

The Meselson-Stahl Experiment

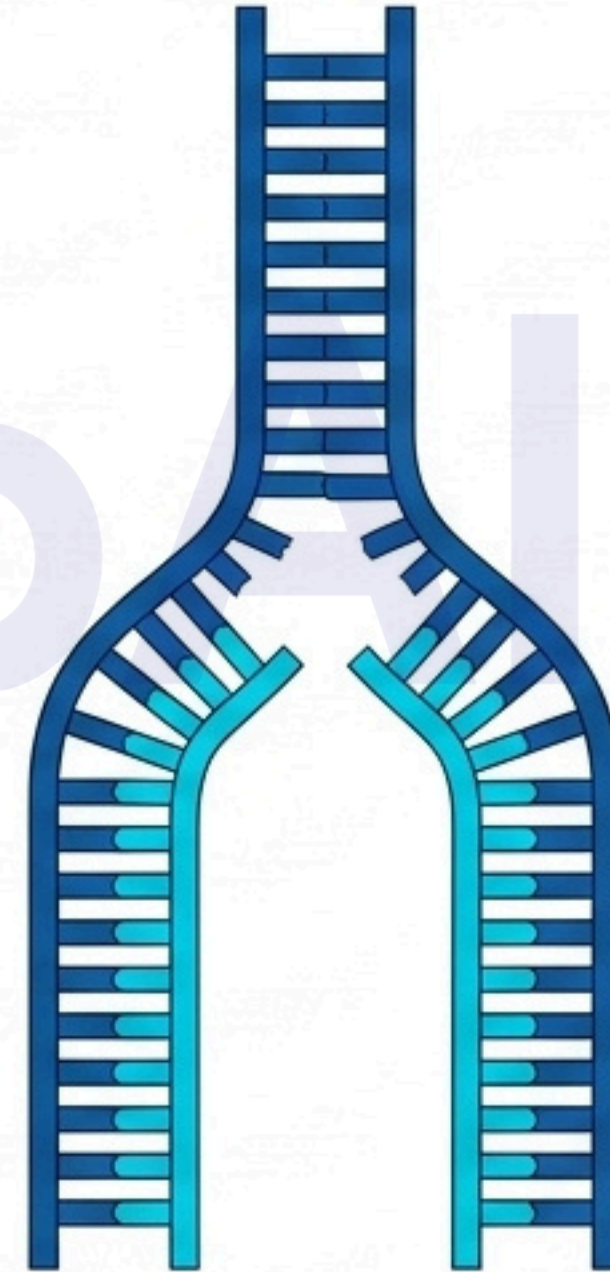
The Elegant Proof of Semiconservative
DNA Replication (1958)

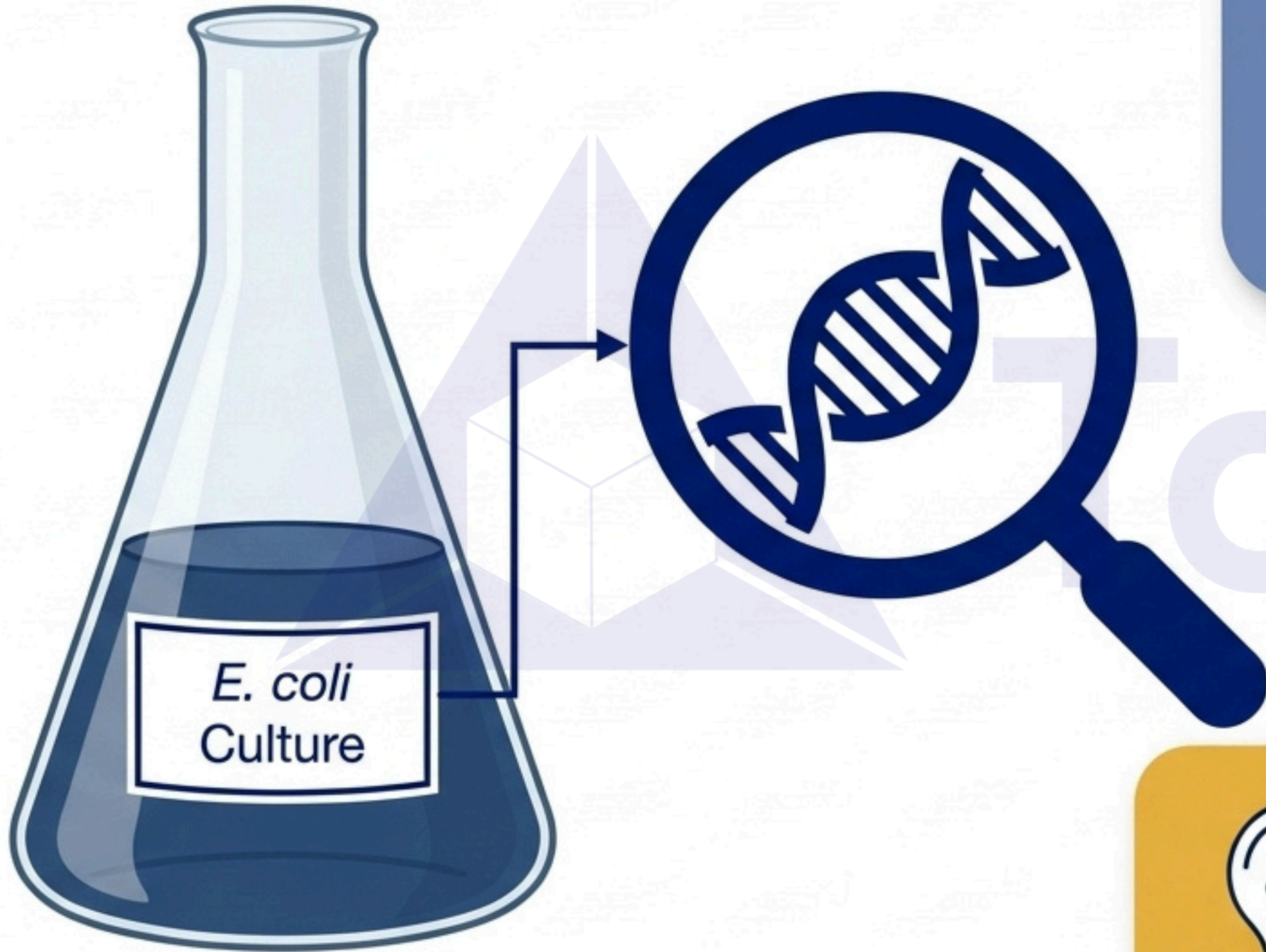
The Watson-Crick Proposition

“It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism...”

(1953)

Semiconservative Replication





Phase 1: Heavy Nitrogen Labeling

- *E. coli* grown in $^{15}\text{NH}_4\text{Cl}$ as the sole nitrogen source for many generations.
- Result: ^{15}N is fully incorporated into the synthesized DNA.



Note: ^{15}N is a heavy isotope of nitrogen, NOT a radioactive isotope. Separation is based purely on mass and density.



You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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Practice Now

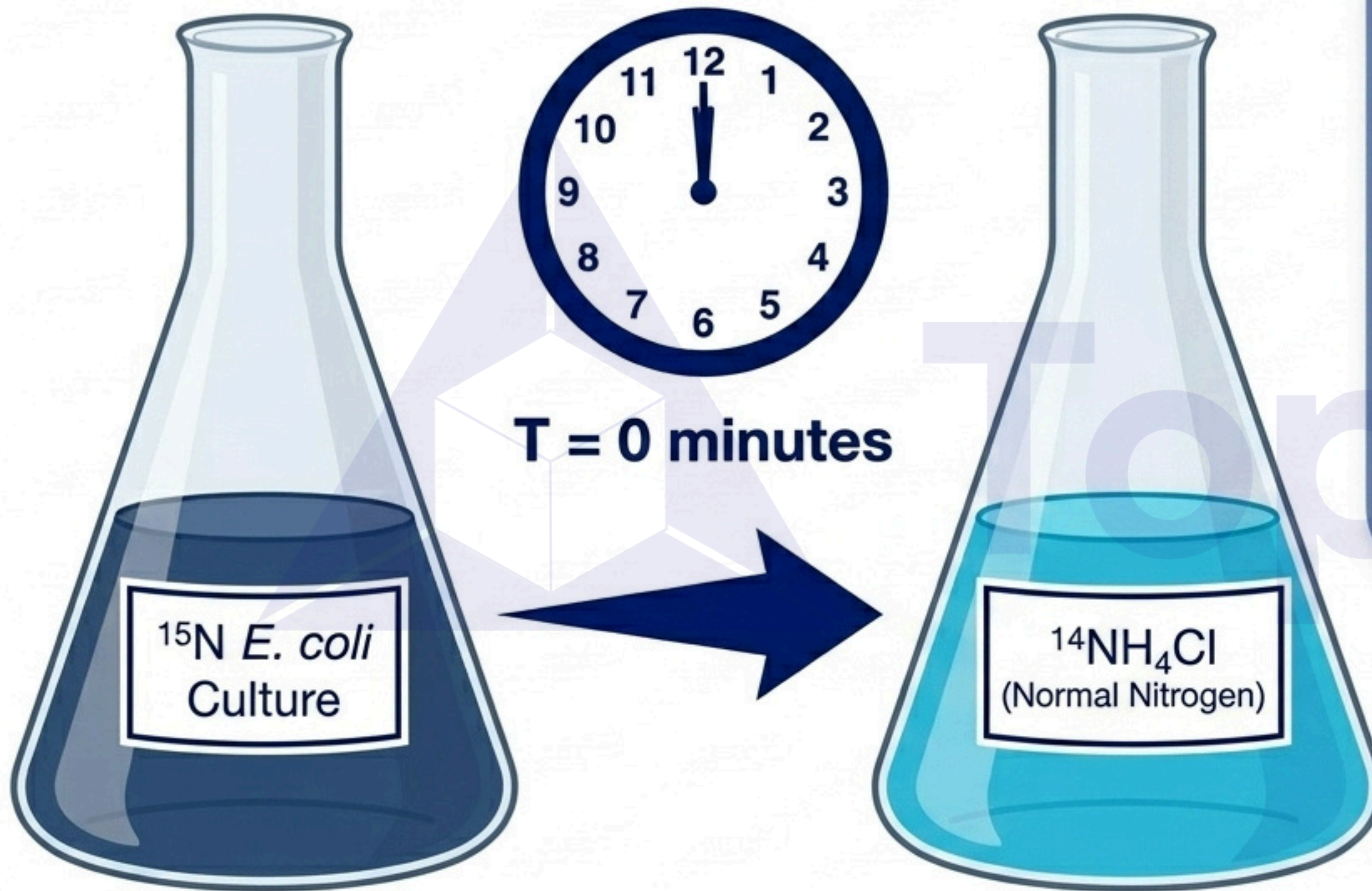


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Key Highlights

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Phase 2: The Transfer

The heavily labeled cells are transferred into a medium with normal $^{14}\text{NH}_4\text{Cl}$.



Key Detail: *E. coli* divides exactly every 20 minutes. Samples are extracted at definite time intervals to analyze double-stranded DNA.

The Measurement Tool: CsCl Density Gradient

Step 1: Extract

DNA is extracted from the *E. coli* cells as intact double-stranded helices.



Step 2: Spin

The DNA is placed in a Cesium Chloride (CsCl) solution and spun in a high-speed centrifuge.



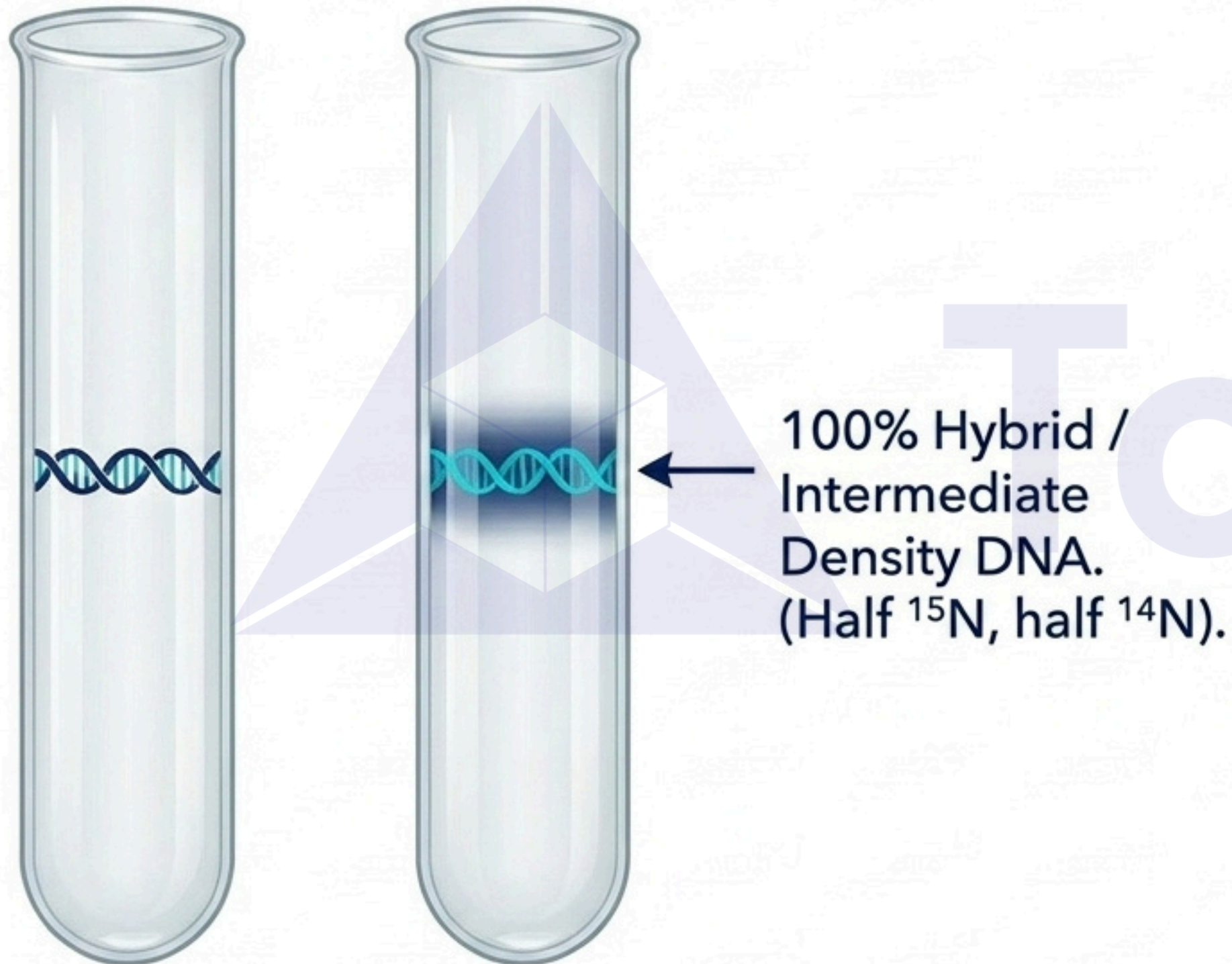
Step 3: Separate

Heavier molecules (^{15}N DNA) sediment faster and sink lower.



Lighter molecules (^{14}N DNA) float higher.

Generation I (T = 20 Minutes)



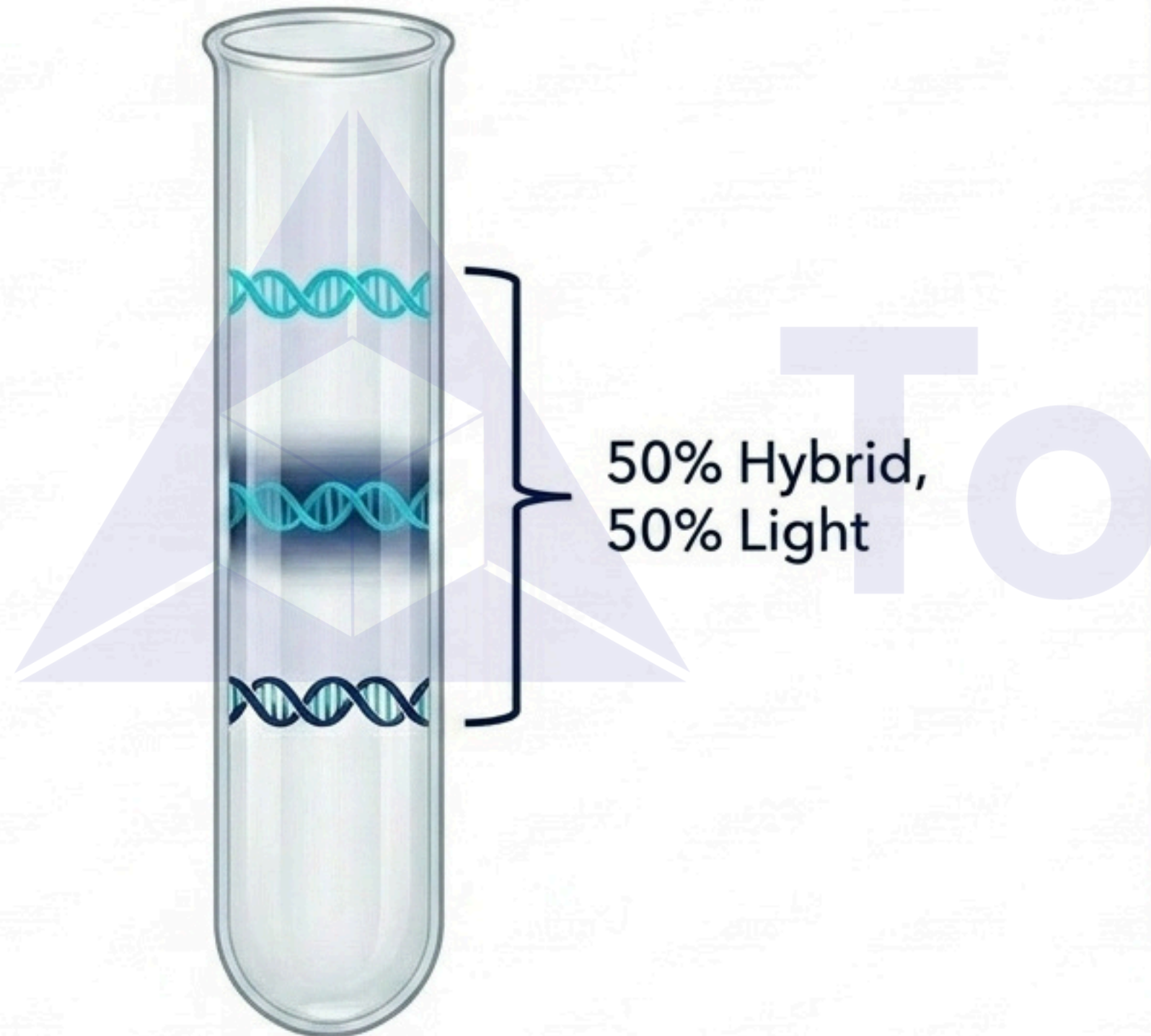
× Dispelling Alternative Theories

Why not Conservative Replication?

If the conservative model were true, we would see TWO bands here: one completely heavy (parent) and one completely light (new).

The single hybrid band definitively disproves conservative replication.

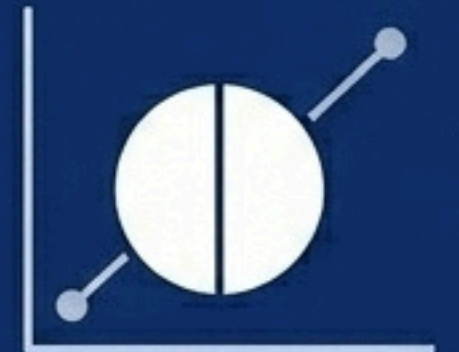
Generation II (T = 40 Minutes)



The Mathematical Match

The DNA is composed of exactly equal amounts: **50% hybrid density** and **50% "light" density**.

This perfectly matches the mathematical prediction of the **semiconservative model** after two cell divisions.



0 min - Gen 0

20 min - Gen 1

40 min - Gen 2



$(^{15}\text{N}-^{15}\text{N})$



Heavy Density
DNA ($^{15}\text{N}-^{15}\text{N}$).
100%.



$(^{15}\text{N}-^{14}\text{N})$



$(^{15}\text{N}-^{14}\text{N})$



100%
Hybrid/
Intermediate
Density DNA
($^{15}\text{N}-^{14}\text{N}$).



$(^{15}\text{N}-^{14}\text{N})$



$(^{14}\text{N}-^{14}\text{N})$



50% Hybrid
($^{15}\text{N}-^{14}\text{N}$) &
50% Light ($^{14}\text{N}-^{14}\text{N}$)
Density DNA.



Key Takeaway

The Meselson-Stahl experiment provided the unequivocal experimental proof that DNA replicates semiconservatively. Every new DNA double helix consists of one original parental strand and one newly synthesized complementary strand.



You've Learned the Theory.

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