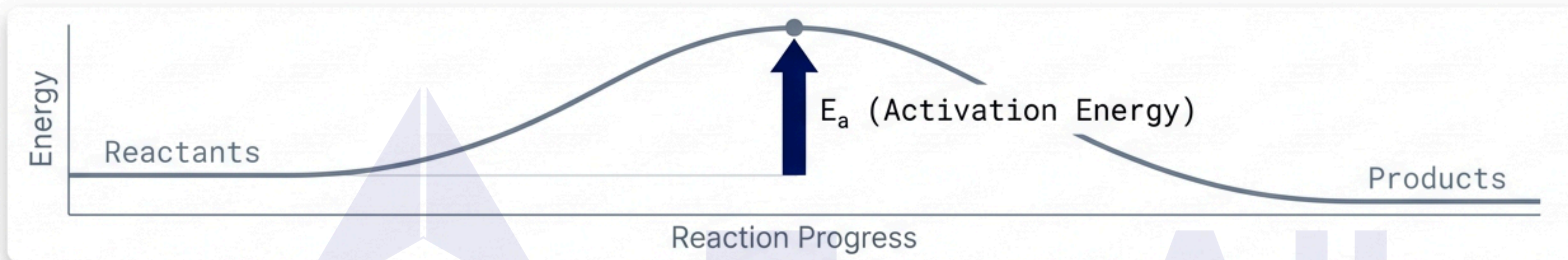


10.3.1 Mechanism of Enzyme Action



Why Reactions Need Activation Energy

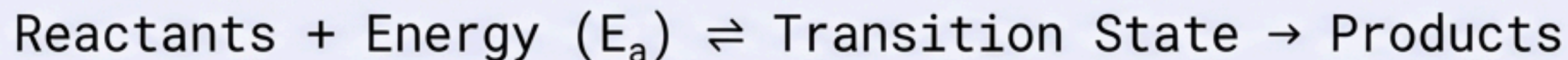


The Barrier

Even favorable reactions require an initial energy investment to break existing chemical bonds before new ones can form.

The Transition State

The peak of the curve represents a highly unstable, high-energy intermediate state that must be reached for the reaction to proceed.



Without the activation energy barrier, complex biological molecules would spontaneously break down.



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$$E=mc^2$$



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Enzymes Lower Activation Energy



No New Energy

Enzymes do not add heat or energy to a system. Instead, they provide an entirely new reaction mechanism with a lower energy requirement.

Active Site Stabilization

Globular enzyme proteins physically bind to substrates, placing stress on specific bonds and stabilizing the transition state.

Enzymes speed up reactions strictly by reducing the magnitude of the activation energy (E_a).

Sucrose Hydrolysis Example: Acid vs. Sucrase

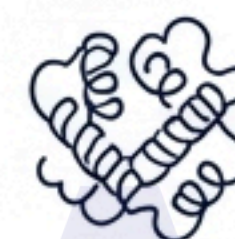
Chemical Catalyst (Acid)



$$E_a = 6.22 \text{ kJ/mol}$$

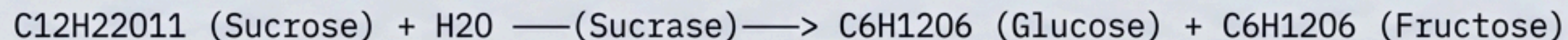
Requires higher activation energy; significantly slower at normal biological temperatures.

Biocatalyst (Sucrase Enzyme)



$$E_a = 2.15 \text{ kJ/mol}$$

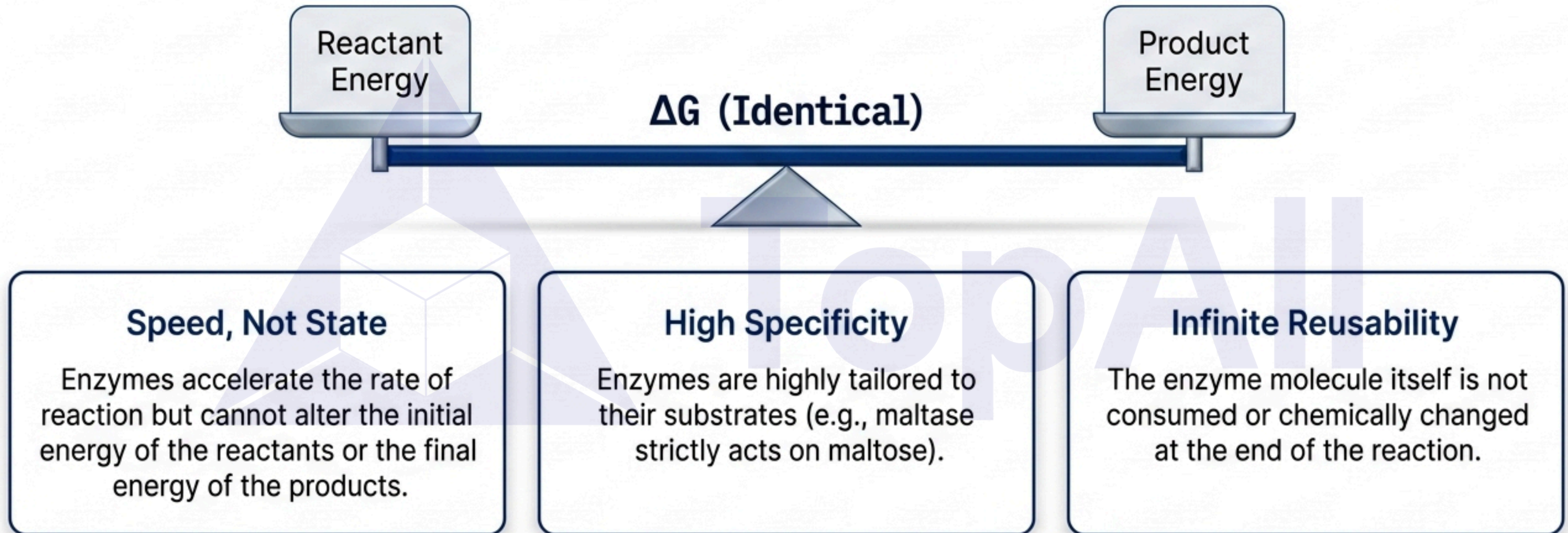
Highly efficient; rapidly catalyzes hydrolysis under mild biological conditions.



Recap Panel

The enzyme sucrase reduces the activation energy barrier to nearly a third of what is required by a standard acid catalyst.

Final Recap: Faster Reactions, Identical Products



It is the harmonious and synchronous progress of chemical reactions in body which leads to life.

Enzymes are the ultimate biological shortcuts that make this possible.



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