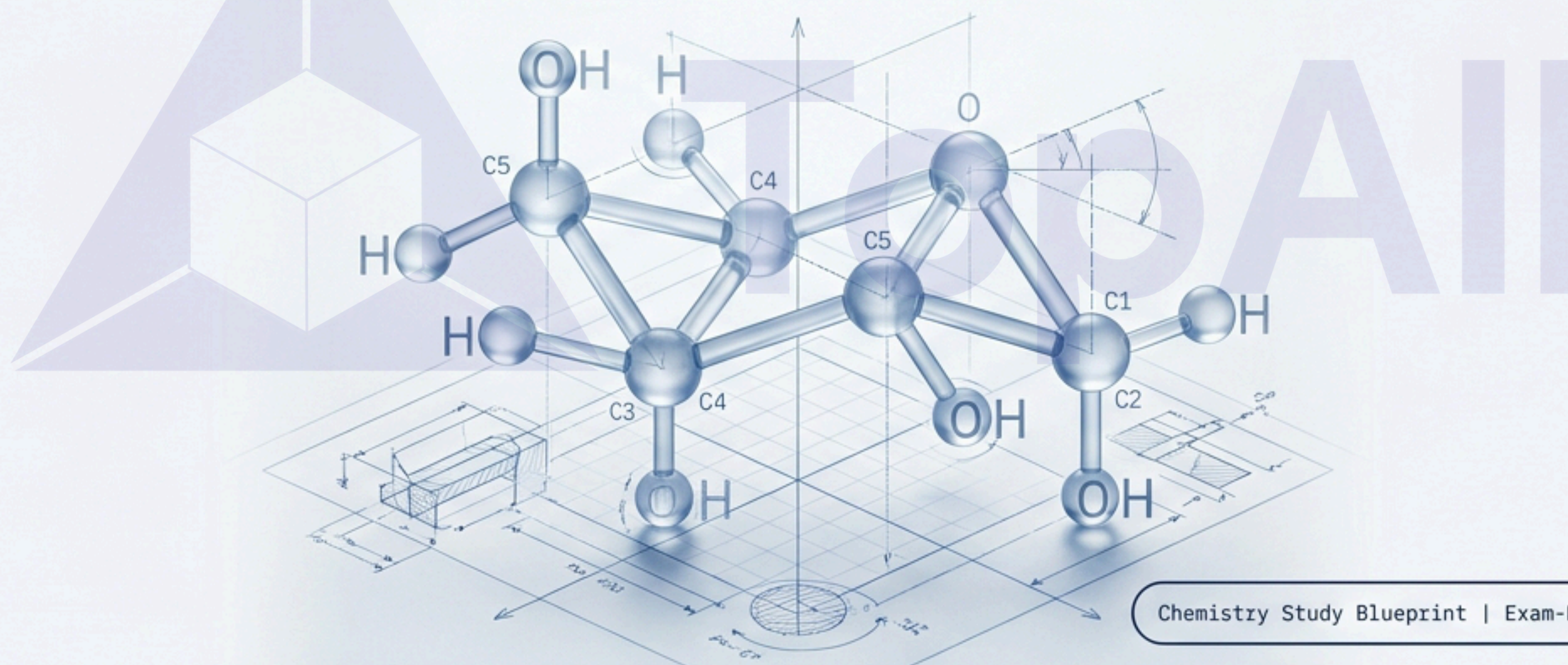


BIOMOLECULES 10.1.2.1



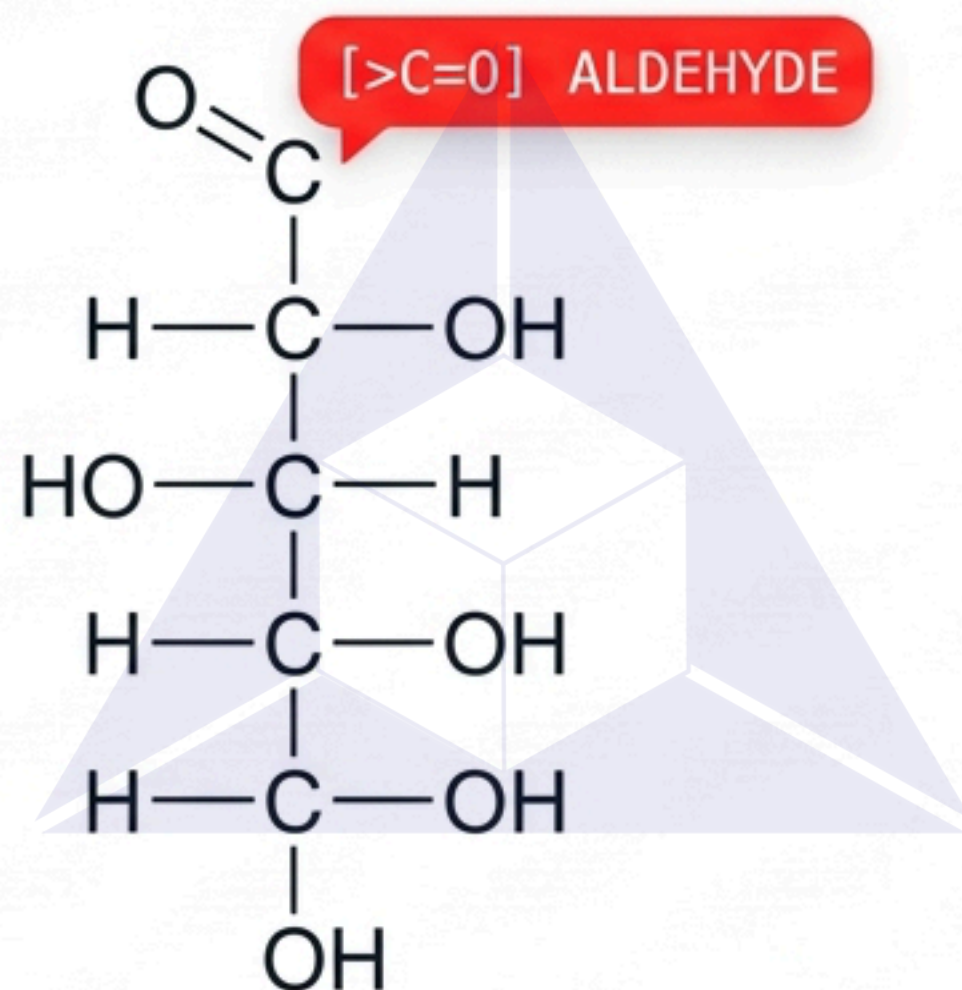
The Cyclic Structure of Glucose

Beyond the open-chain model: The architectural blueprint of nature's primary fuel.



The Anomalies of the Open-Chain Model

Theoretical Model



Observed Chemical Failures

Failed Test

Anomaly 1: Does not give Schiff's test or form hydrogensulphite addition products with NaHSO_3 (contradicts free aldehyde).

Failed Test

Anomaly 2: Pentaacetate of glucose fails to react with hydroxylamine (proves absence of free $-\text{CHO}$).

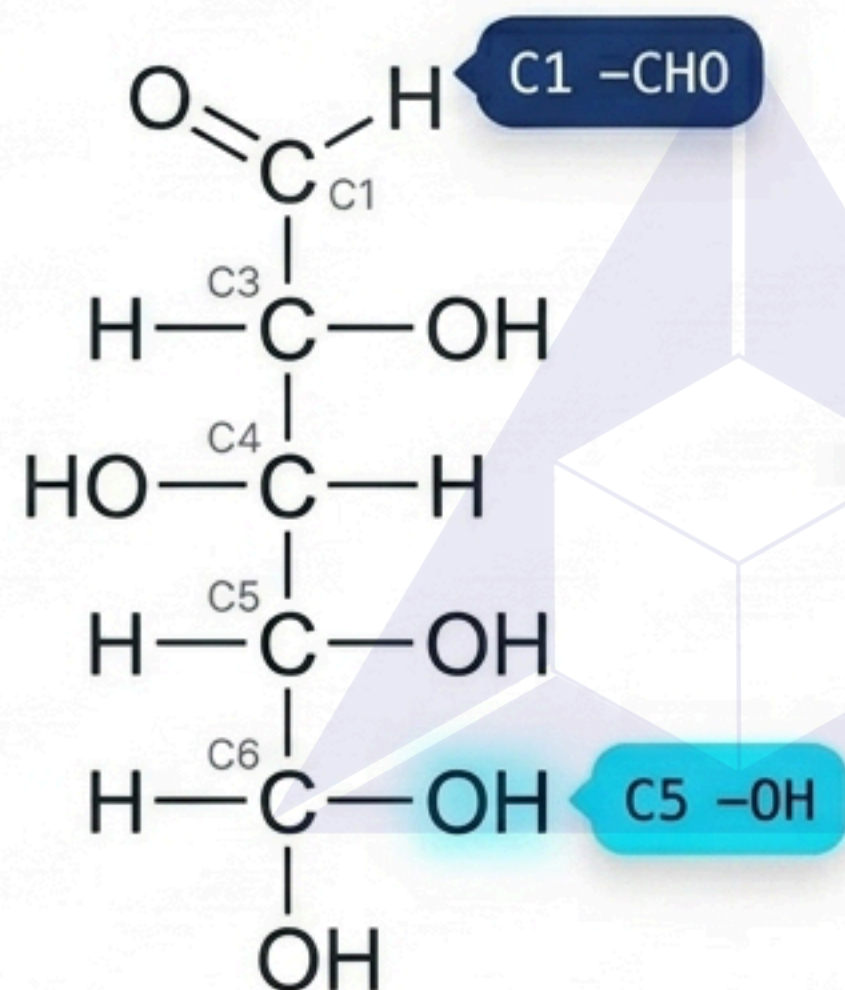
Failed Test

Anomaly 3: Exists in two distinct crystalline forms (α and β), which a single straight-chain model cannot explain.

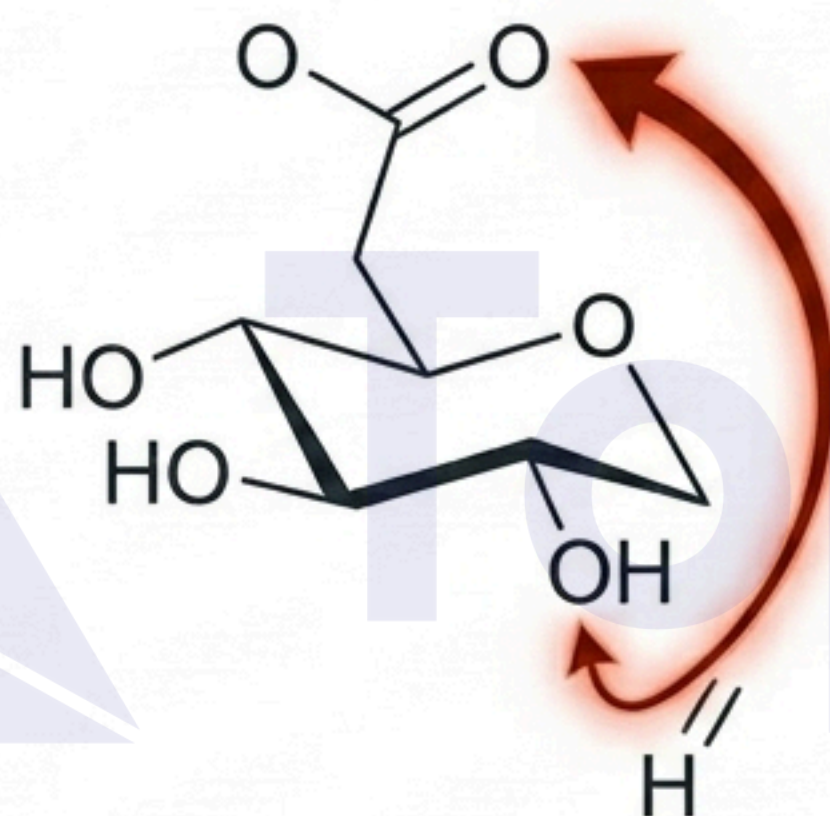
Conclusion: The open-chain structure cannot be the whole truth. An alternate structural model is required.

Formation of the Cyclic Hemiacetal

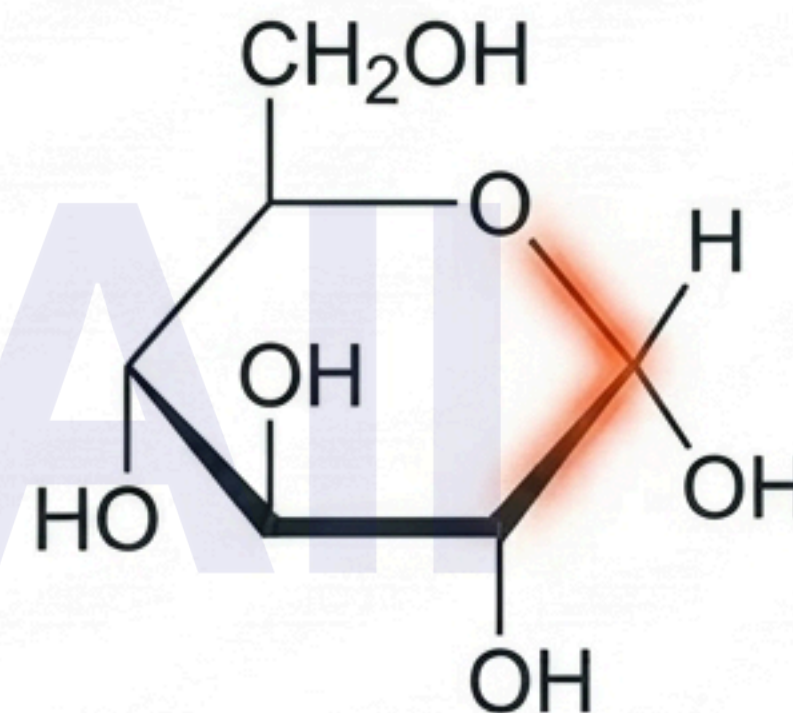
Open-Chain State



Nucleophilic Attack



Cyclic Hemiacetal



Intramolecular Cyclization

The -OH group at C5 adds across the -CHO double bond. The aldehyde group is consumed, perfectly explaining the failed Schiff's tests.



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$$E=mc^2$$



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The Two Faces of Glucose: α and β Forms

α -D-glucose

419 K

Melting Point

Crystallization: Obtained from concentrated aqueous solutions at 303 K.

β -D-glucose

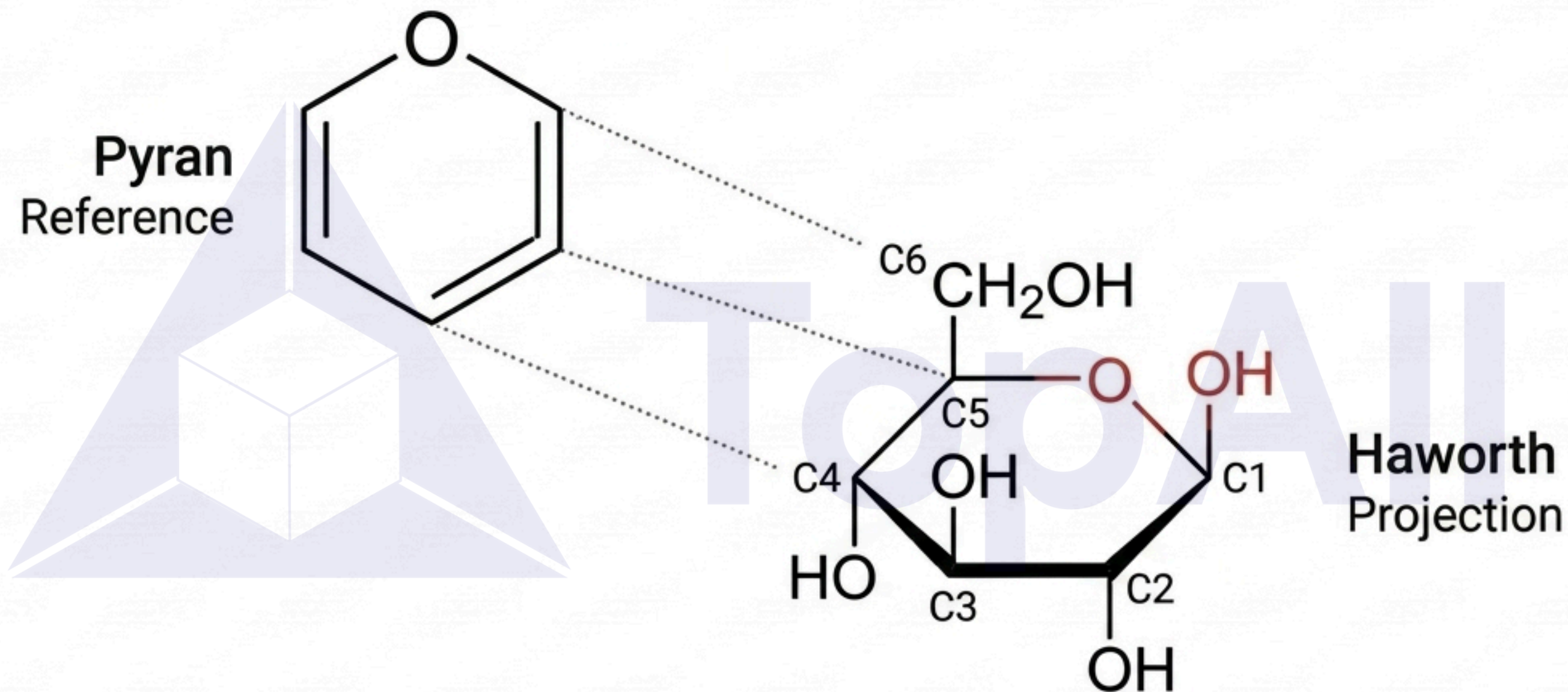
423 K

Melting Point

Crystallization: Obtained from hot and saturated aqueous solutions at 371 K.

Both forms are stable, physically distinct crystals derived from the exact same chemical formula ($C_6H_{12}O_6$).

Standardizing the Blueprint: Pyranose & Haworth



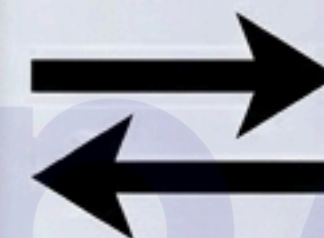
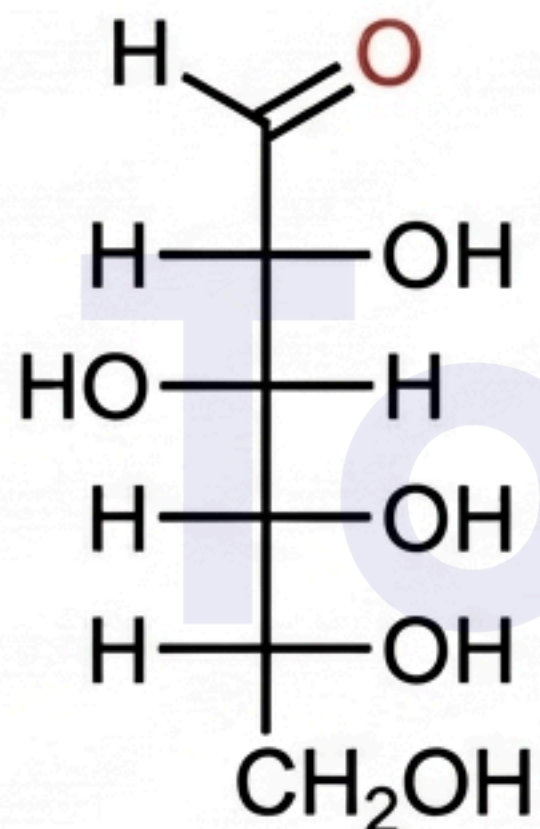
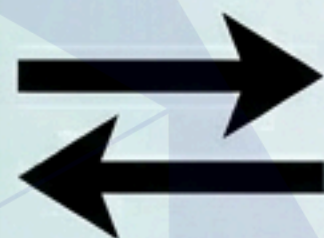
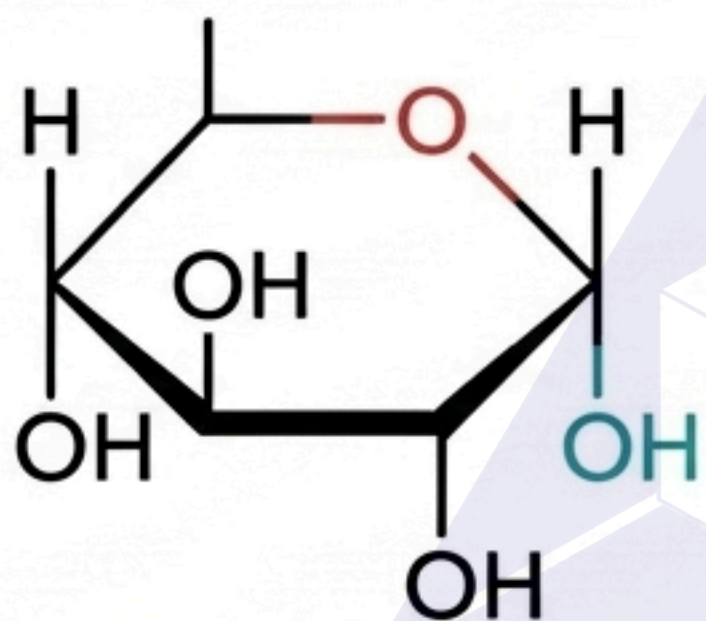
Nomenclature Rule: The six-membered cyclic structure of glucose is called a pyranose structure due to its exact structural analogy with pyran.

The Reality in Solution: Dynamic Equilibrium

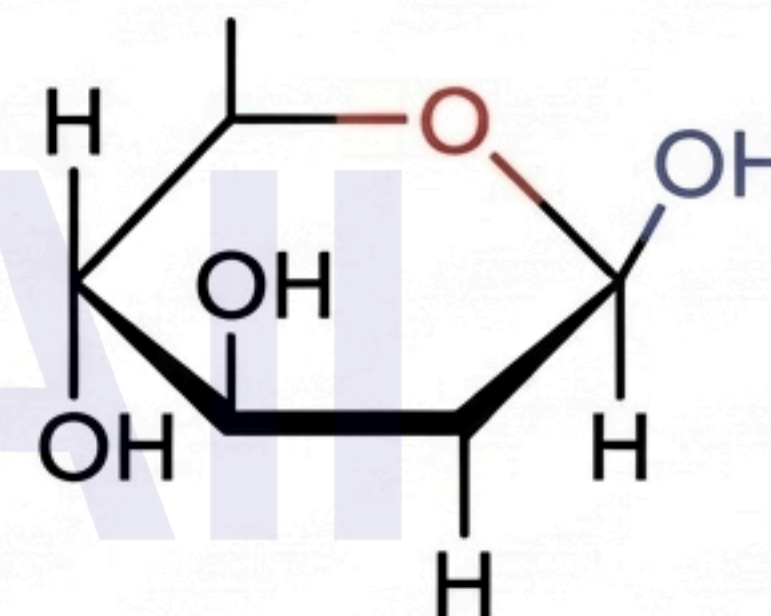
The Complete
Blueprint

Transient Open-Chain (~0.02%)

α -D-Glucose (~36%)



β -D-Glucose (~64%)



RECAP

The Synthesis: The open-chain model is not entirely 'wrong'—it exists as a transient intermediate. In an aqueous solution, glucose exists in a dynamic equilibrium, constantly fluctuating between the open chain and the two cyclic hemiacetal forms.



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