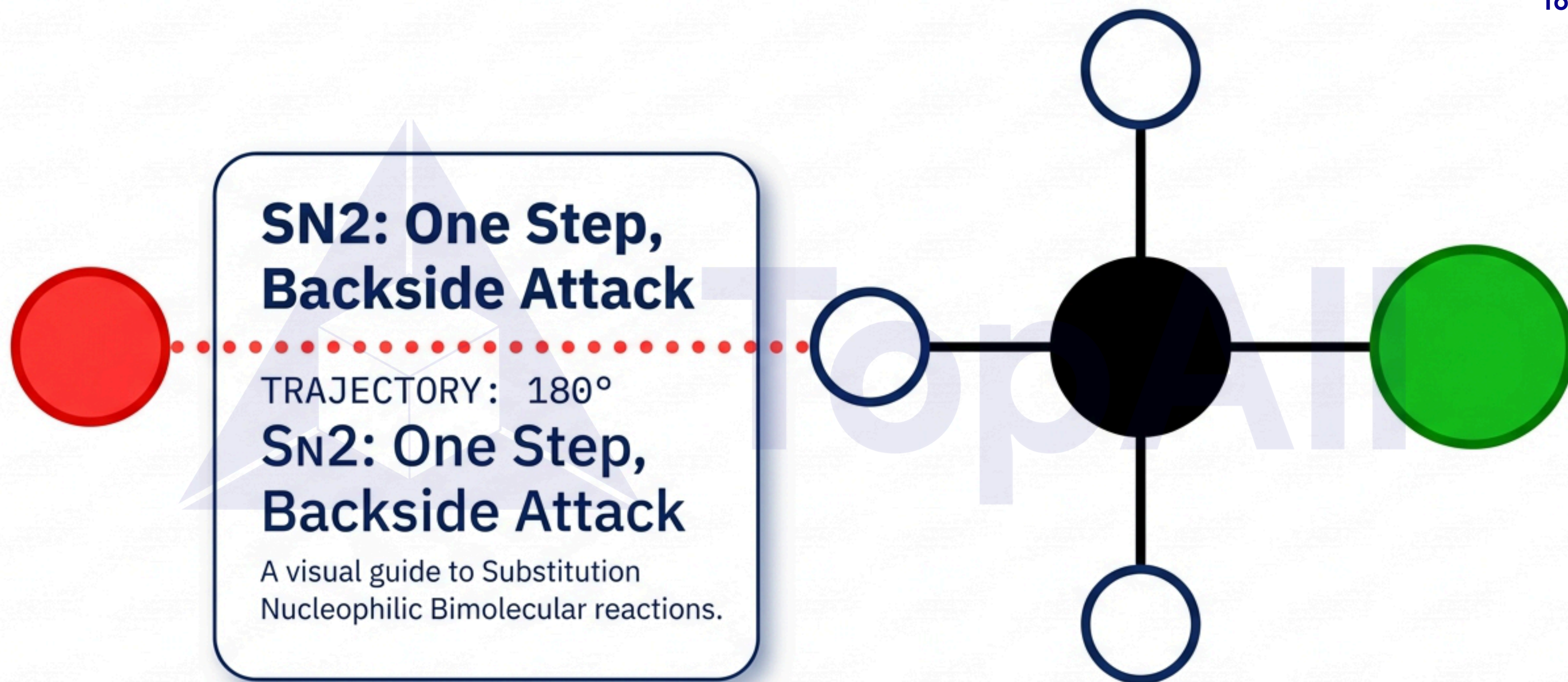




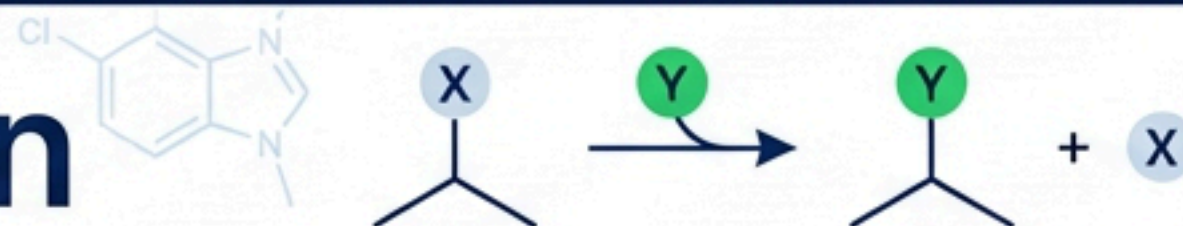
# Molecular Blueprint

## Second Order Kinetics

# S

## Substitution

A chemical reaction where one functional group in a chemical compound is directly replaced by another.



# N

## Nucleophilic

The attacking species is a Nucleophile (electron-rich), which seeks out an electron-deficient center.

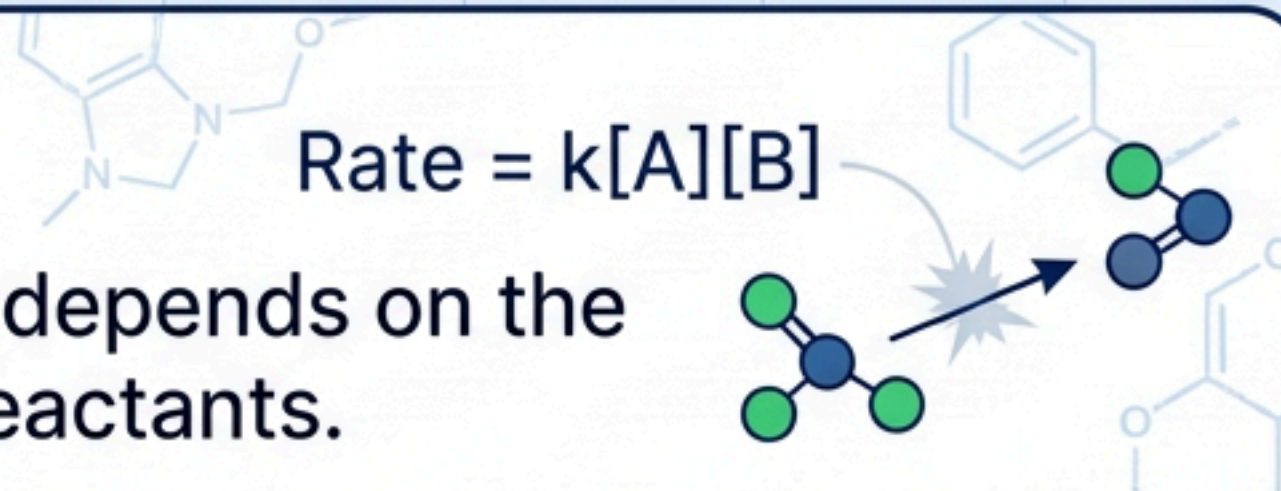


# 2

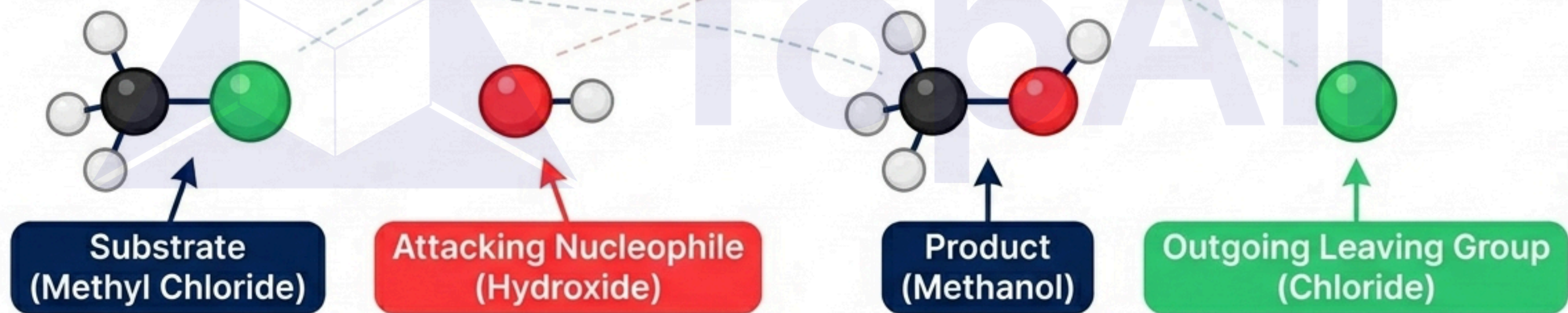
## Bimolecular

The rate of the reaction depends on the concentration of both reactants.

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



### The Standard Reaction

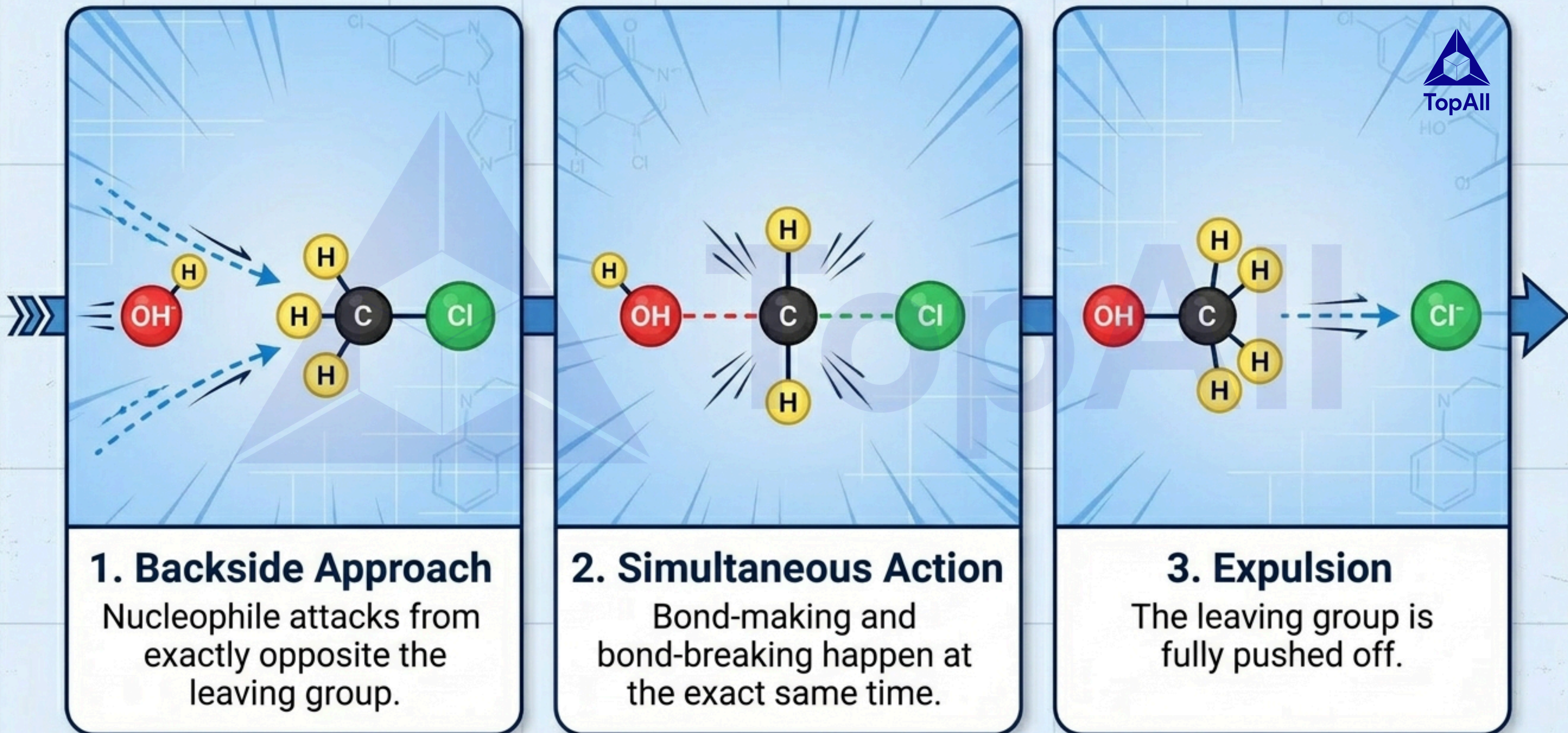


The nucleophile targets the carbon, breaking the carbon-halide bond to form a new carbon-oxygen bond.

# The Concerted Mechanism

**Amber**

No Intermediate. Reaction occurs in a single step.





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

$$E=mc^2$$



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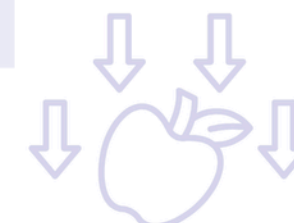
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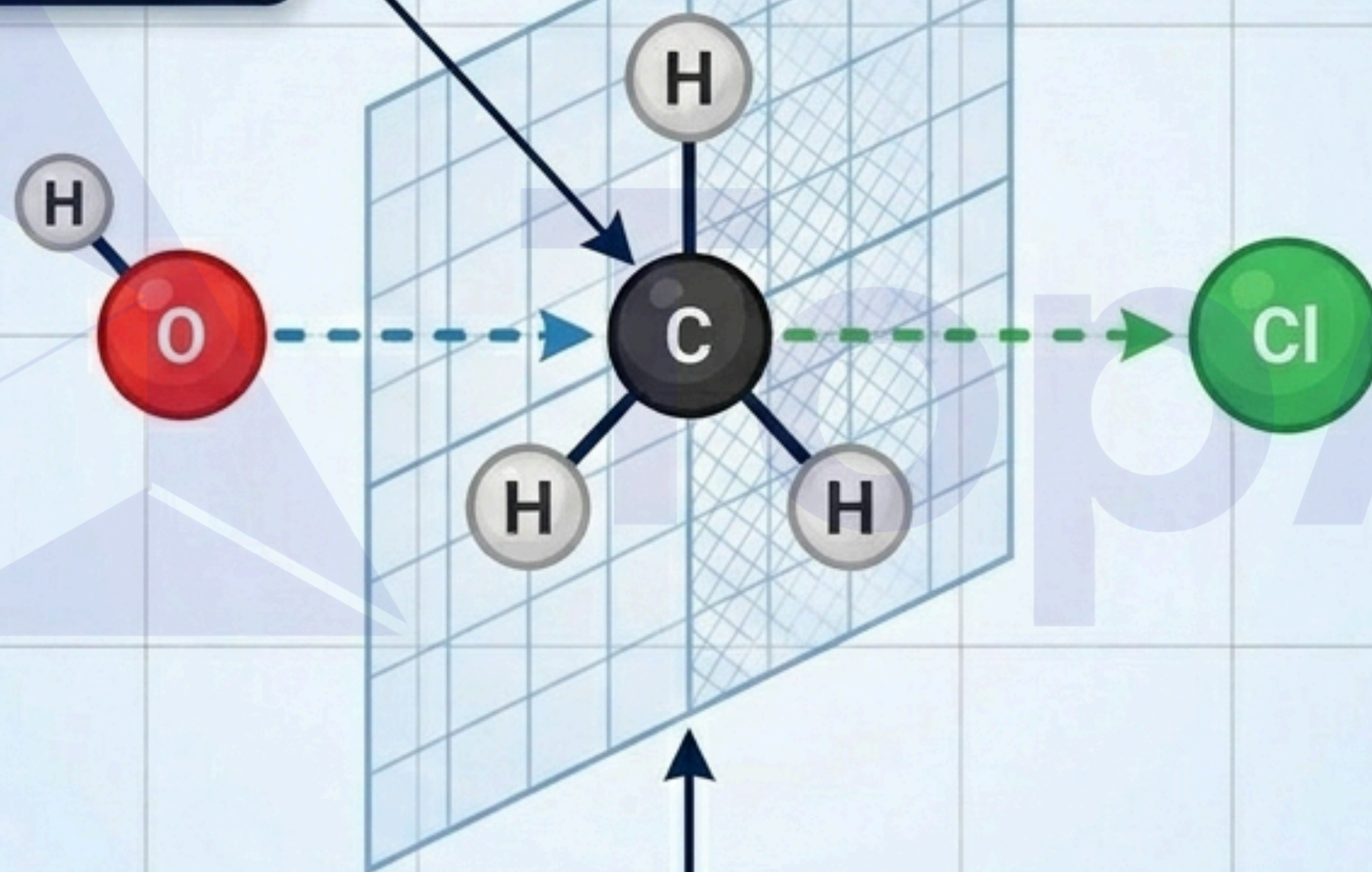


# The Fleeting Transition State

Cannot be isolated. Highly unstable state requiring maximum activation energy.

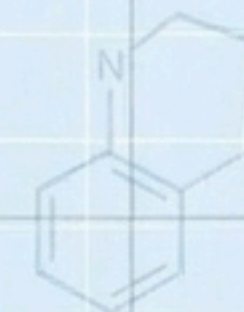
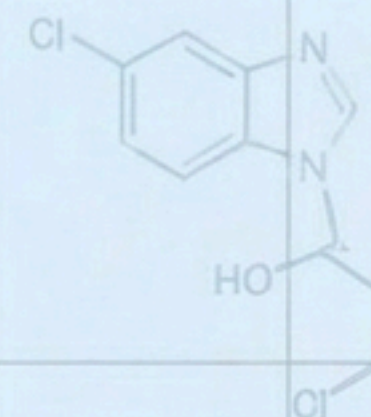
## Pentacoordinate Carbon

Carbon is momentarily bonded to 5 atoms simultaneously.



## Planar Geometry

The three C-H bonds are forced into a single, flat plane to accommodate both attacking and leaving groups.

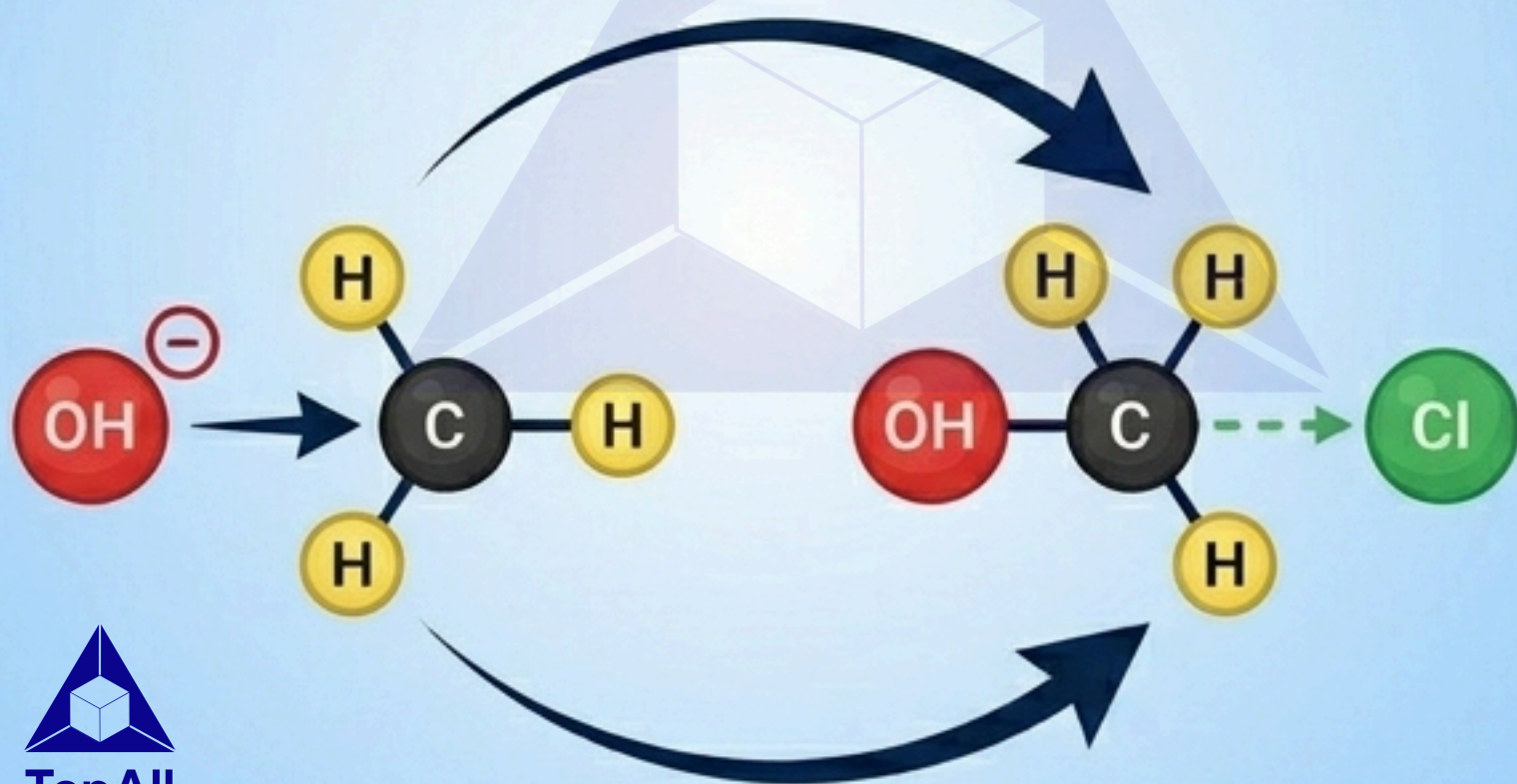


# The Umbrella Inversion

## Stereospecific Inversion

### Chemical Flip

The incoming nucleophile physically forces the existing bonds to flip to the opposite side of the central carbon.



### Physical Analogy

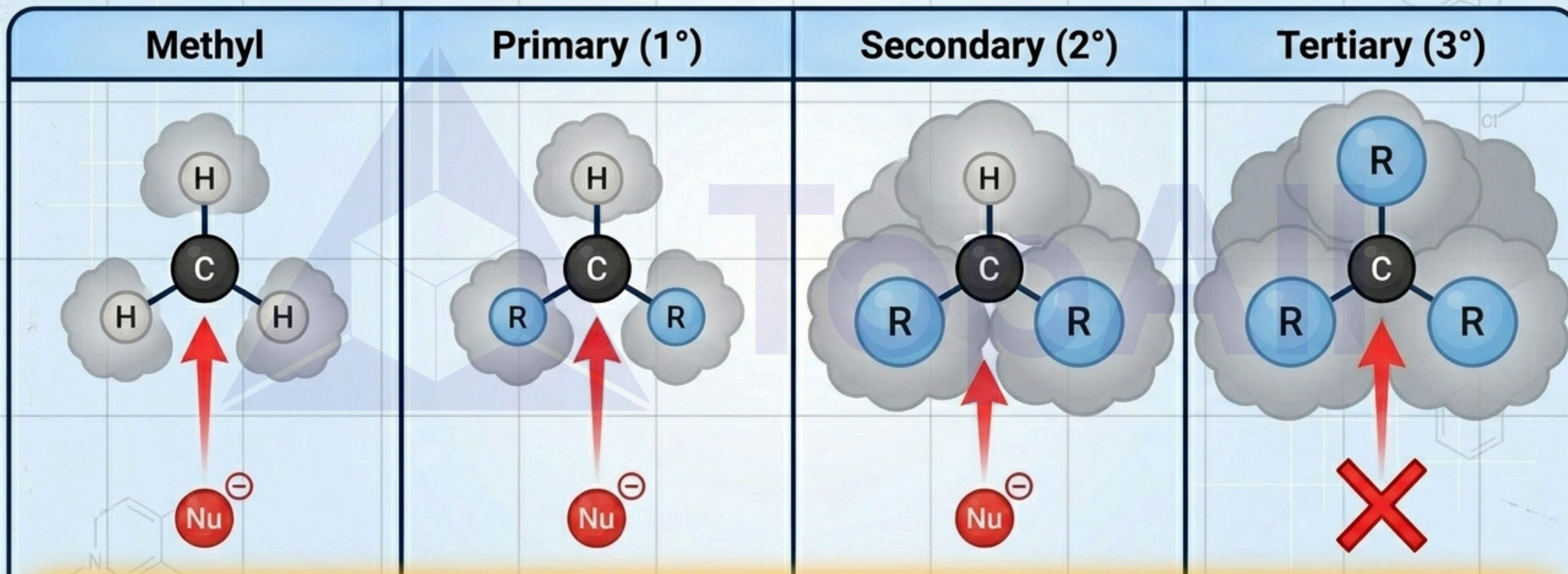
The stereocenter configuration inverts in the exact same manner as an umbrella catching a strong gust of wind.



Normal State → Inverted State

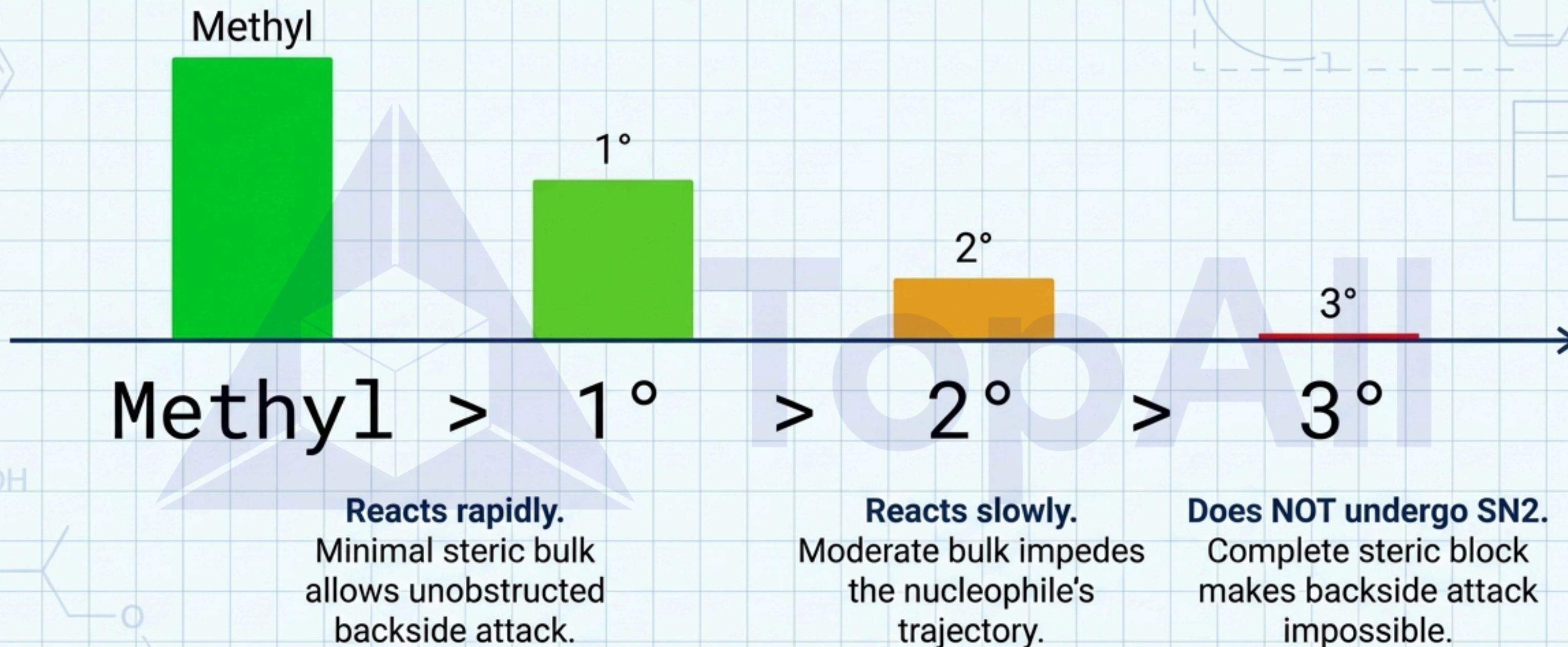
# Steric Hindrance: The Ultimate Barrier

The  $S_N2$  reaction requires clear backside access.



Bulky substituents physically block the nucleophile from reaching the central, electron-deficient carbon.

# The Rule of Reactivity



The smaller the physical obstacle around the target carbon, the faster the SN2 reaction will occur.



# You've Learned the Theory.

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