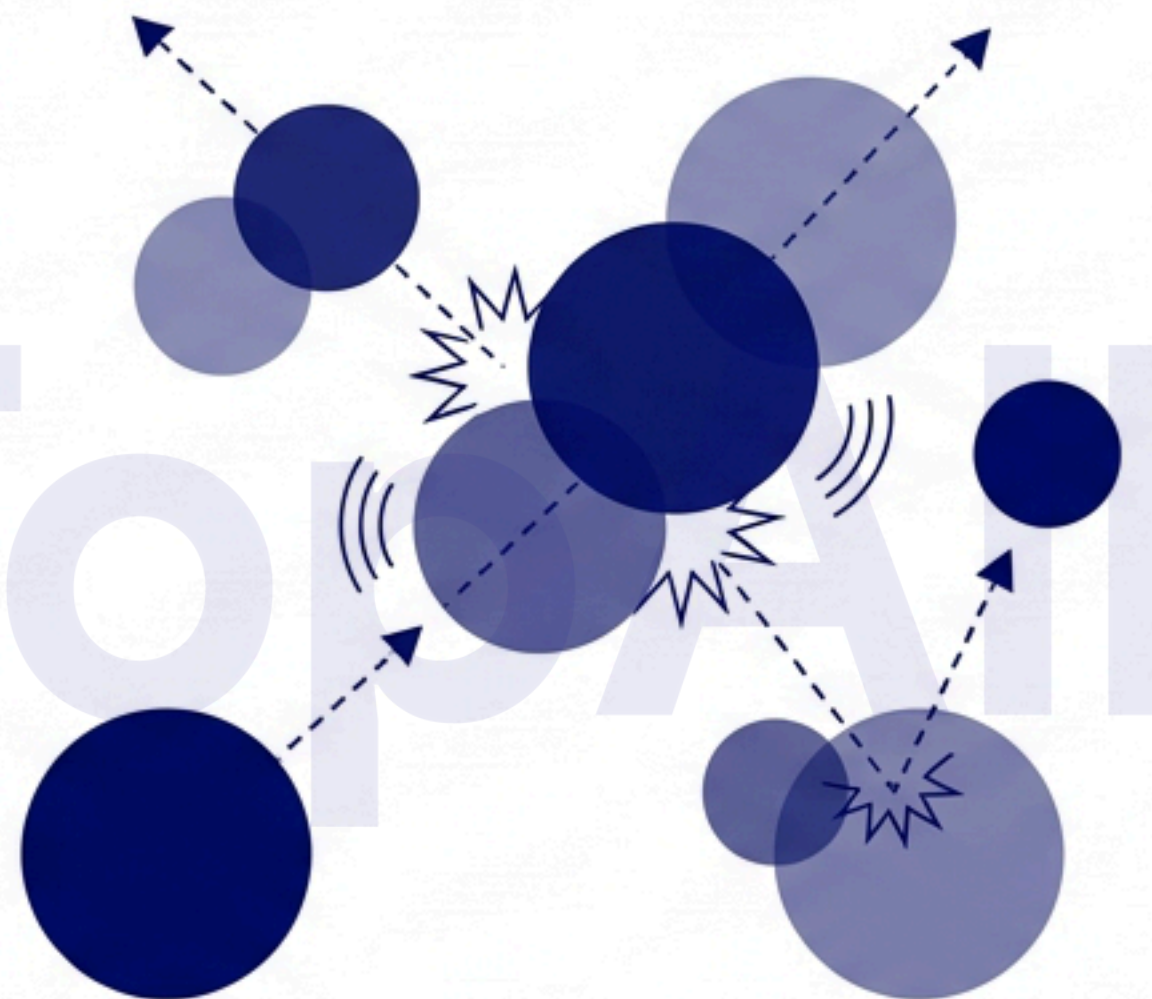


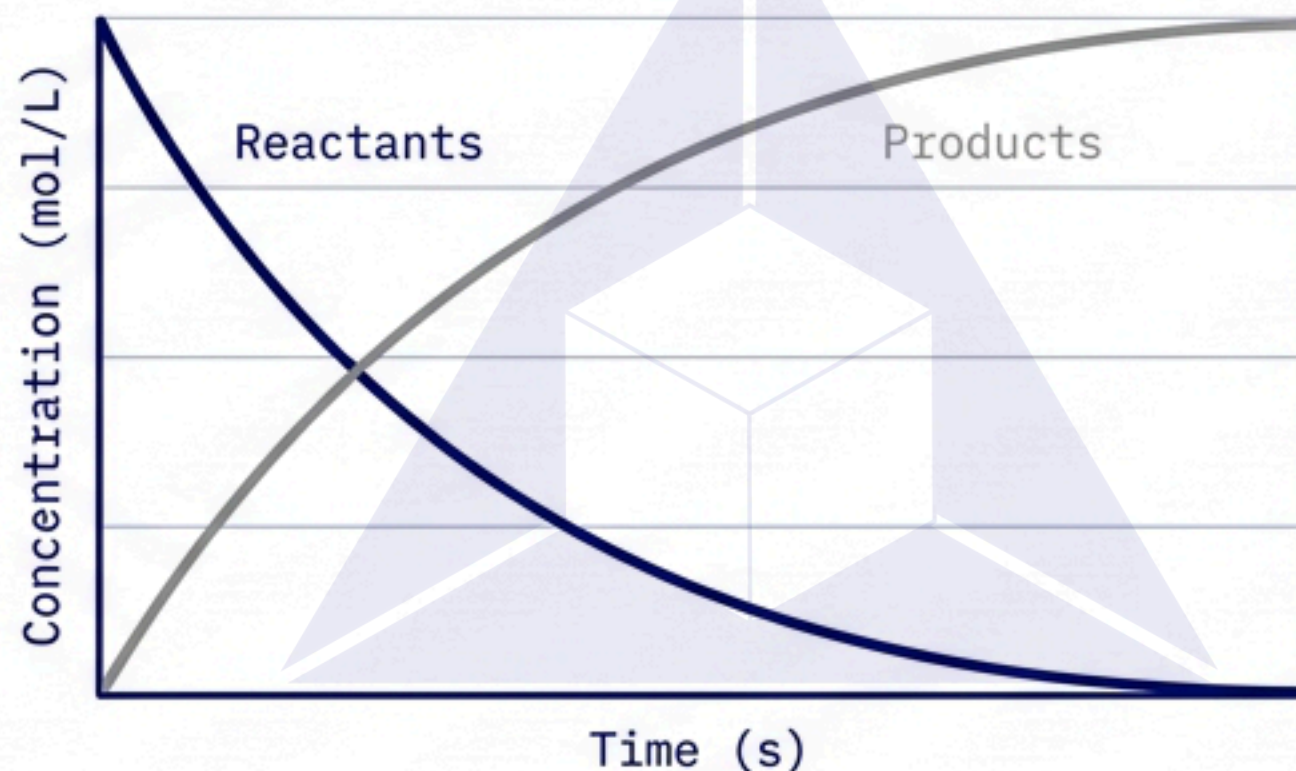
Chemical Kinetics Masterclass

3.2 Factors Influencing Rate of a Reaction



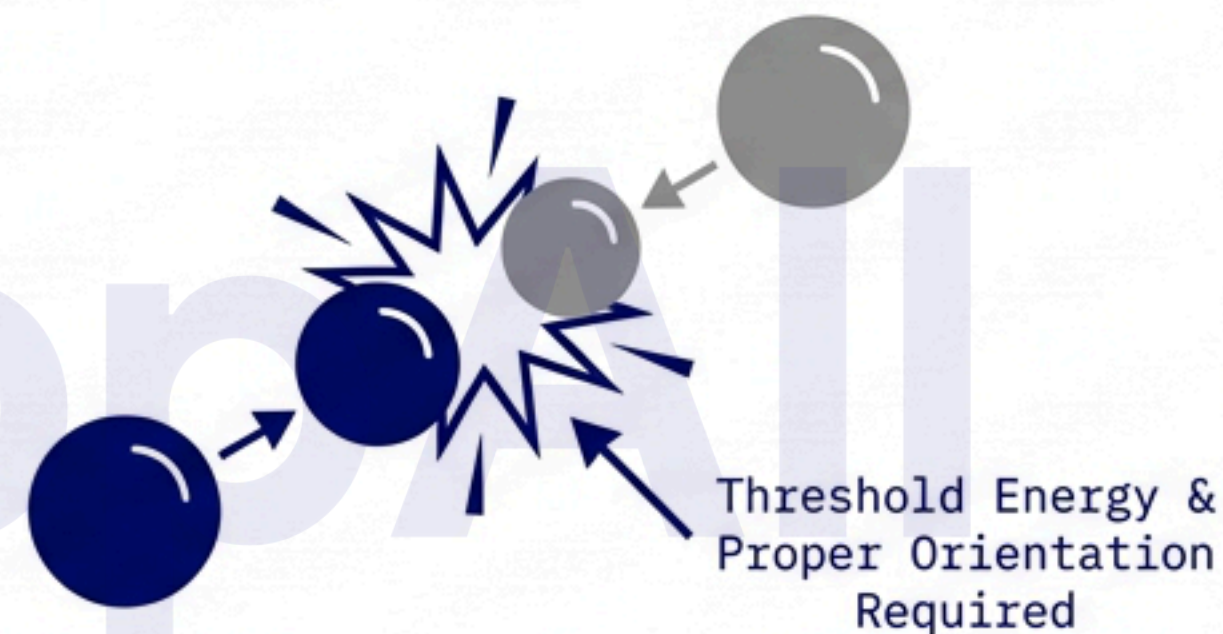
The Mechanics of Reaction Rates

The Macroscopic View



At the macroscopic level, we measure the amounts of reactants consumed or products formed per unit of time.

The Microscopic View

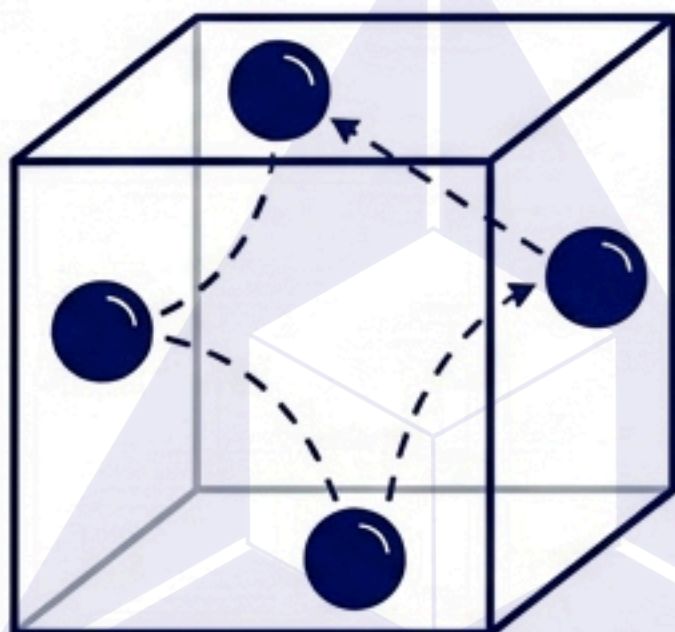


At the molecular level, Collision Theory dictates that molecules must collide with proper orientation and sufficient energy to react.

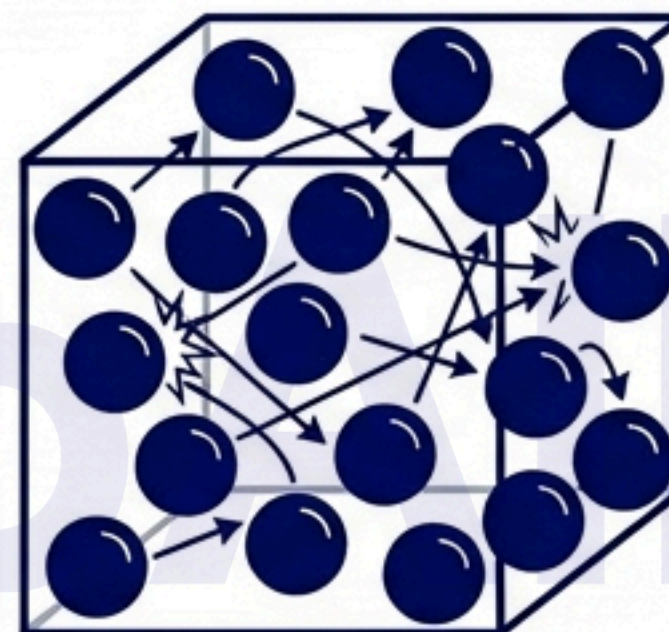
Kinetic studies not only determine the speed of a reaction but describe the conditions by which reaction rates can be altered.

Concentration & The Rate Law

Low Concentration



High Concentration



$$\text{Rate} = k [A]^x [B]^y$$

Rate Constant

Reaction Order

Reaction Order

Reaction order cannot be predicted theoretically; it must be determined experimentally.

Higher concentration → higher collision frequency → faster rate.



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Let's Test Them Now.**

$$E=mc^2$$



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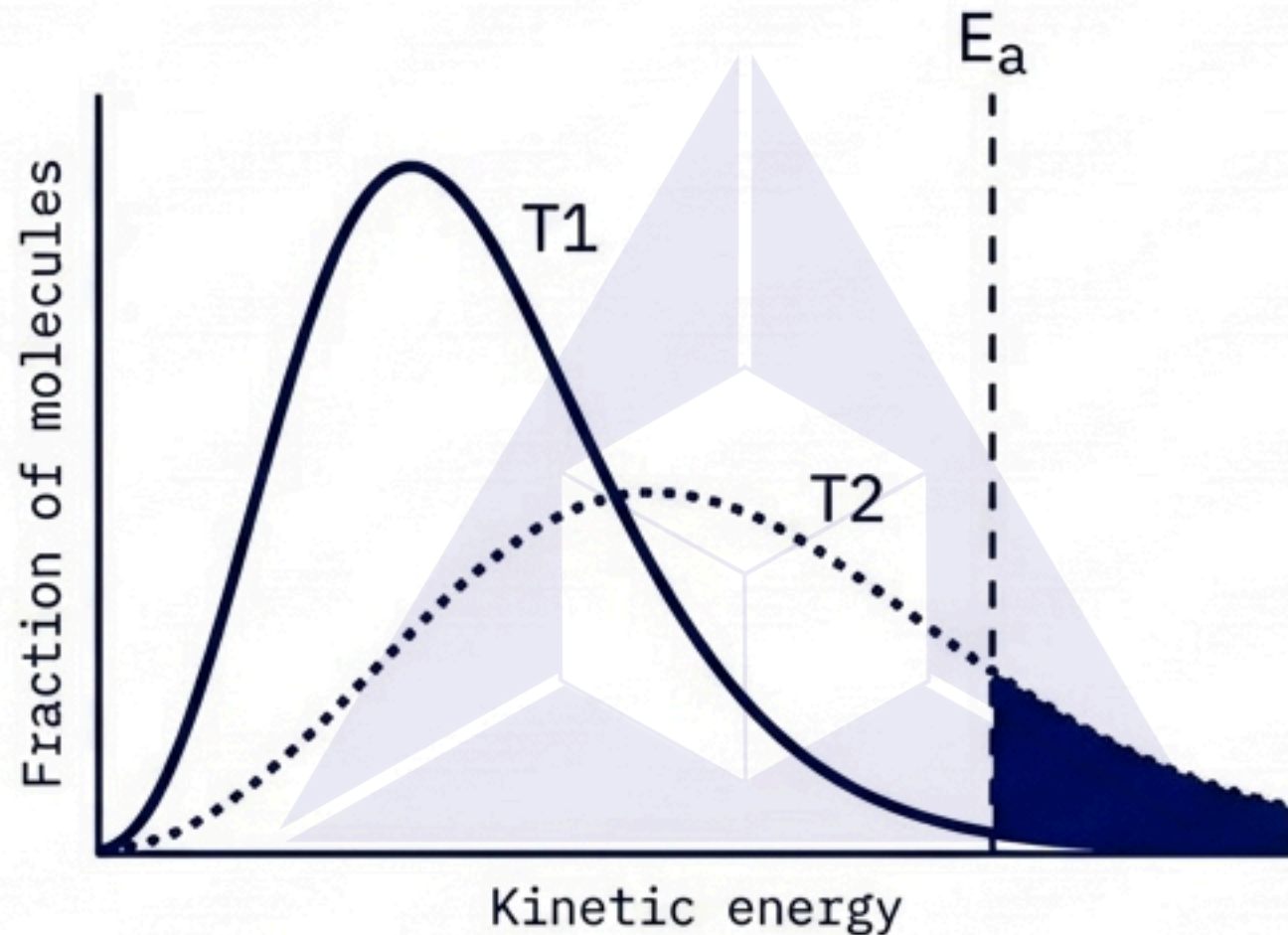
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Temperature & Activation Energy



Maxwell-Boltzmann distribution curves at two temperatures, showing a greater proportion of molecules with energy $\geq E_a$ at higher temperature (T2).

$$k = A e^{-E_a/RT}$$

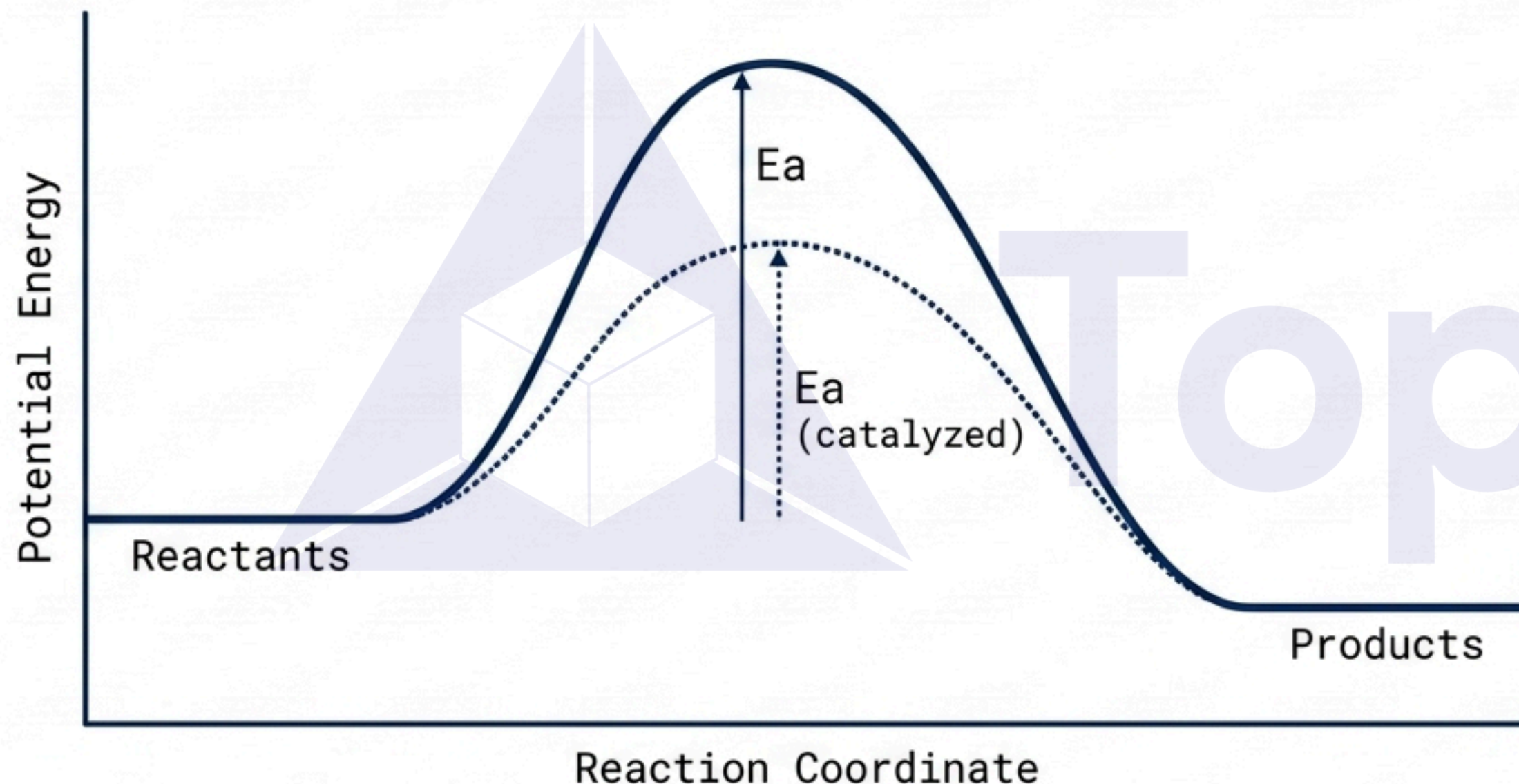
Activation Energy

Arrhenius/frequency factor

The rate of a chemical reaction typically doubles for every 10K increase in absolute temperature.

Higher temperature $\rightarrow$ greater proportion of molecules cross the E_a threshold $\rightarrow$ faster rate.

Catalysts & Alternate Pathways



Crucial Caveat:

Catalysts lower activation energy by providing an alternate pathway. They do not alter the thermodynamic feasibility (Delta G) of the reaction, nor do they change the final equilibrium state.

$$k = A e^{-E_a / RT}$$

Inserting a smaller E_a value mathematically yields an exponentially larger rate constant k .

Catalyst added -> alternate, lower activation energy pathway provided -> faster rate.

The Kinetic Control Panel

Concentration

Mechanism

Crowds the space, increasing total collision frequency (Z).

Governing Math

$$\text{Rate} = k[A]^x[B]^y$$

Temperature

Mechanism

Increases molecular kinetic energy; vastly expands the proportion of molecules exceeding the energy threshold.

Governing Math

$$k = A e^{(-E_a/RT)}$$

Catalyst

Mechanism

Provides an entirely new reaction pathway, actively lowering the activation energy barrier (E_a).

Governing Math

Modified Arrhenius
(smaller E_a term)

Chemical kinetics provides the tools not just to observe chemical changes, but to actively engineer their speed using concentration, heat, and catalysis.



You've Learned the Theory.

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