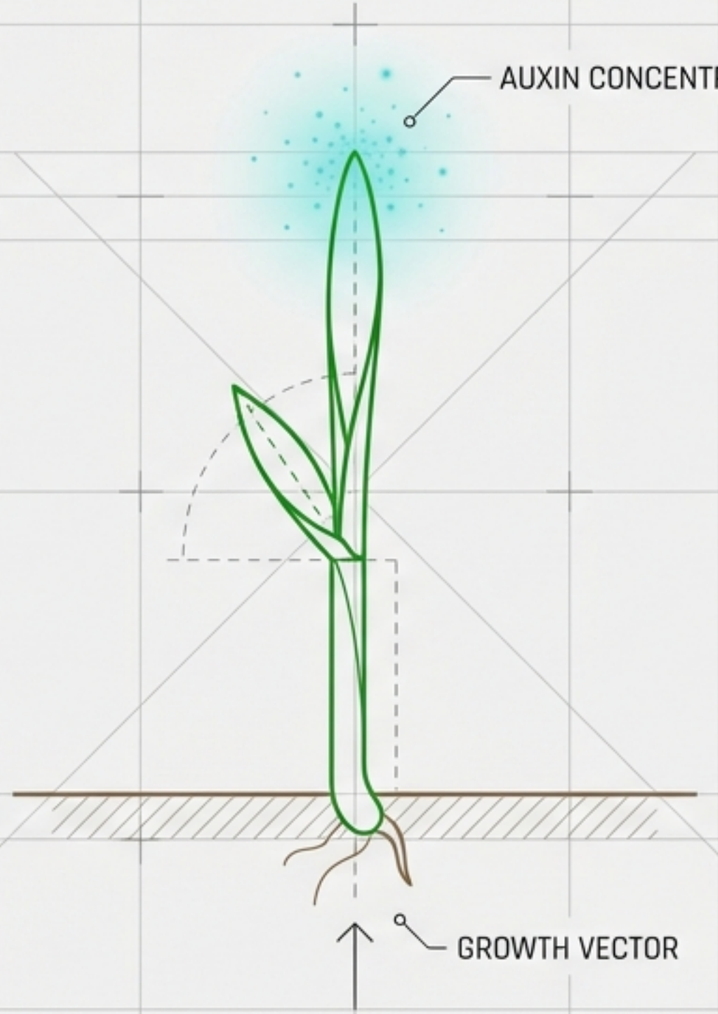
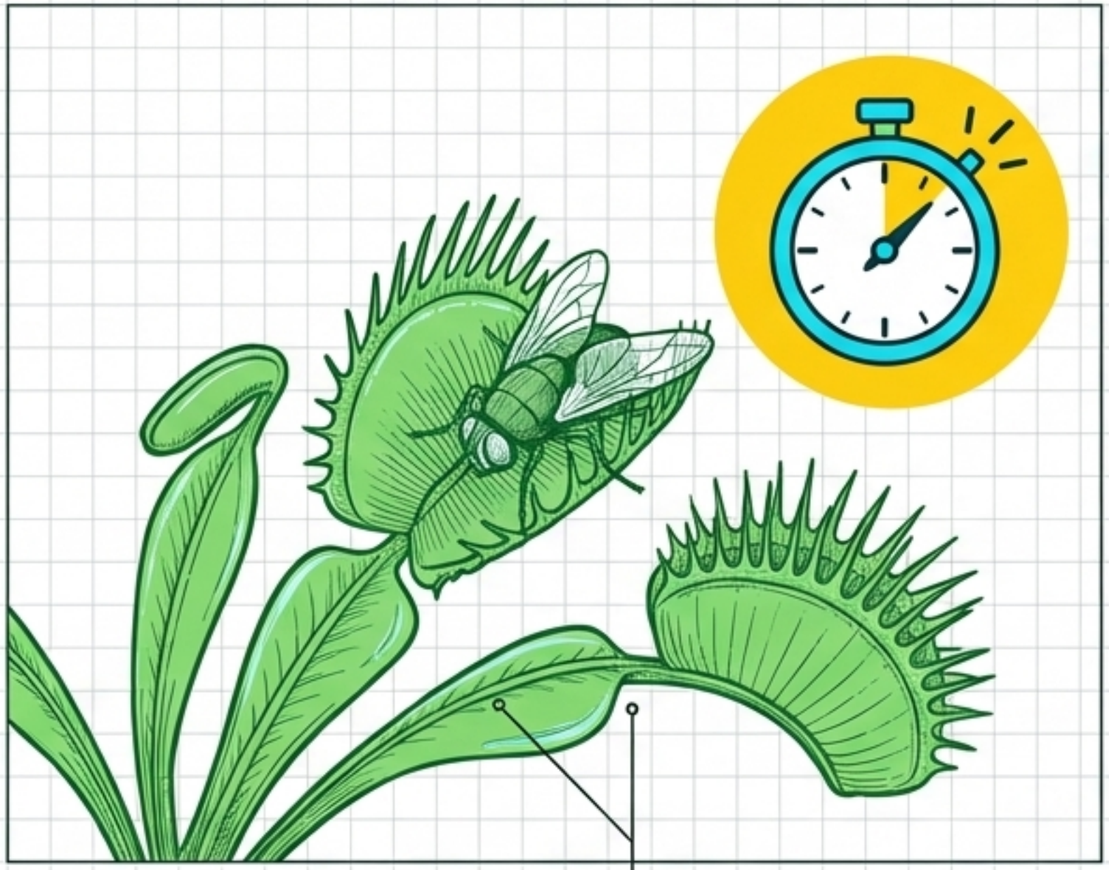
DECODING BOTANICAL MOVEMENT



SUBJECT: CHEMICAL COORDINATION IN PLANTS

FOCUS: TROPISMS & AUXIN MECHANISMS

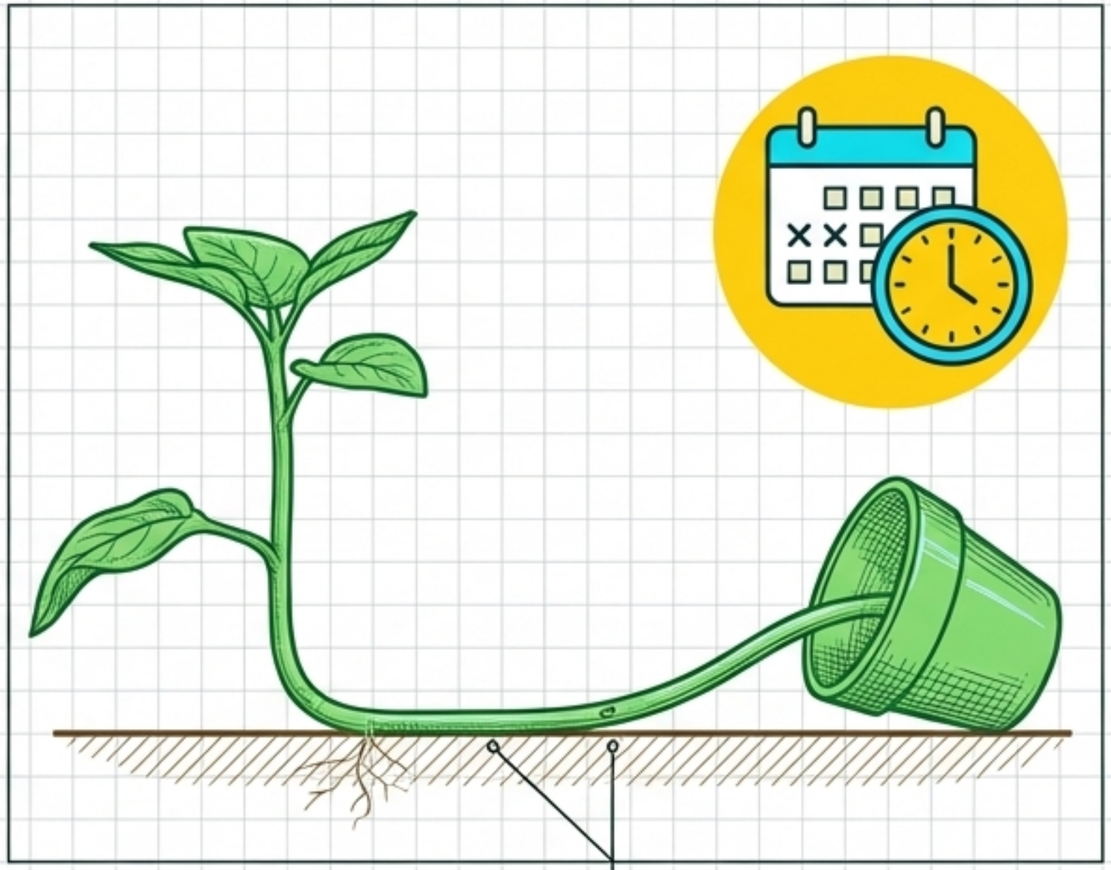
Two Speeds of Botanical Movement



Rapid Response

Fraction of a second.

Turgor pressure changes at the base of leaves.

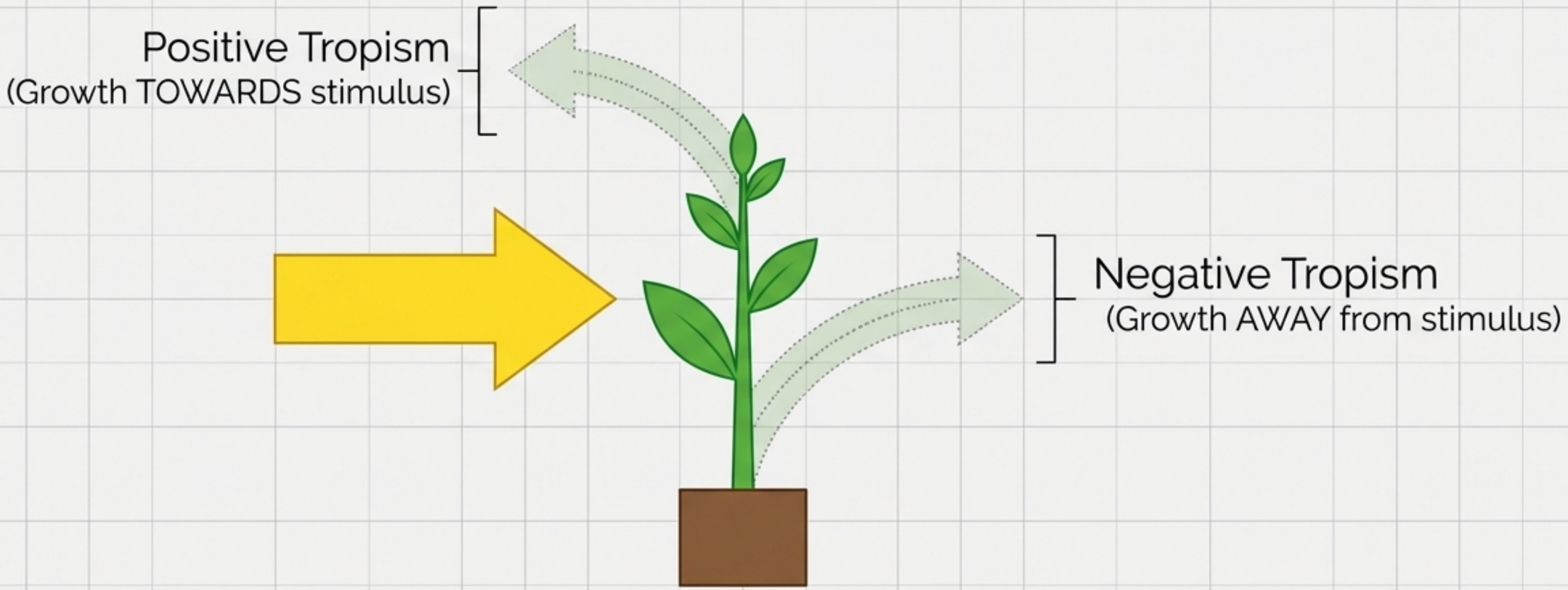


Slow Response

Hours to days.

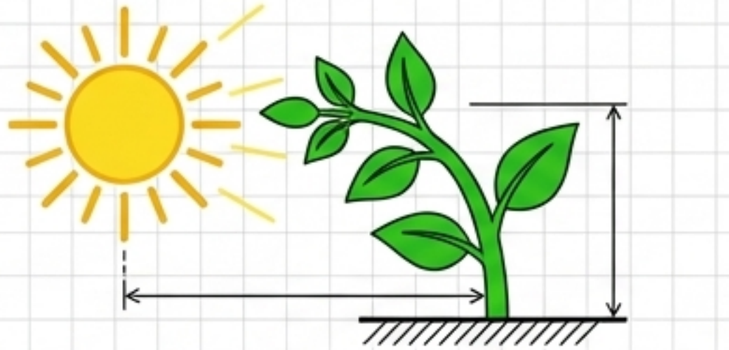
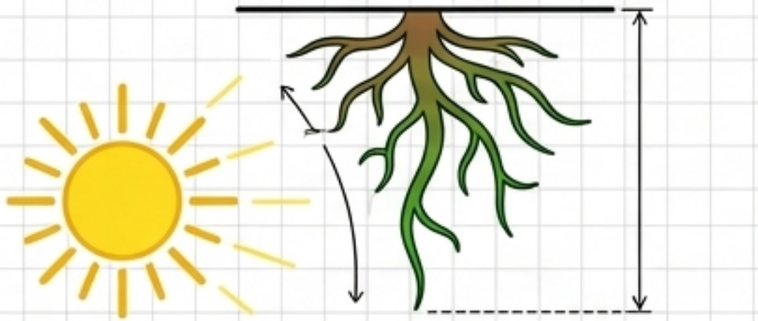
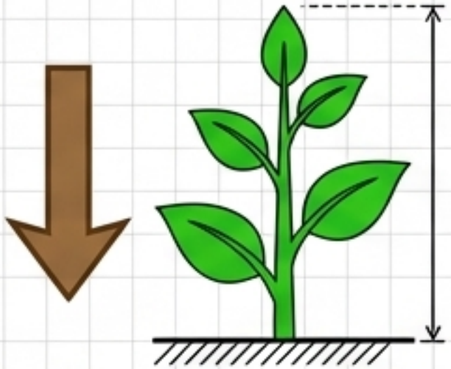
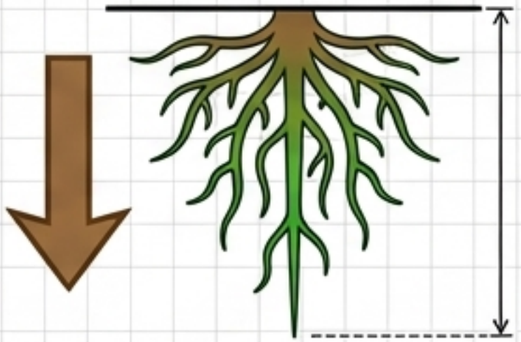
Directional growth responses to stimuli.

Tropisms are Directional Growth Responses

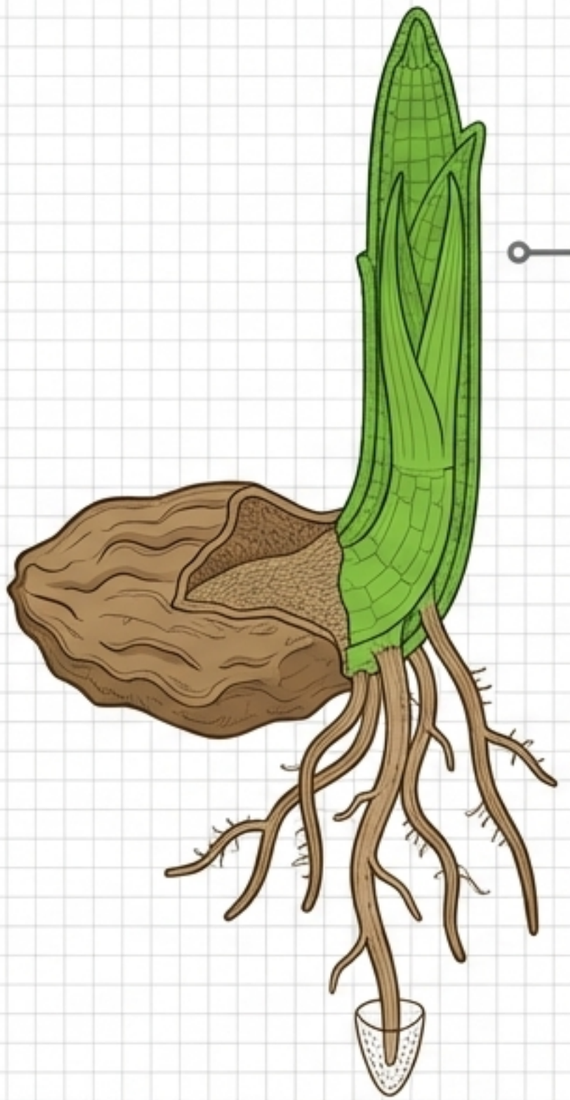


Unlike rapid, non-directional reflexes, tropisms permanently alter the plant's structure based on environmental geometry.

The Tropism Matrix

	Shoots	Roots
Light / Phototropism	 Positive Phototropism	 Most show no response; some negative
Gravity / Geotropism	 Negative Geotropism	 Positive Geotropism (Anchorage)

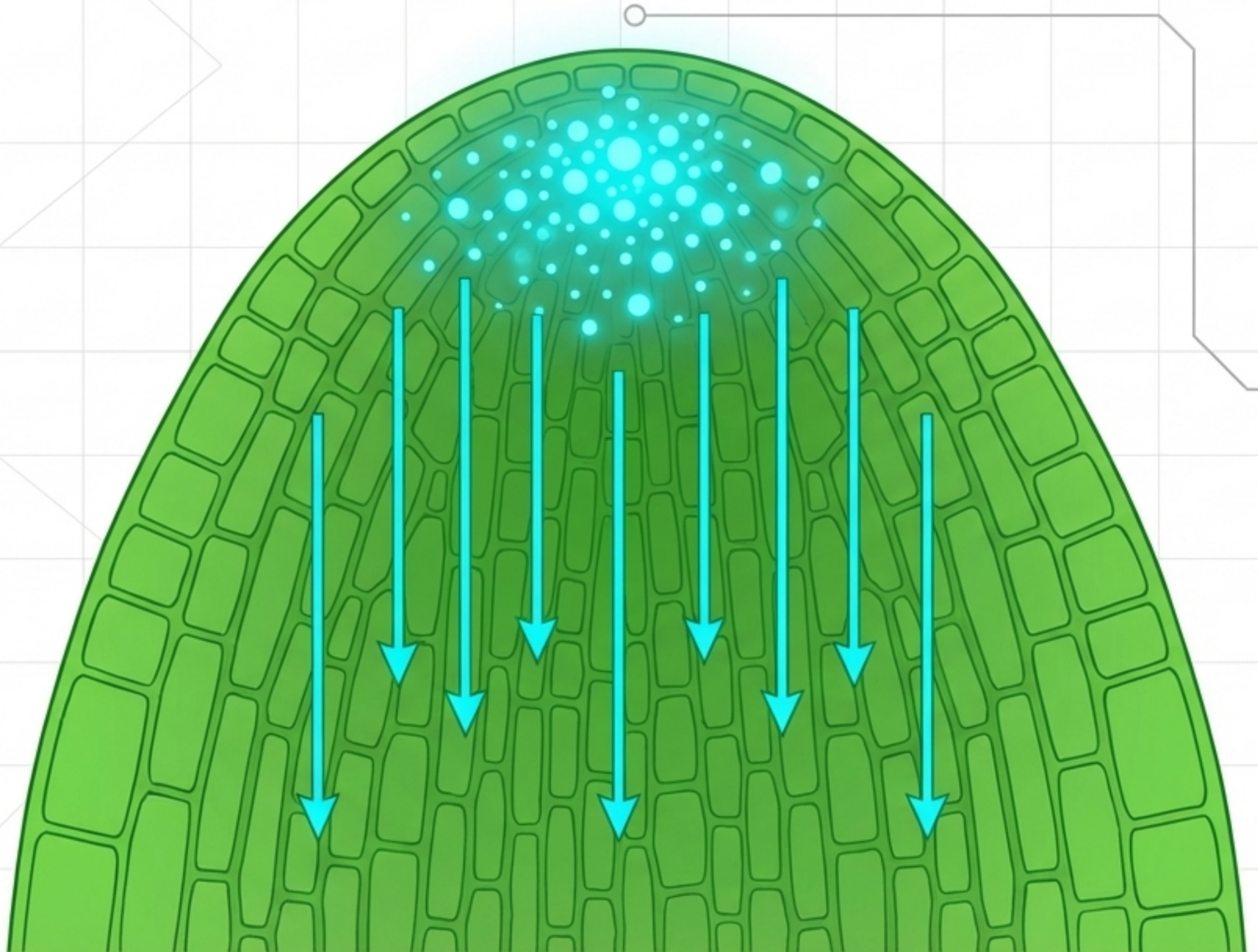
The Coleoptile: A Model for Discovery



Coleoptile

A protective sheath covering the first leaves of a cereal seedling. Because of its simple structure and rapid response, Charles Darwin and subsequent biologists used the coleoptile to isolate the mechanics of plant movement.

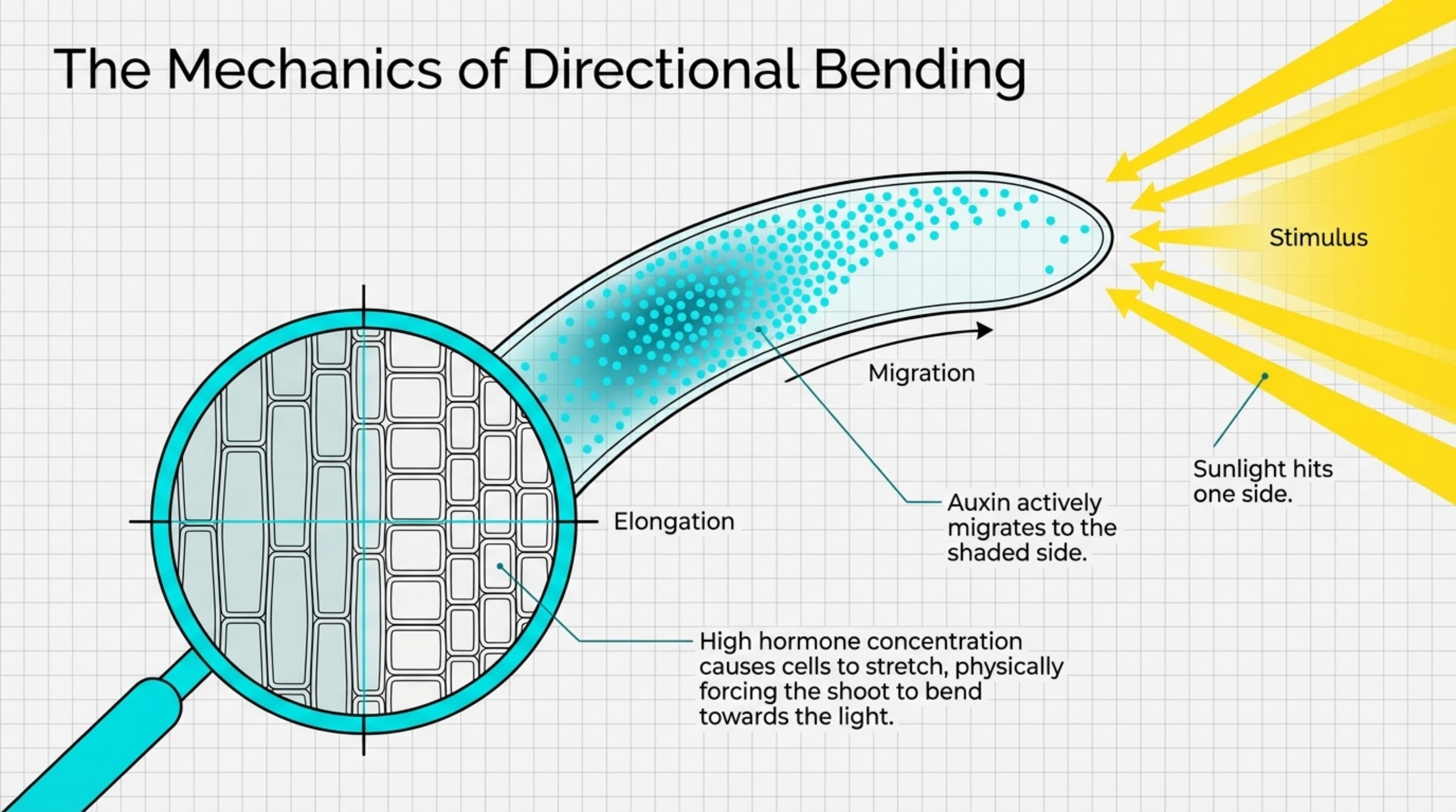
Auxin is the Invisible Messenger



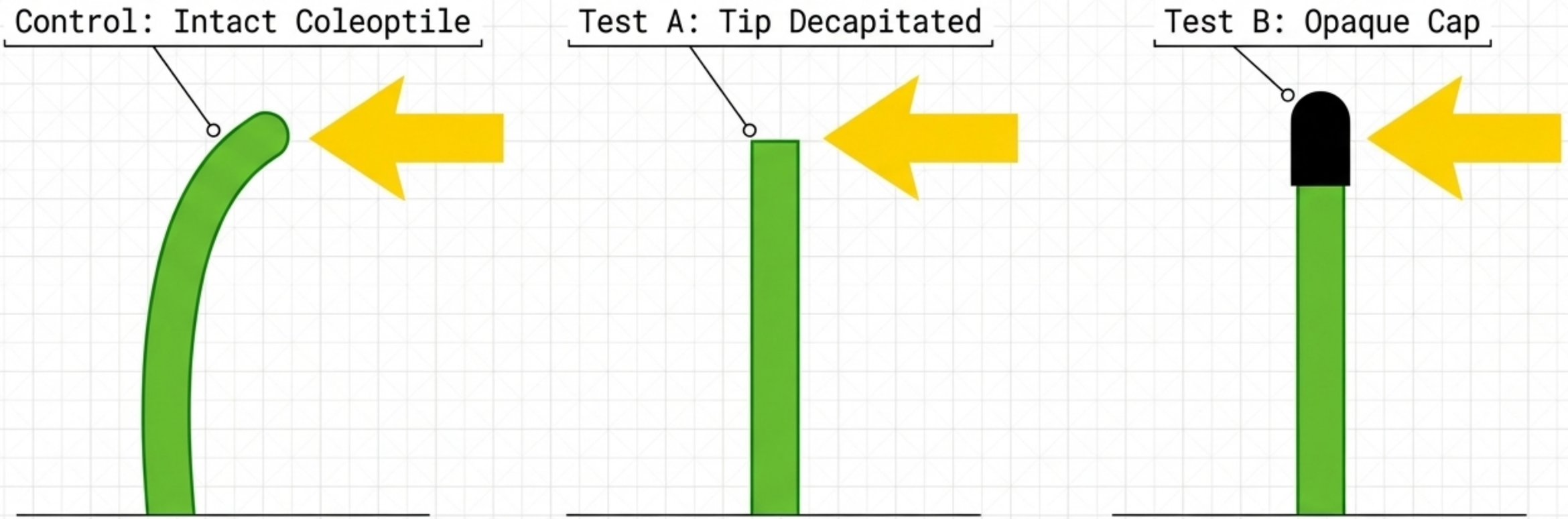
Plants lack nervous systems. Instead, they rely on chemical messengers called **plant growth substances.**

The most important for phototropism is **Auxin,** produced in the tip of the shoot and diffusing downward to control cellular elongation.

The Mechanics of Directional Bending



Experiment 1: Locating the Sensor



Bends toward light.

No bending.

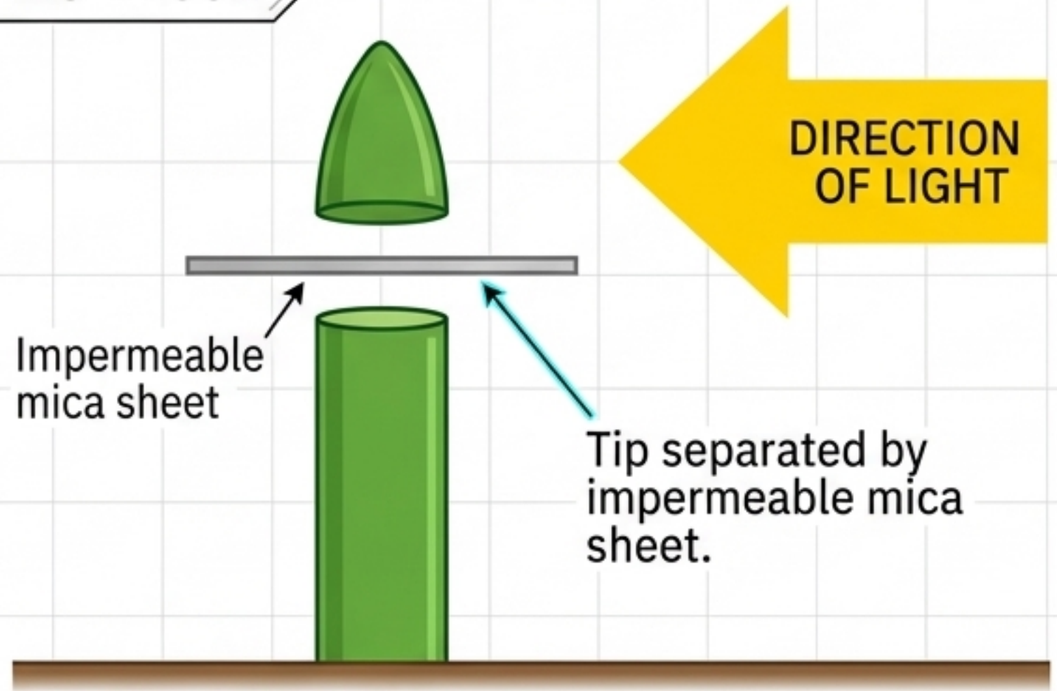
Grows upward, but no bending.

Darwin's Conclusion: The unidirectional light stimulus is detected exclusively at the tip, but the actual bending occurs in a growth zone lower down.

Experiment 2: The Nature of the Signal

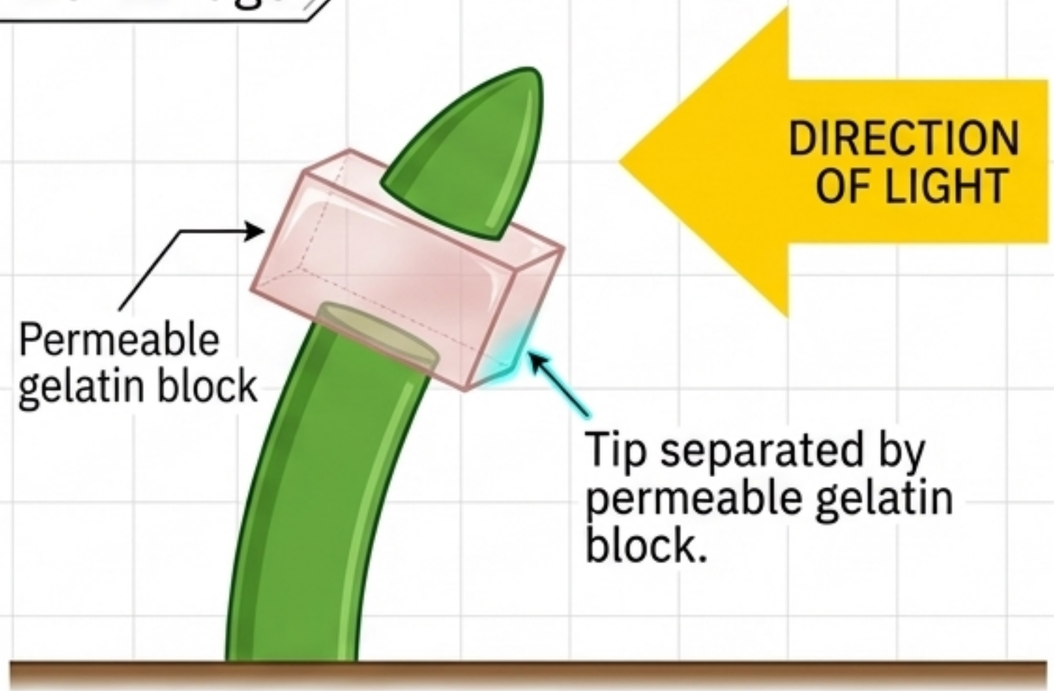
Botanical Blueprint

The Block



Result: No bending.

The Bridge

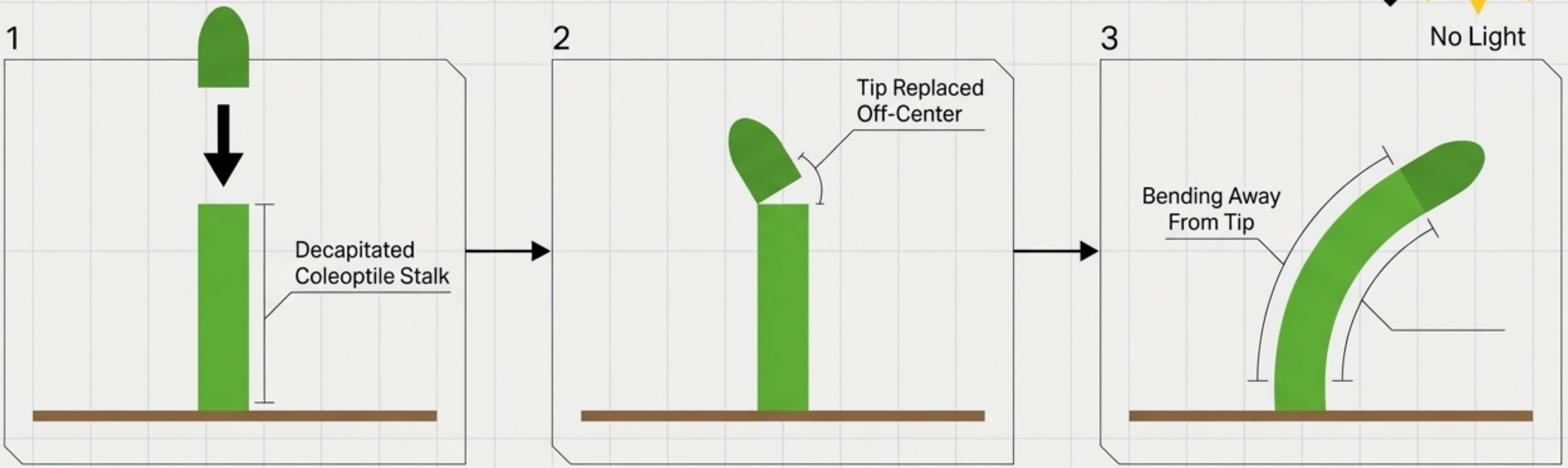


Result: Normal bending toward the light.

Conclusion: The signal is not electrical. It is a water-soluble chemical that must physically diffuse from the tip down into the shoot.

Experiment 3: Forcing Asymmetry

No Light



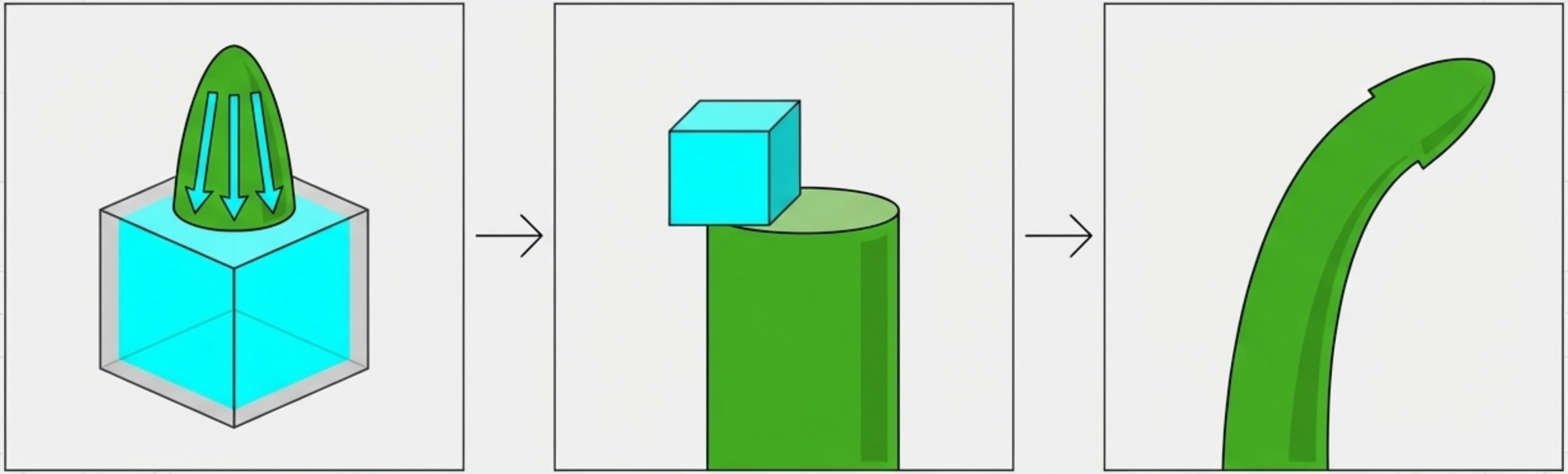
Tip is completely removed.

Tip is replaced highly off-center.

Stalk bends without any light stimulus.

By manually placing the auxin source on one side, researchers forced the cells on that side to elongate, proving bending is caused entirely by chemical concentration, not the light itself.

Experiment 4: Capturing the Messenger



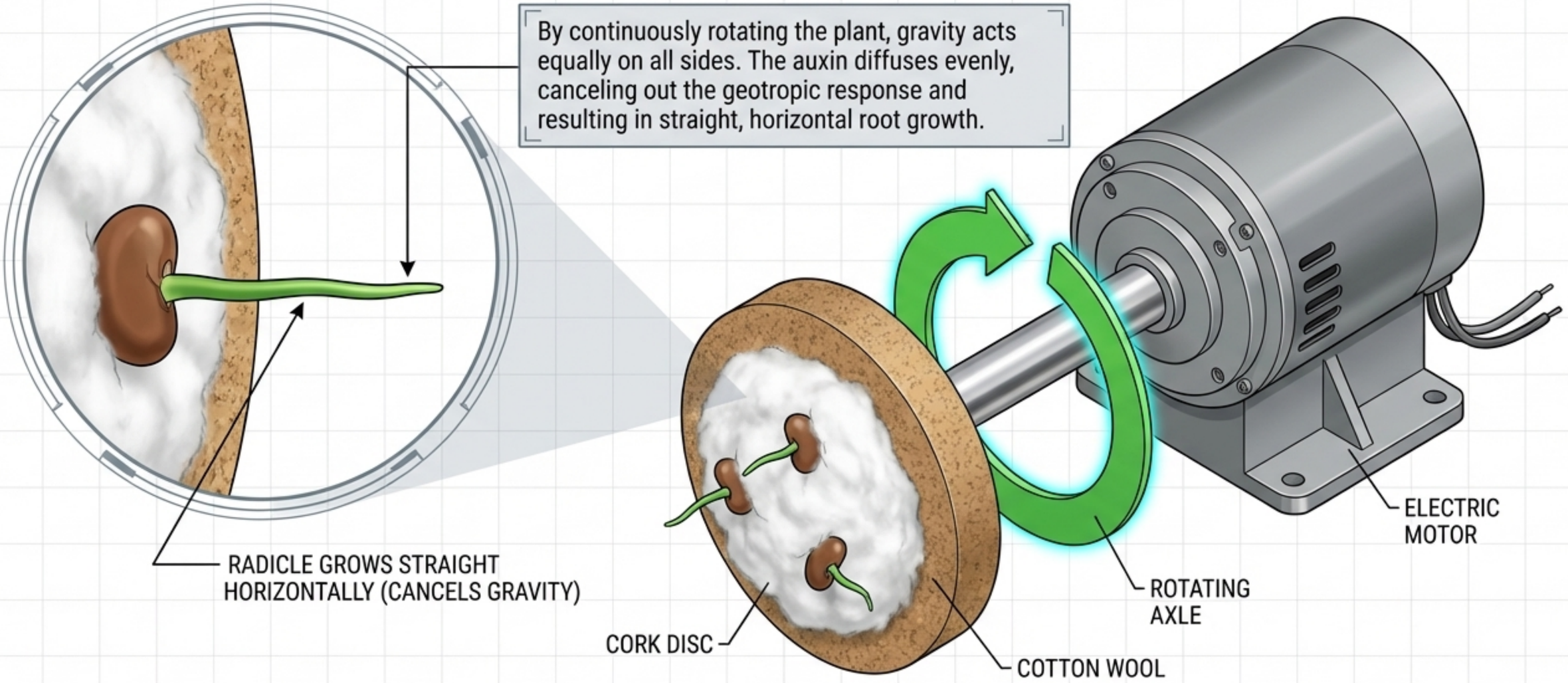
1. Tip drains auxin into agar block.

2. Tip discarded. Charged agar block placed off-center.

3. Bending occurs in total darkness.

The ultimate proof: The isolated hormone, captured in a synthetic block, is entirely sufficient to trigger the directional growth response.

The Clinostat: Canceling Directional Stimuli



The Cycle of Chemical Coordination