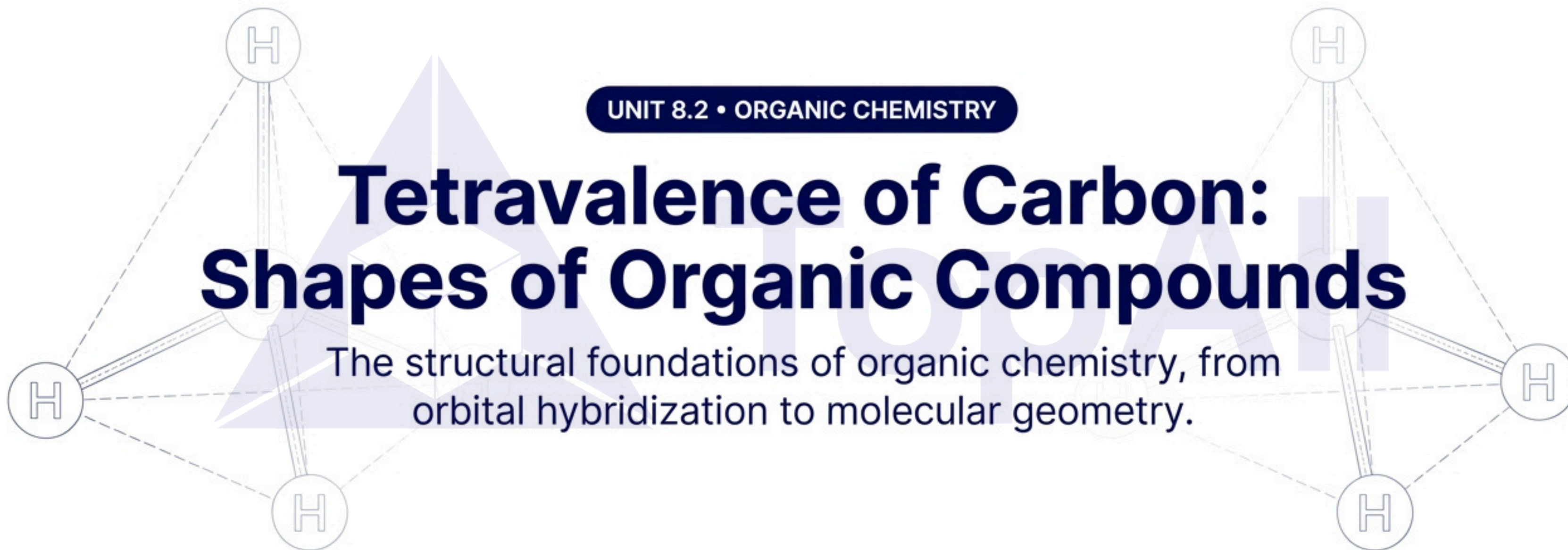


UNIT 8.2 • ORGANIC CHEMISTRY

Tetravalence of Carbon: Shapes of Organic Compounds

The structural foundations of organic chemistry, from orbital hybridization to molecular geometry.



The Power of Four

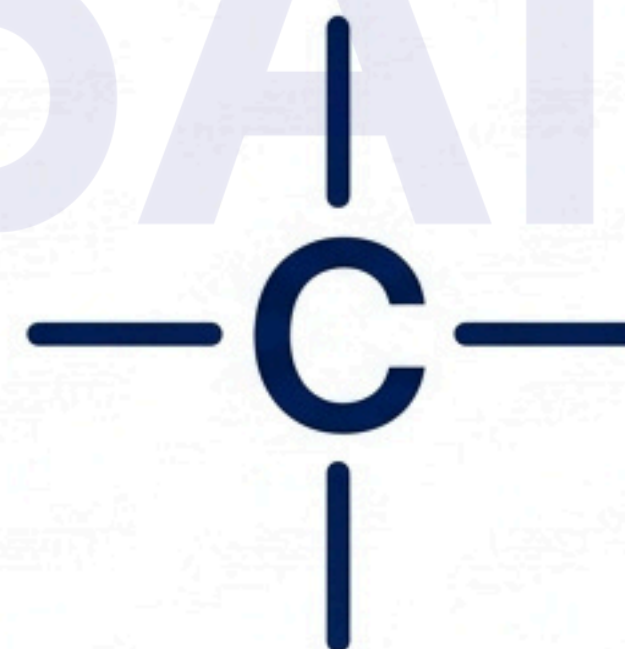
The Quest for an Octet

Carbon has exactly four valence electrons in its outermost shell. To achieve a highly stable, noble-gas electron configuration, it must acquire four more.



Maximum Bonding Capacity

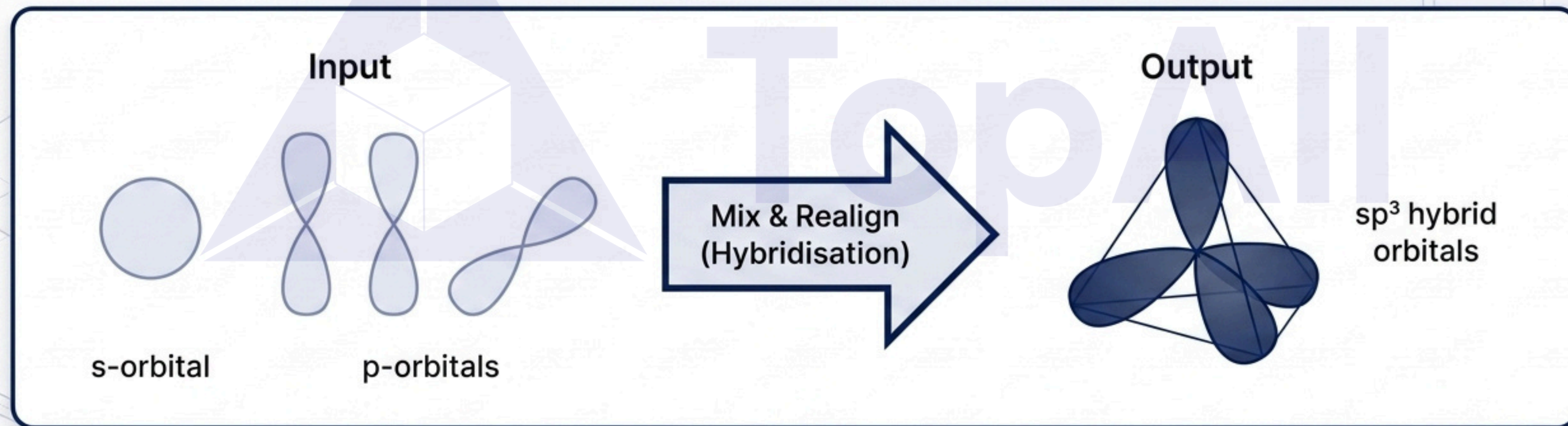
Instead of gaining or losing electrons entirely, carbon shares them. It forms exactly four strong covalent bonds, maximizing its architectural reach.



Nature's optimal balance of electron sharing.

Hybridisation: Reshaping for Stability

Carbon's native 2s and 2p orbitals are different shapes. To form identical, stable bonds, carbon blends these atomic orbitals.



Orbitals hybridize to minimize electron repulsion and maximize bond overlap.



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$$E=mc^2$$



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Key Highlights

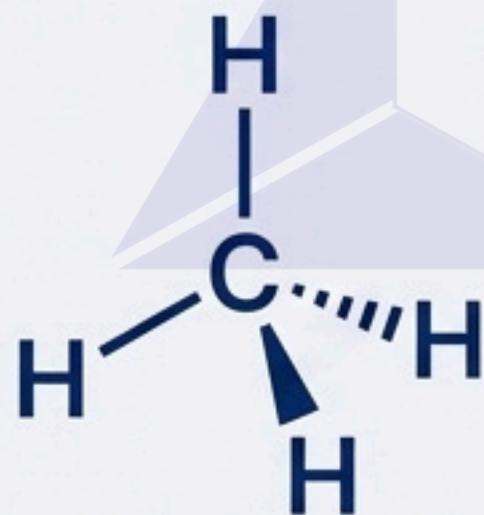
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Geometries of Carbon Compounds

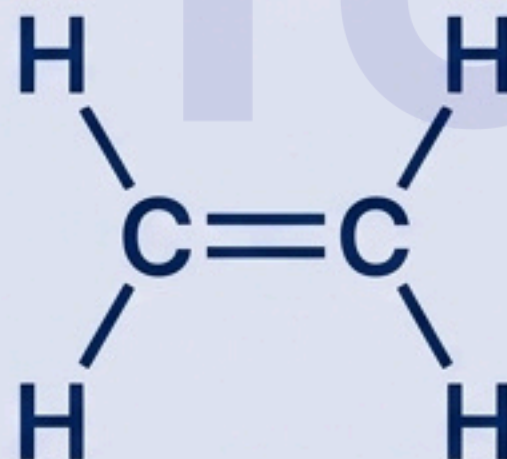
Alkanes (sp^3)

- **Type:** Single bonds
- **Shape:** Tetrahedral (109.5°)
- **s-character:** 25%



Alkenes (sp^2)

- **Type:** One double bond
- **Shape:** Trigonal Planar (120°)
- **s-character:** 33.3%



Alkynes (sp)

- **Type:** One triple bond
- **Shape:** Linear (180°)
- **s-character:** 50%

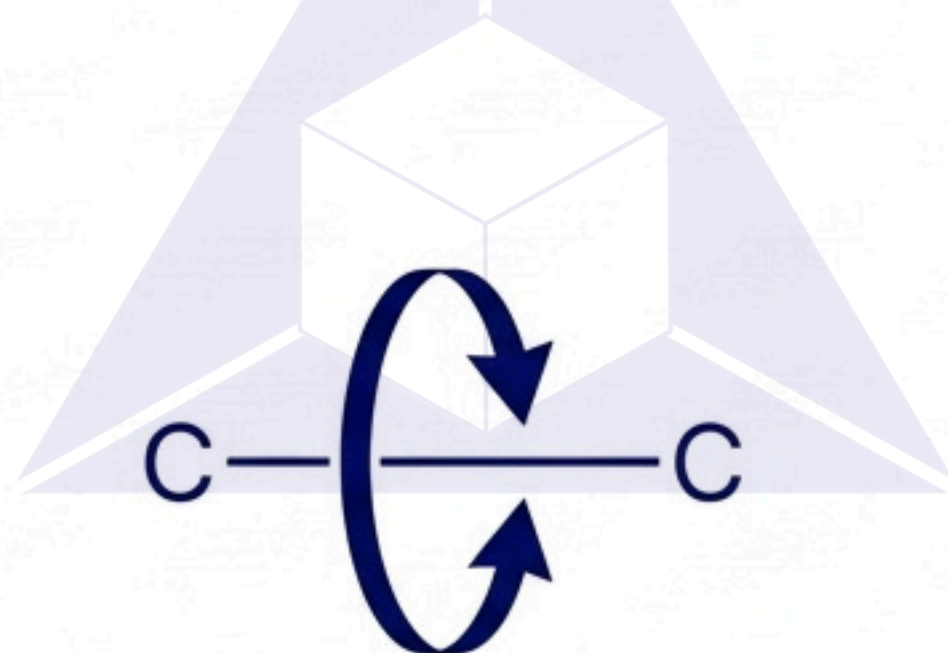


The s-Character Rule: As s-character increases ($25\% \rightarrow 50\%$), the hybrid orbital sits closer to the nucleus.
Result: Shorter bonds, higher bond enthalpy, and greater electronegativity.

How π Bonds Dictate Structure

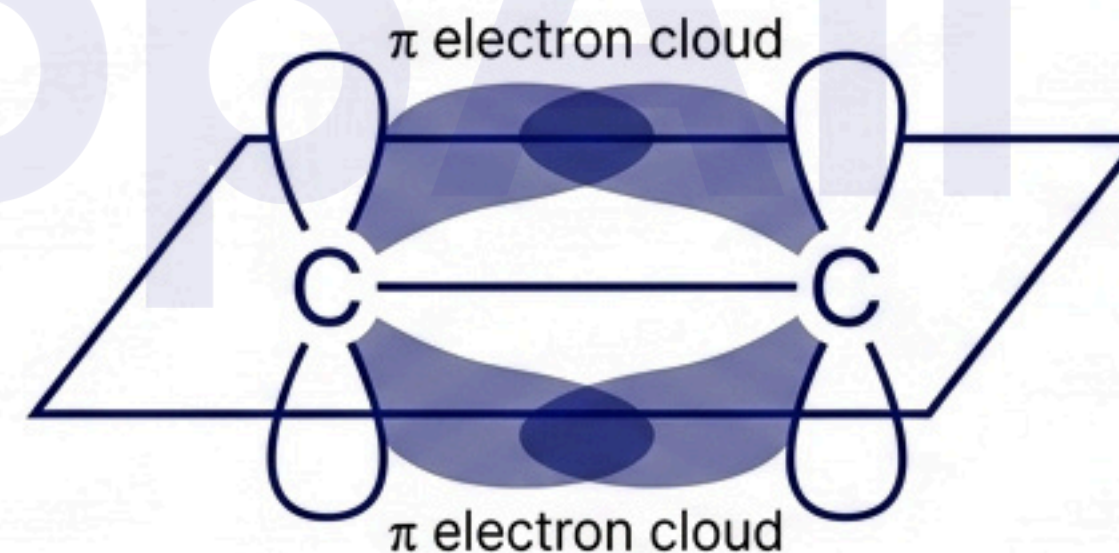
Free Rotation

Head-on orbital overlap allows the molecule to spin freely around the bond axis.



Locked Geometry & Reactivity

Unhybridized p-orbitals overlap sideways, creating electron clouds above and below the bonding plane. This strictly **restricts rotation (coplanar geometry)** and exposes electrons to attacking reagents.



Understanding chemical reactivity begins with locating the π electron cloud.

KEY TAKEAWAYS

Why Carbon Builds So Much Chemistry



Tetravalence (The Branching Rule): Four stable bonding sites allow for complex, multi-directional 3D architectures—a capability unmatched by oxygen or nitrogen.



Hybridisation Flexibility (The Shape Shifter): The fluid ability to shift between sp^3 , sp^2 , and sp orbitals unlocks incredibly diverse structural outputs: infinite chains, closed rings, and flat sheets.



π -Bond Reactivity (The Active Blueprint): Multiple bonds provide structural rigidity to molecular frameworks while simultaneously acting as highly exposed, active sites for chemical reactions to occur.

Mastery achieved: You now understand the architectural foundation of the organic universe.



You've Learned the Theory.

Now Let's Test It.

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