th Century: Walter Cannon coins "Homeostasis" (staying similar)



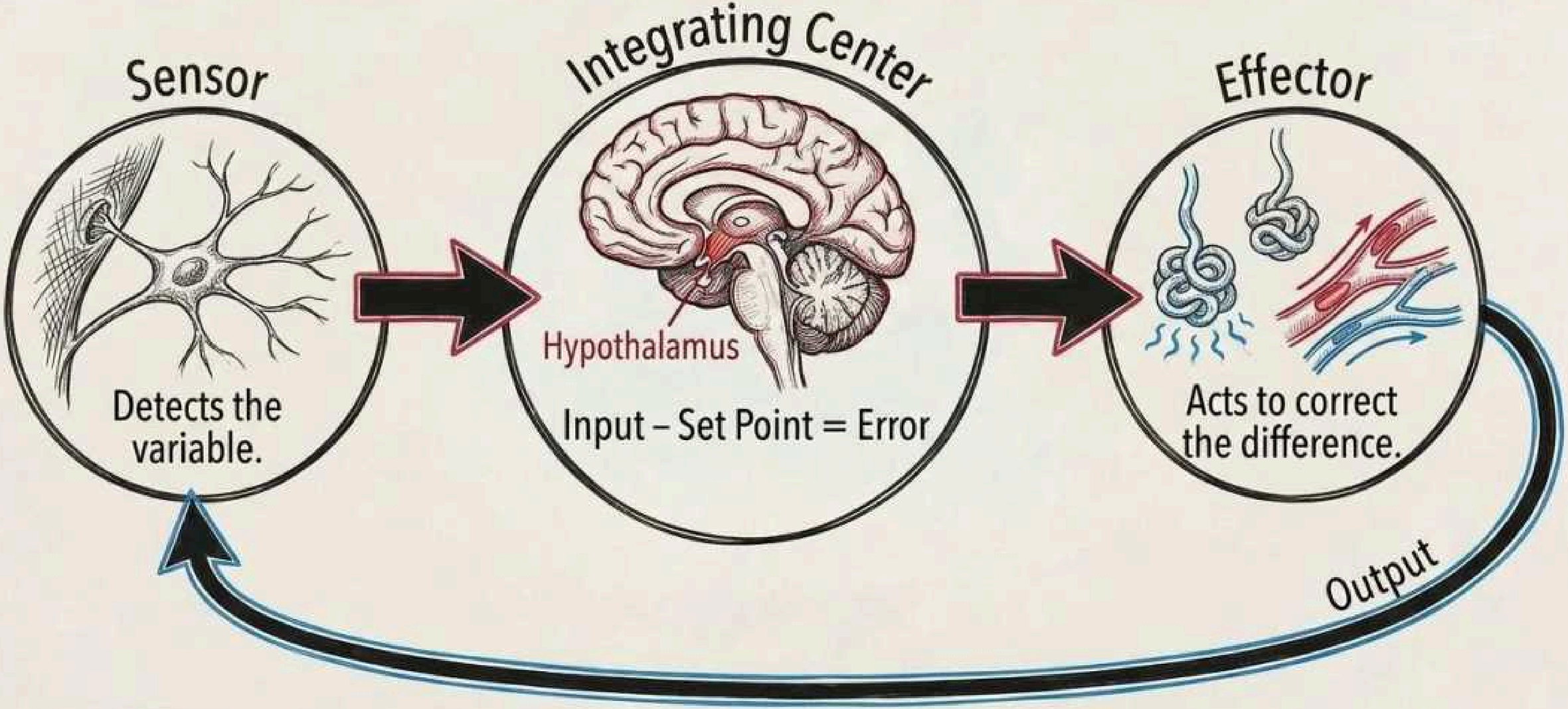
Homeostasis does not mean staying fixed. Conditions wobble around a target, and the body actively pulls them back.

Defending the Core: Body Temperature



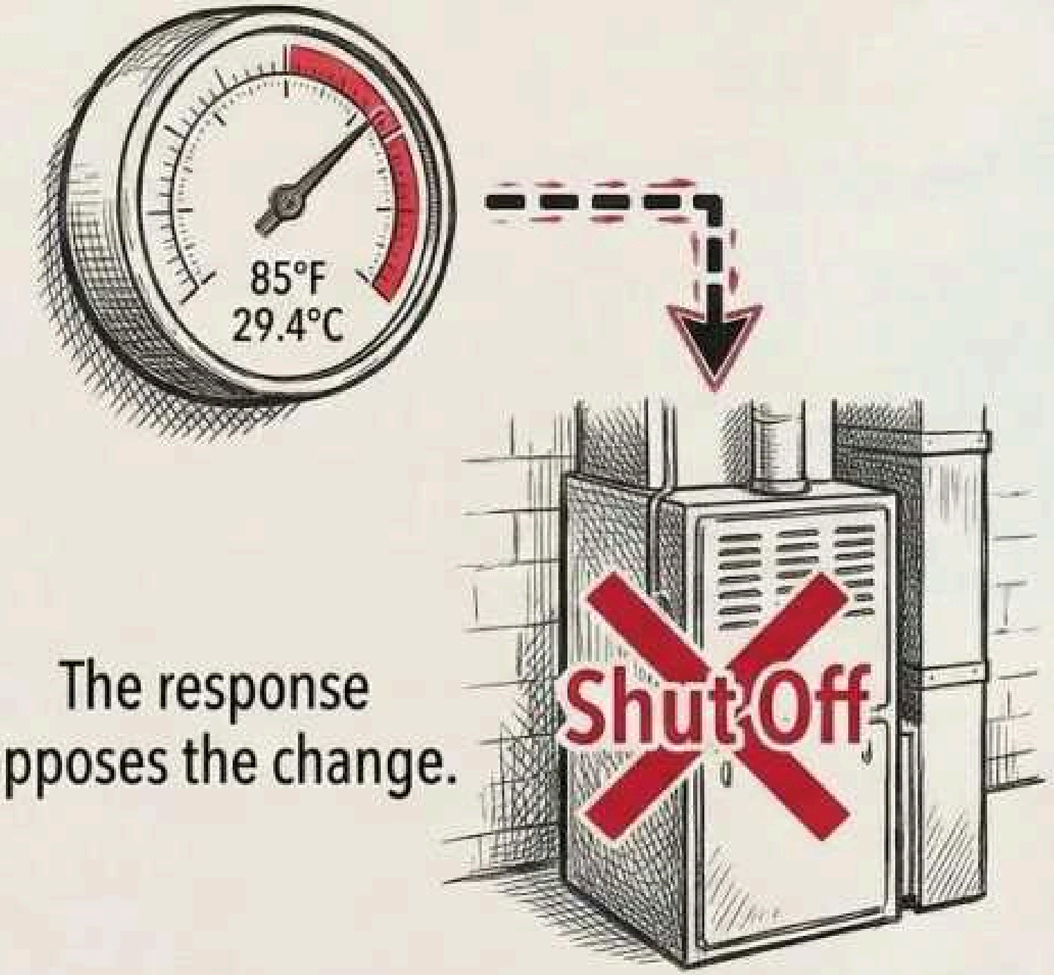
¶ 1.8

The Anatomy of a Control Circuit



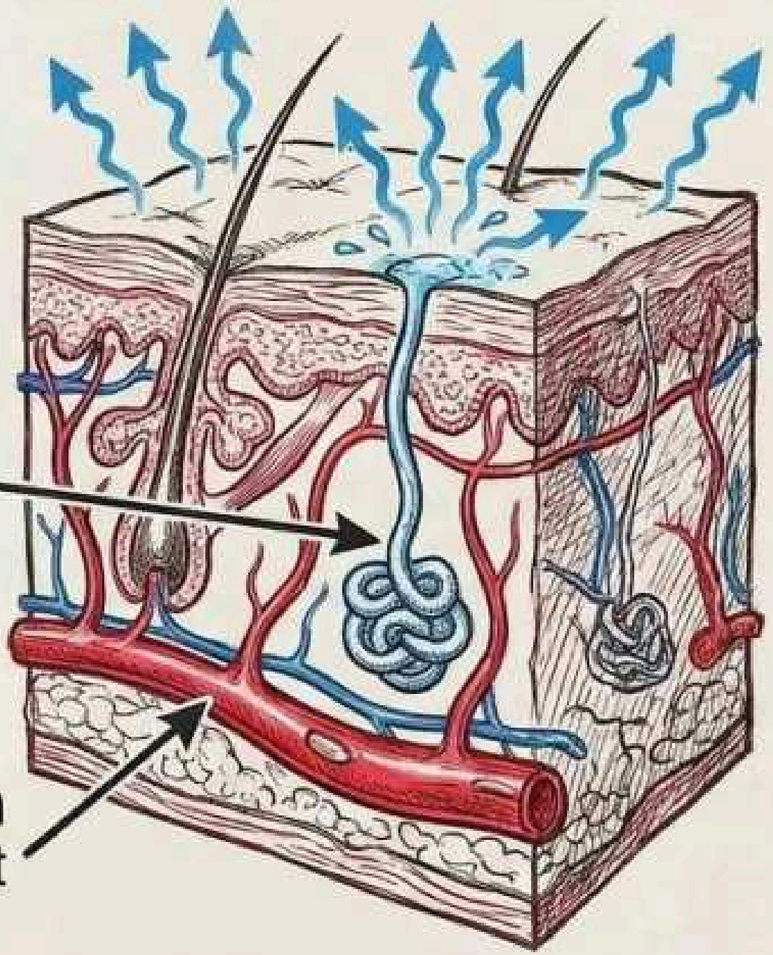
Negative Feedback: Cooling the System

Mechanical Engineering



The response opposes the change.

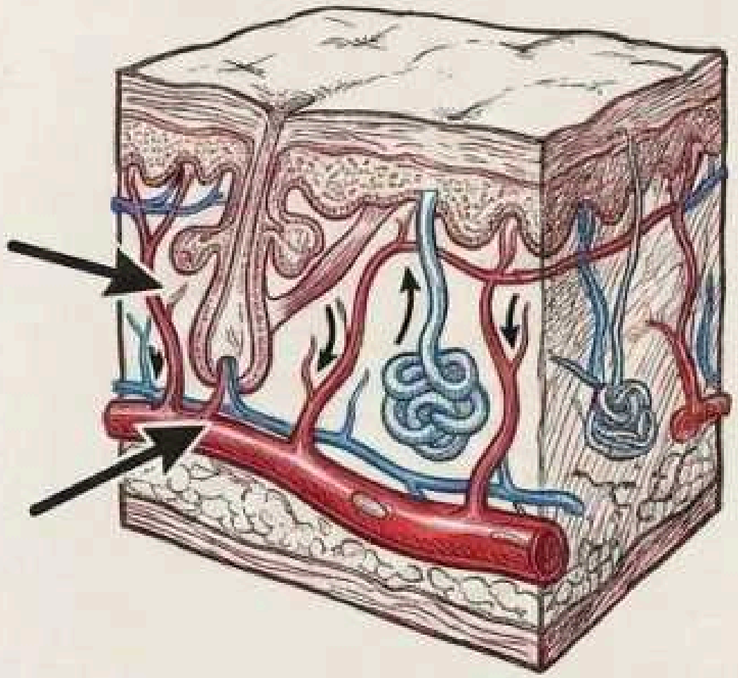
Human Biology



¶1.10

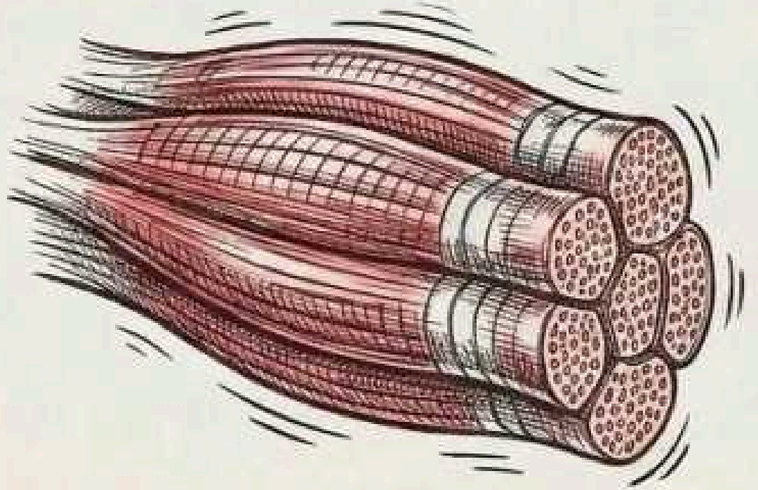
Negative Feedback: Generating Heat

1. Vasoconstriction



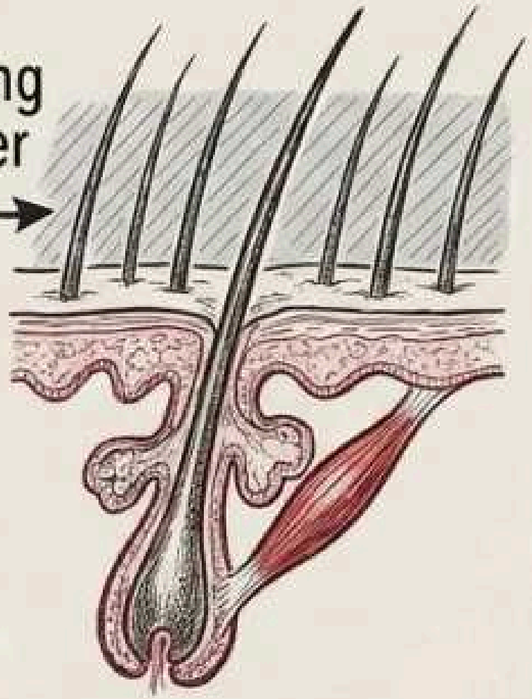
Keeps warm blood deep near the core.

Fuel → Heat



Shivering

3. Piloerection

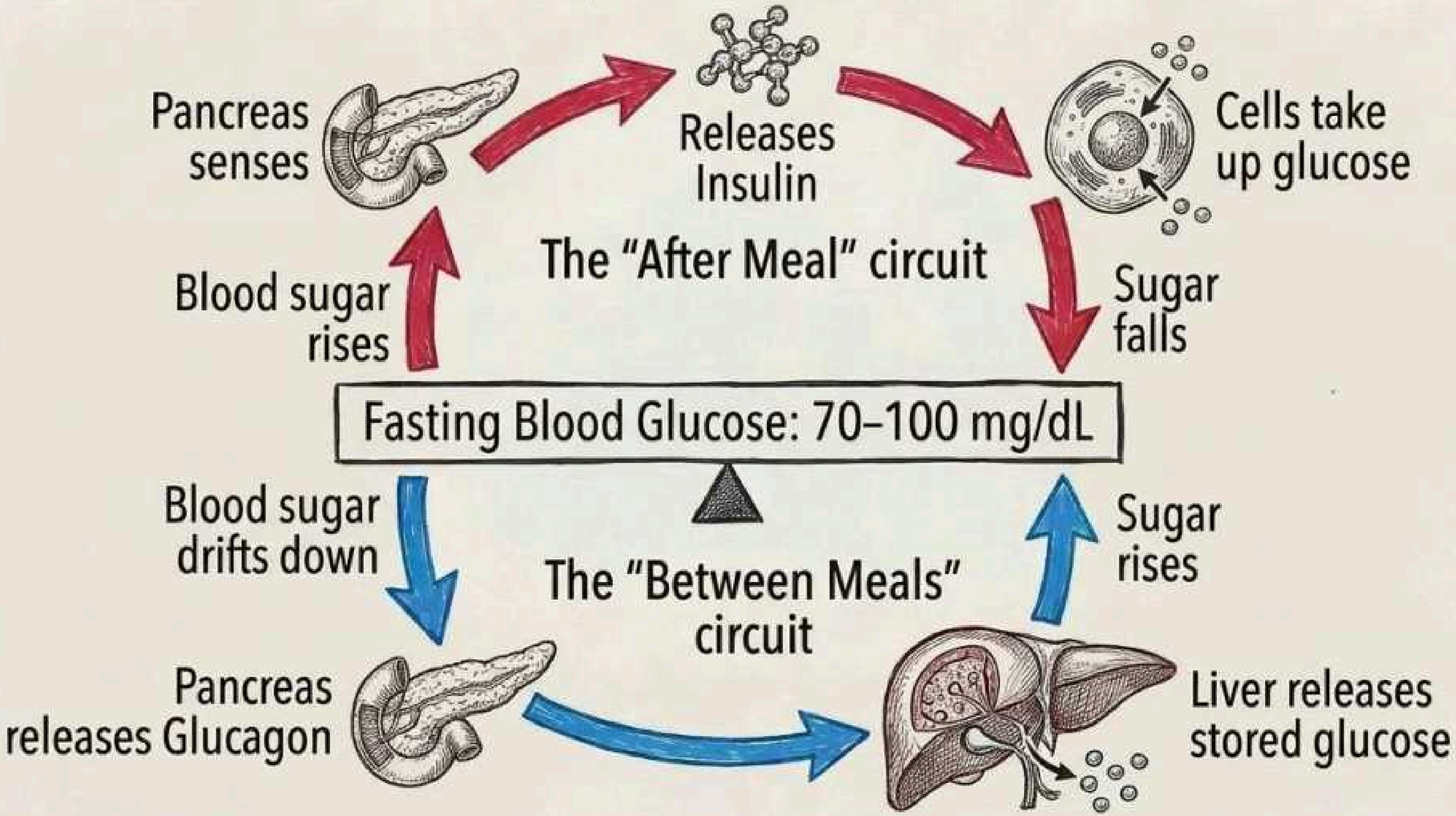


Piloerection

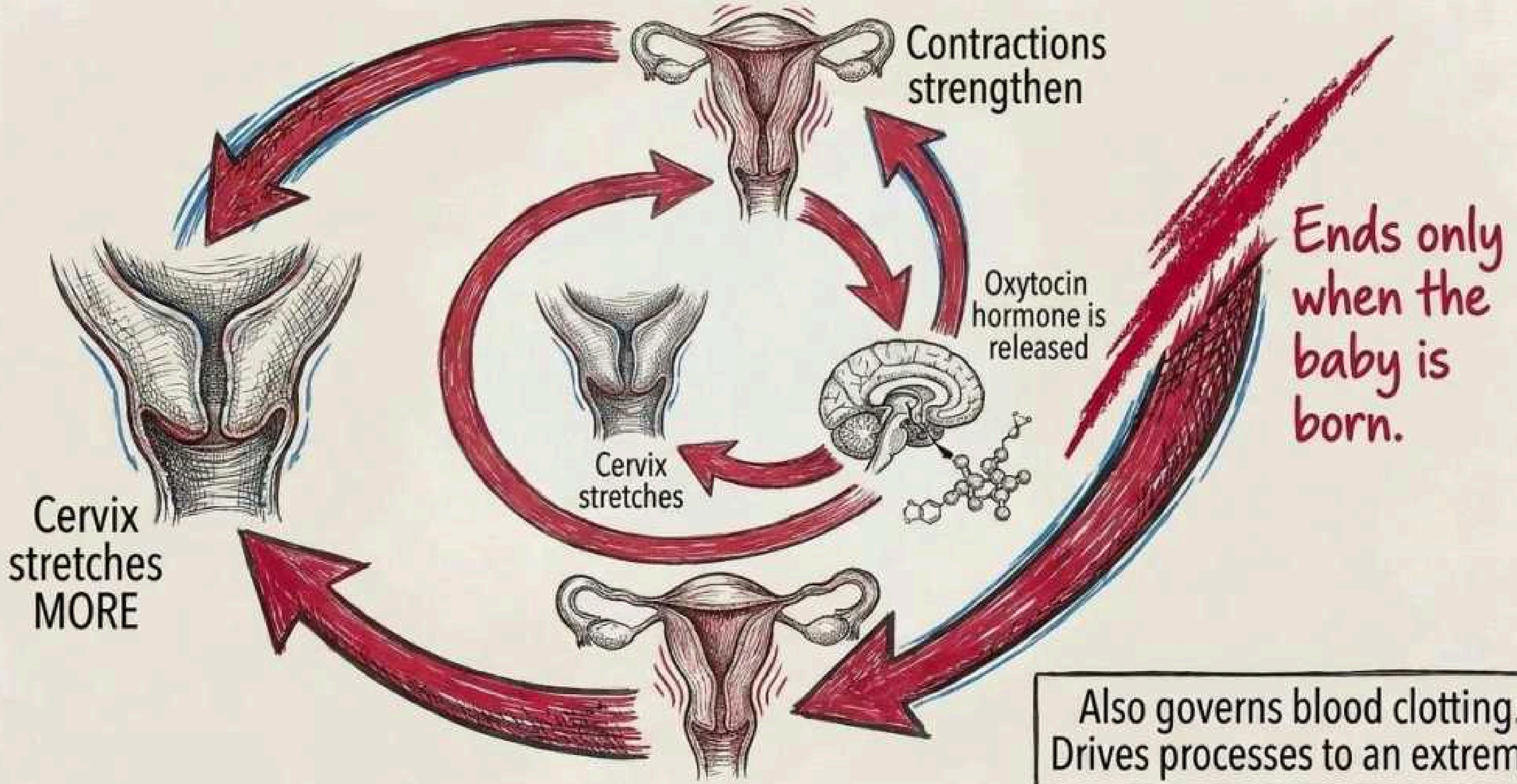
Each effector response pushes core temperature back toward the 37°C set point.

¶1.11

The Dual Loop: Blood Sugar Balance



Positive Feedback: Amplifying the Change



Also governs blood clotting.
Drives processes to an extreme.

Synthesis: Negative vs. Positive Feedback

Negative Feedback	Positive Feedback
• Maintains stability	• Drives to an extreme
• Continuous operation	• Completes a one-way event
• Actively opposes the initial change	• **REQUIRES** an outside stop

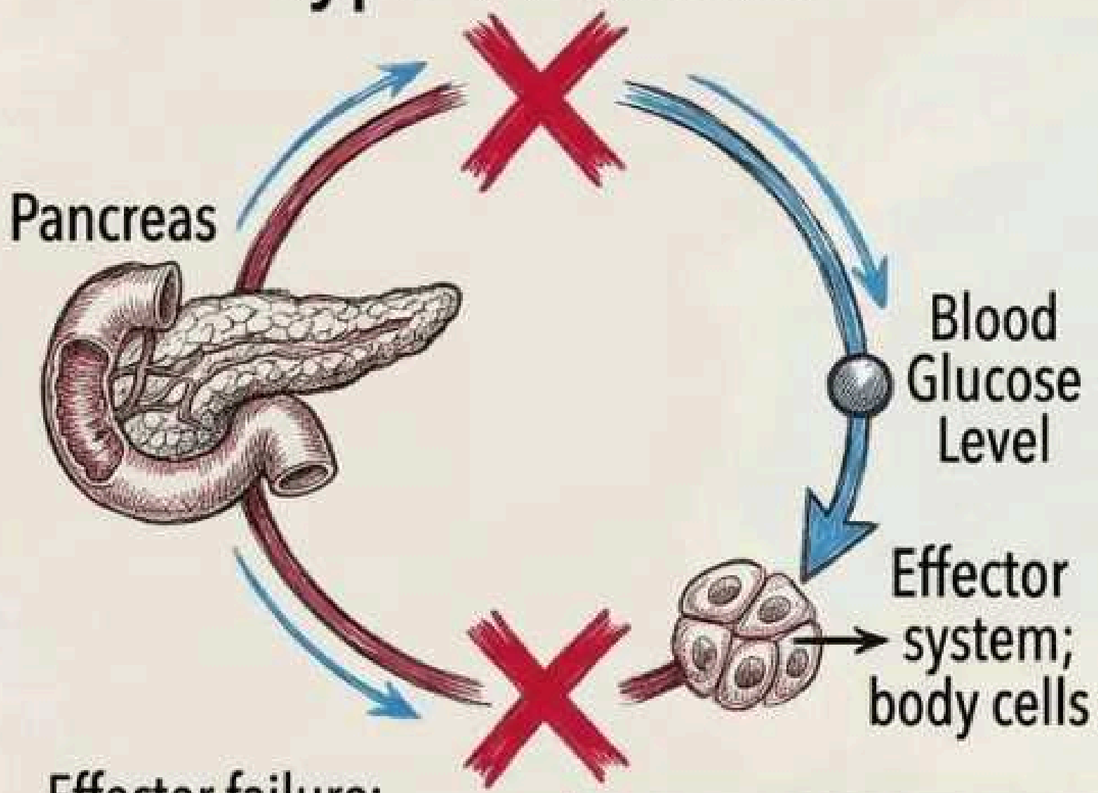


If positive feedback is **not switched off**, it **runs away**.
A thermostat stuck on high eventually ruins the house.

¶1.14

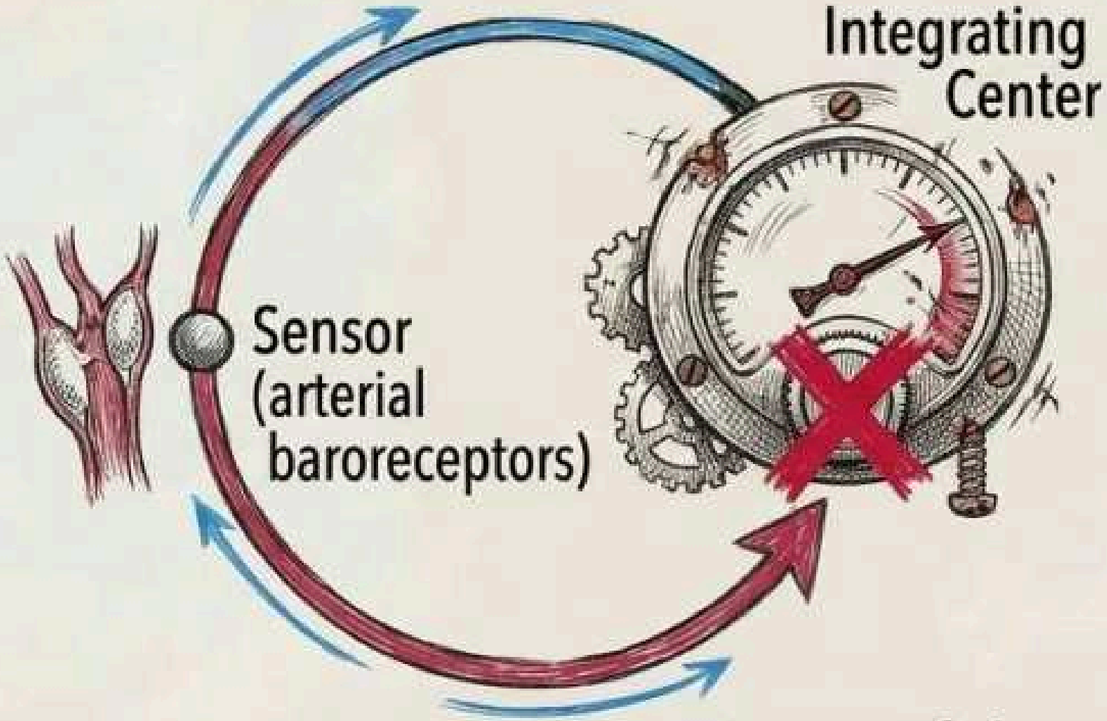
Disease as Failed Homeostasis

Type 1 Diabetes



Effector failure: Pancreas stops making insulin; glucose climbs.

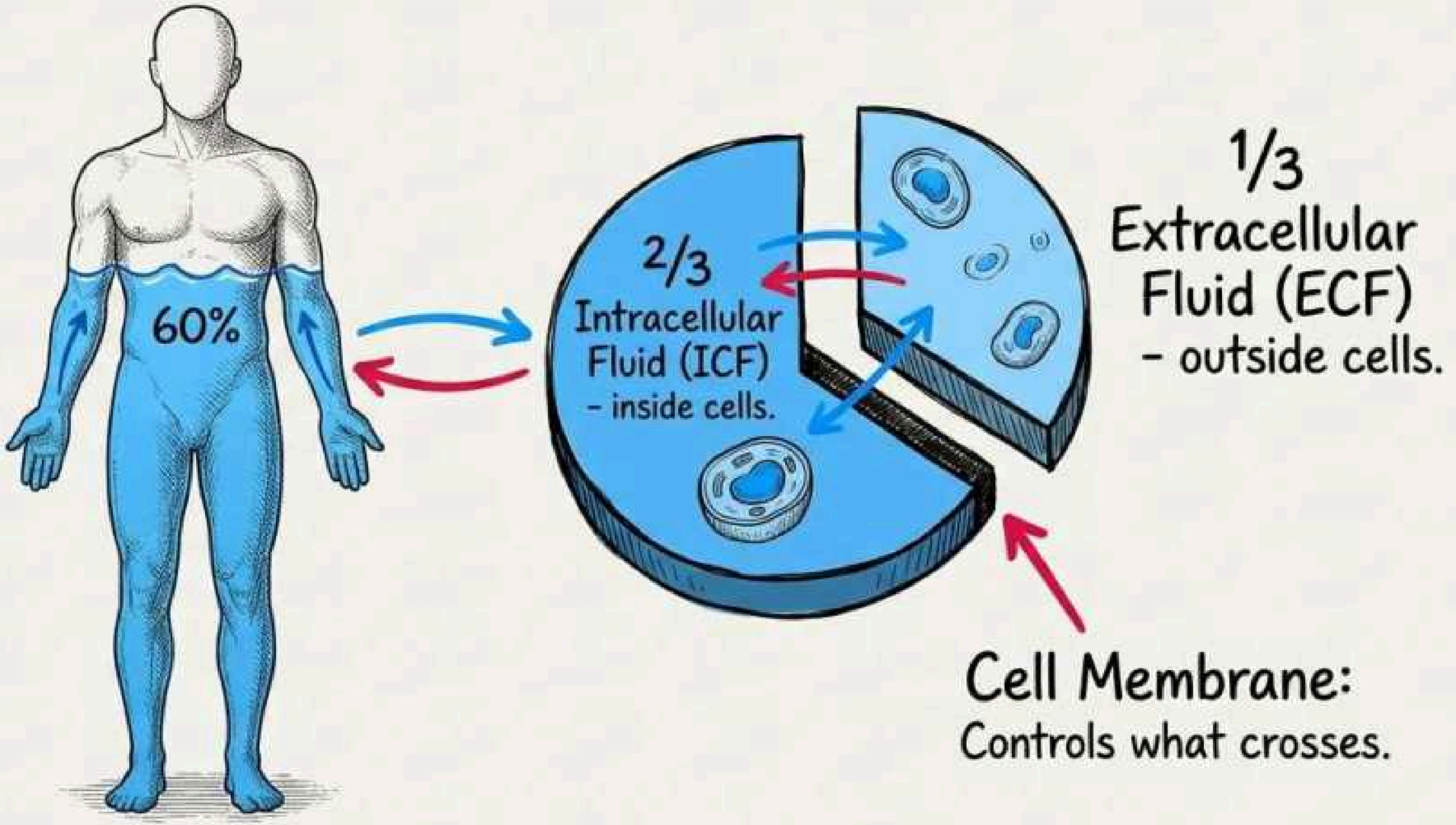
High Blood Pressure



Set-point failure: Control system settles at a dangerously high target.

Medicine is largely the art of restoring a broken loop or replacing a missing part.

The Fluid Architecture of the Body



Fluid Mathematics

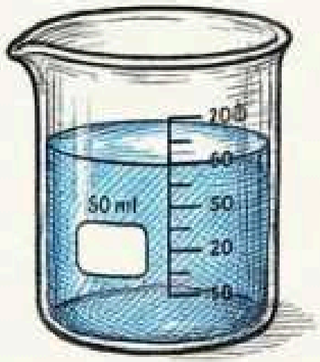
Base Weight = 70 kg

Total Water (60%) = 70 x 0.60 = 42 L

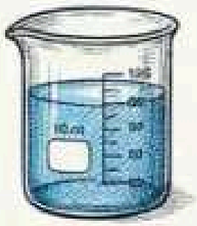


1 kg water
≈ 1 Liter

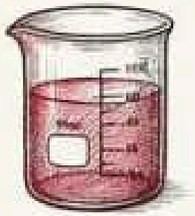
ICF (Inside Cells) = $\frac{2}{3}$ of 42 = 28 L



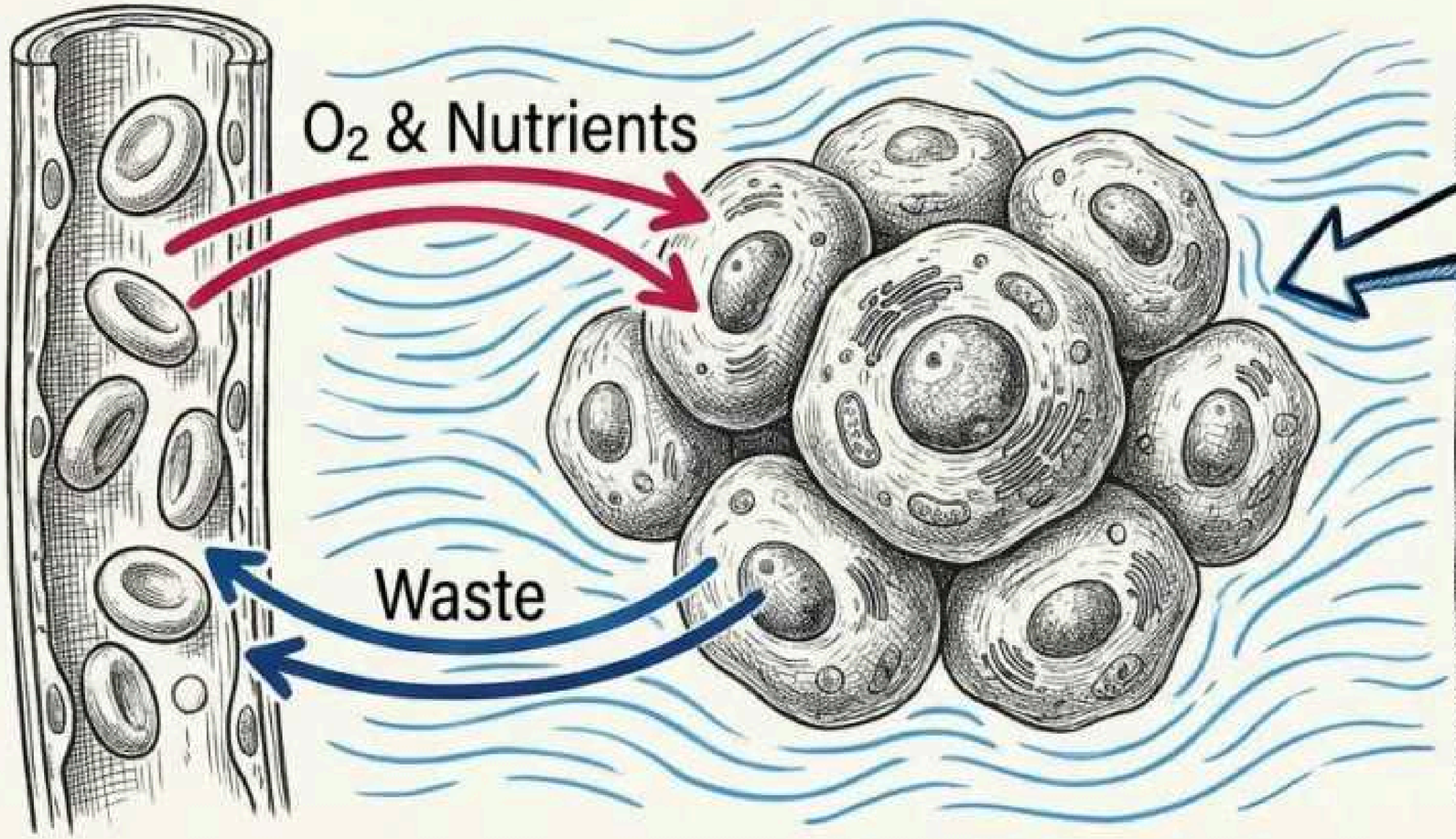
ECF (Outside Cells) = $\frac{1}{3}$ of 42 = 14 L



→ 3 L = Plasma (the liquid part of blood).



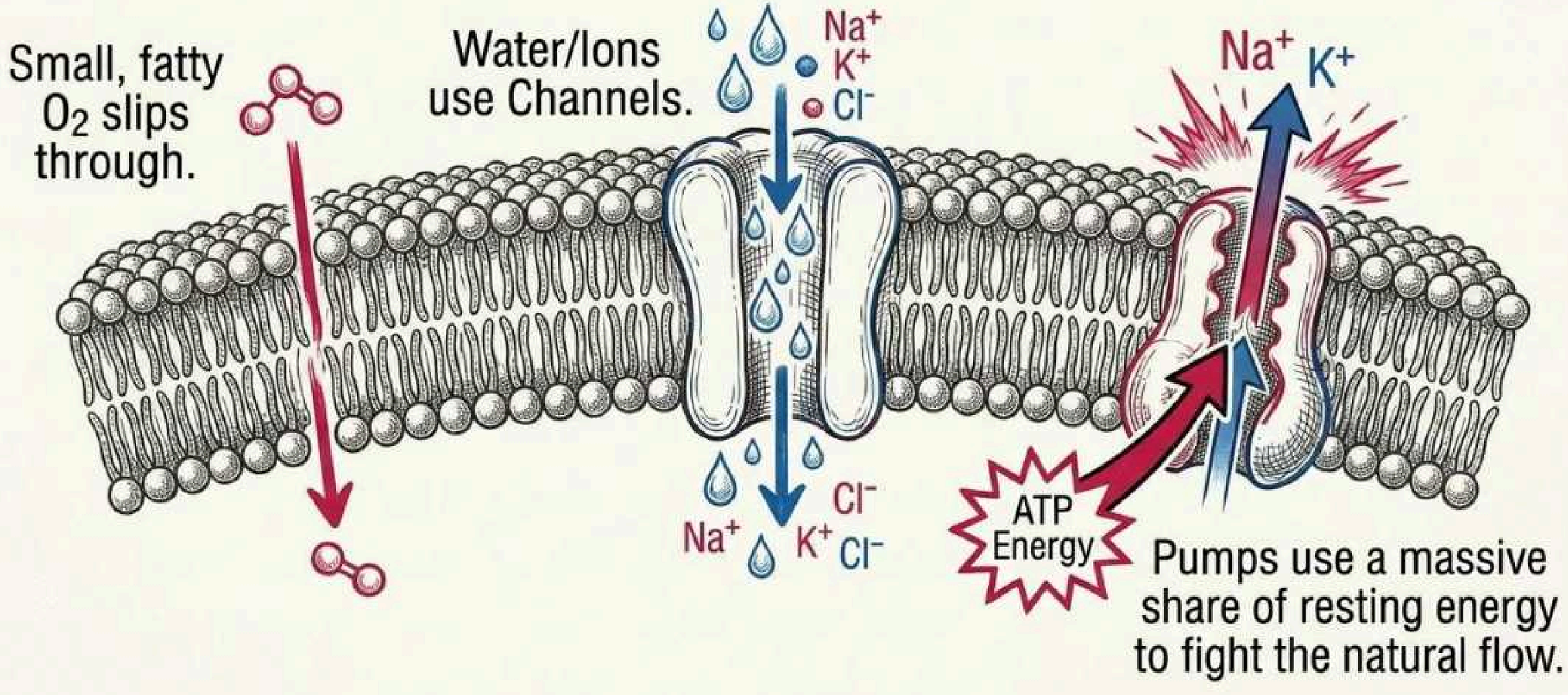
Interstitial Fluid: The True Internal Environment



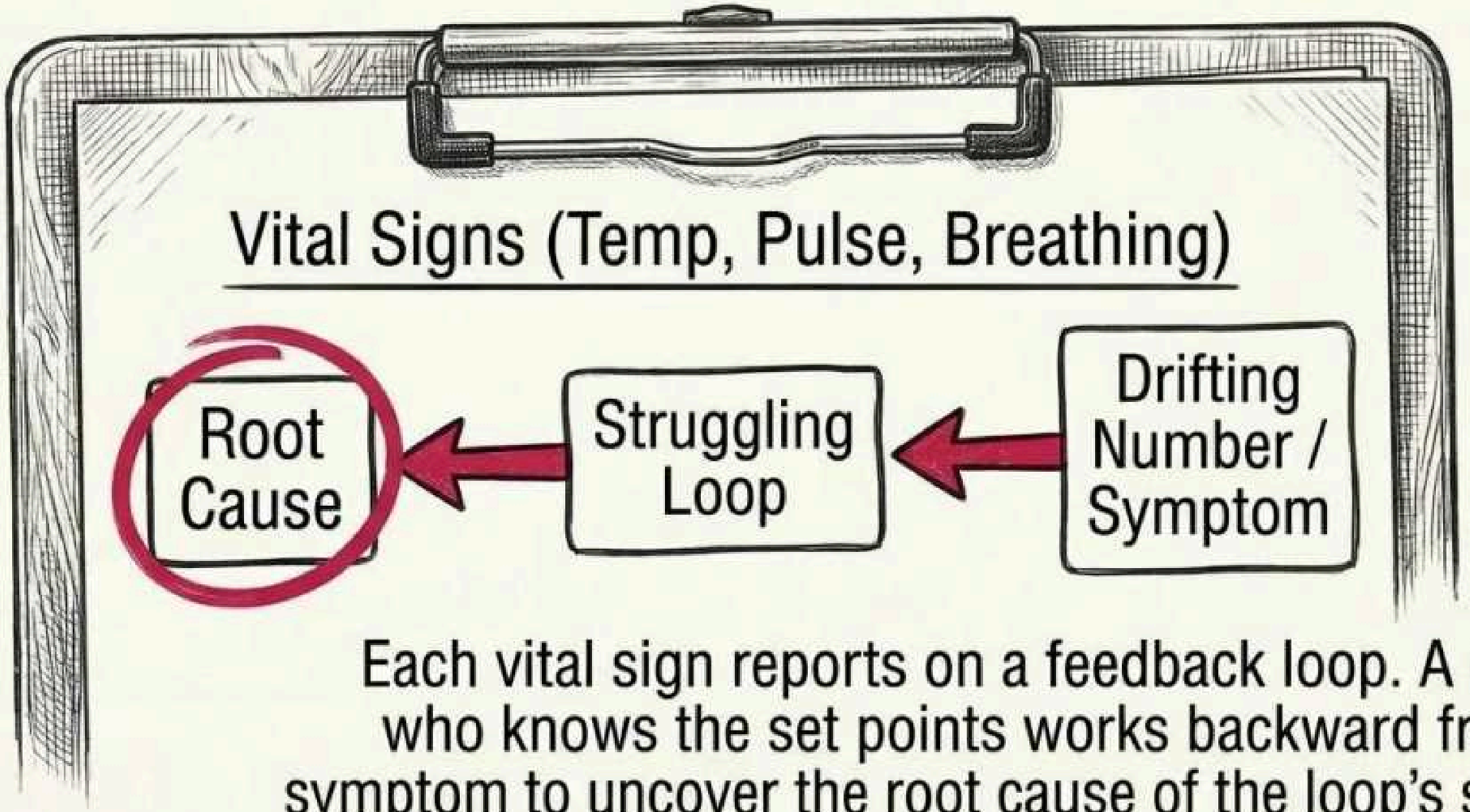
The remaining **11 Liters = Interstitial Fluid.** It directly bathes the cells.

Everything in this course is about keeping these 11 liters fit for living.

The Cell Membrane: Border Control



Clinical Application: Vital Signs



Each vital sign reports on a feedback loop. A clinician who knows the set points works backward from a symptom to uncover the root cause of the loop's struggle.

Test Your System Logic

¶ 1.20

Scenario: Hot after exercise.

Sensor: [_____]

Integrating Center: [_____]

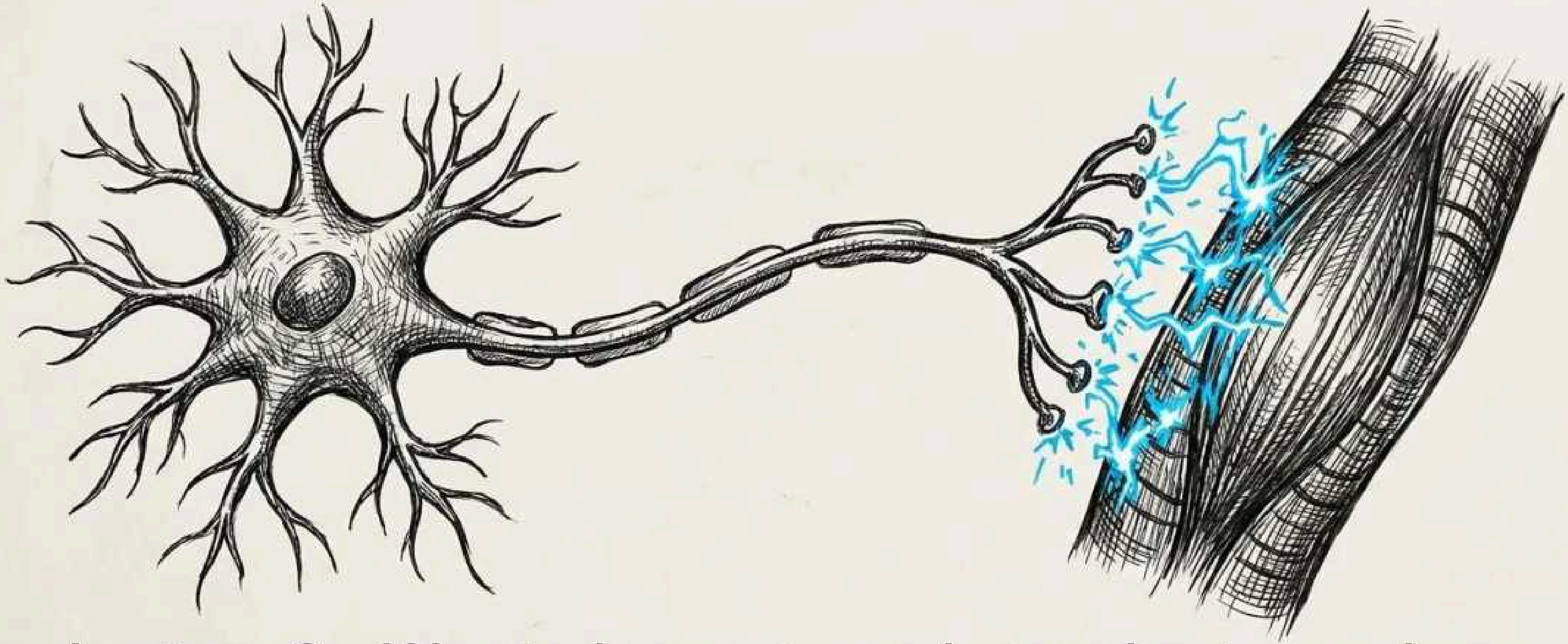
Effectors: [_____]

Loop Type: Negative or Positive? Why?

Mastering this logic unlocks the entire course.

Coming Next: Excitable Cells

¶ 1.21



Lecture 2 - We study nerves and muscles to see how electrical signals produce thought and movement.