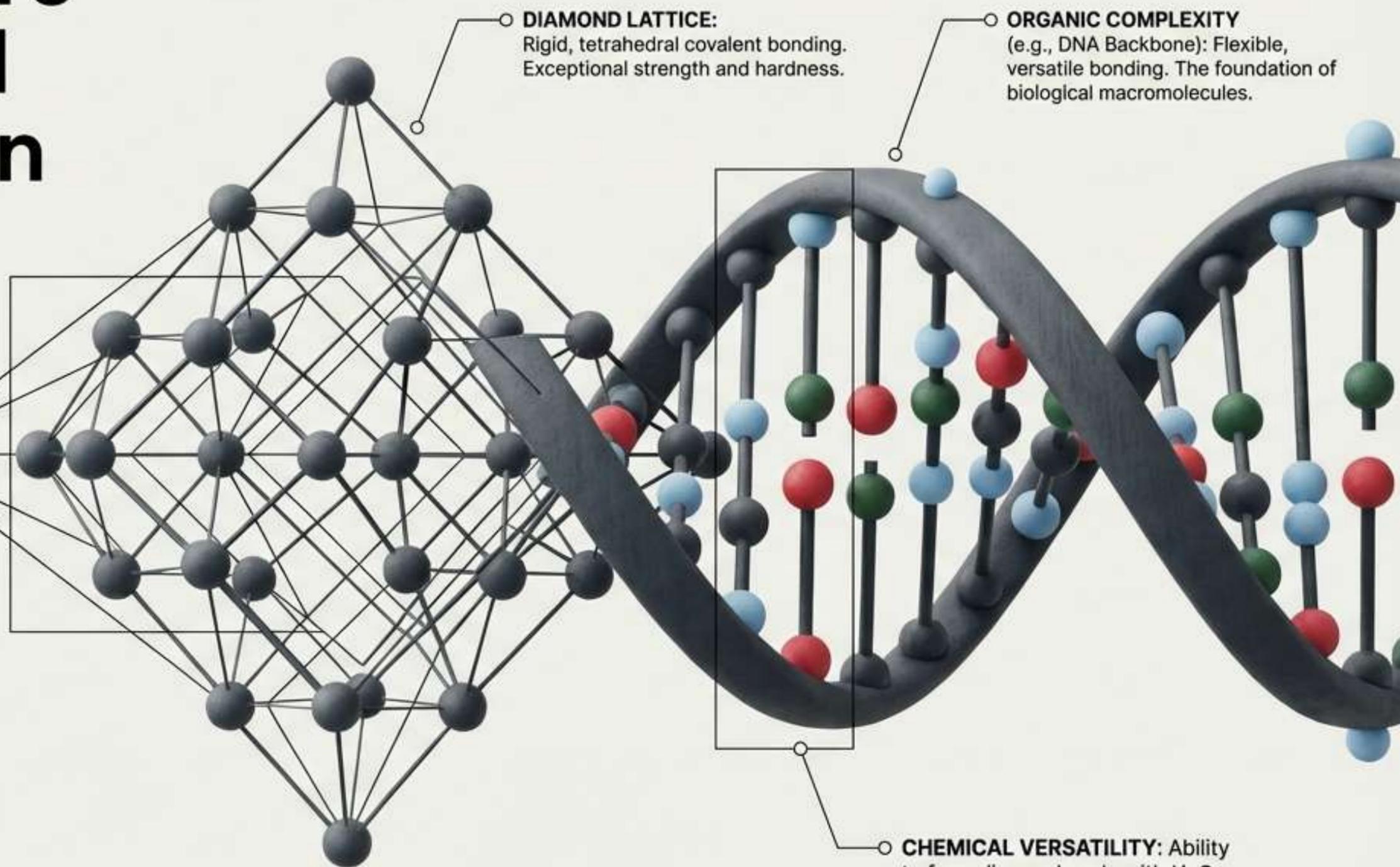


The Architecture of Life: A Visual Guide to Carbon



CARBON ATOM (C)
Atomic Number: 6



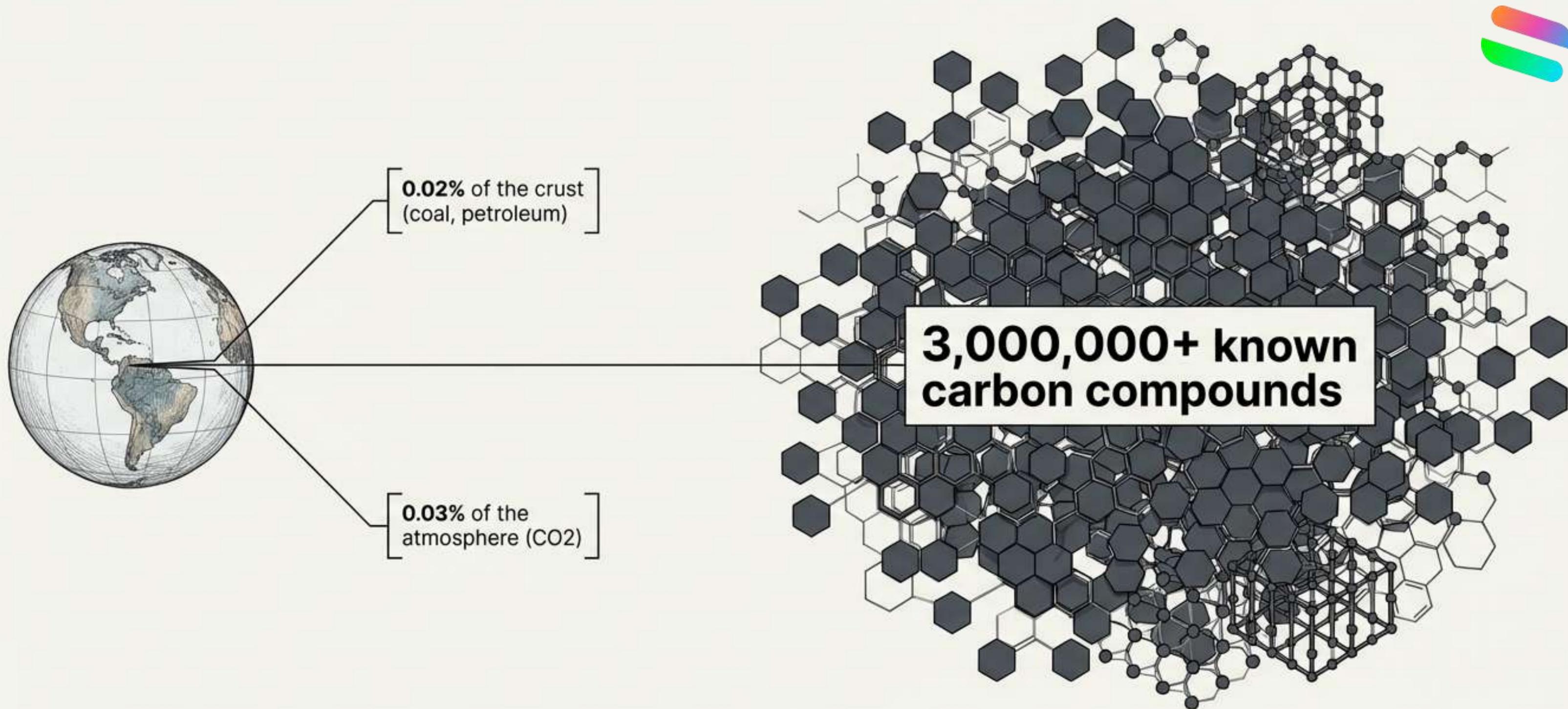
DIAMOND LATTICE:
Rigid, tetrahedral covalent bonding.
Exceptional strength and hardness.

ORGANIC COMPLEXITY
(e.g., DNA Backbone): Flexible,
versatile bonding. The foundation of
biological macromolecules.

CHEMICAL VERSATILITY: Ability
to form diverse bonds with H, O,
N, and itself, creating infinite
molecular possibilities.

Exploring the atomic mechanics,
structural blueprints, and infinite
chemical canvas of the universe's
most versatile element.

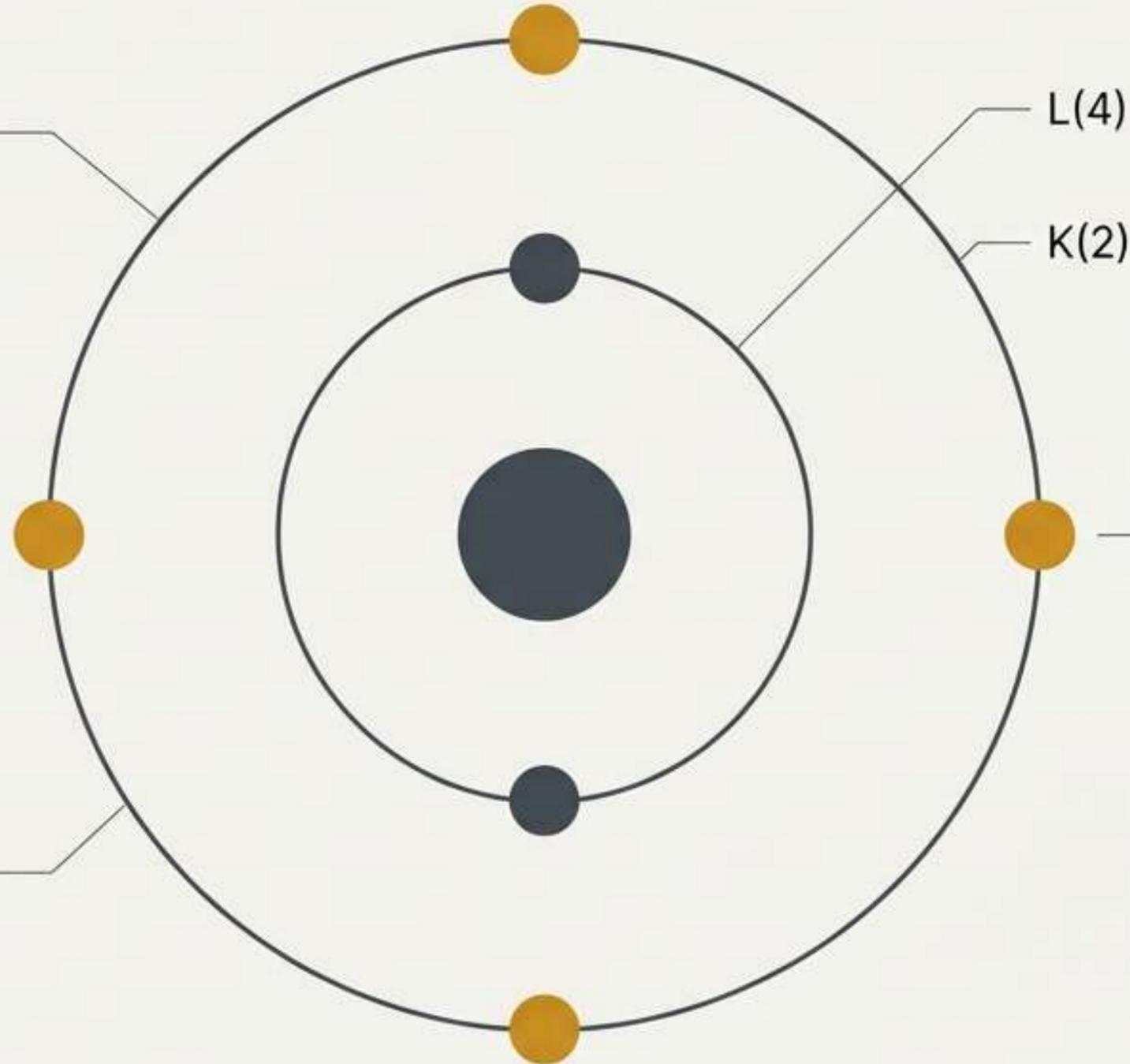
A tiny fraction of the Earth creates over three million compounds



Despite its scarcity in the natural environment, carbon forms the basis of all living structures and produces more compounds than all other elements combined.

The Tetravalent nature of Carbon requires it to share, not steal

Atomic Number 6:
2 inner electrons,
4 outer electrons.

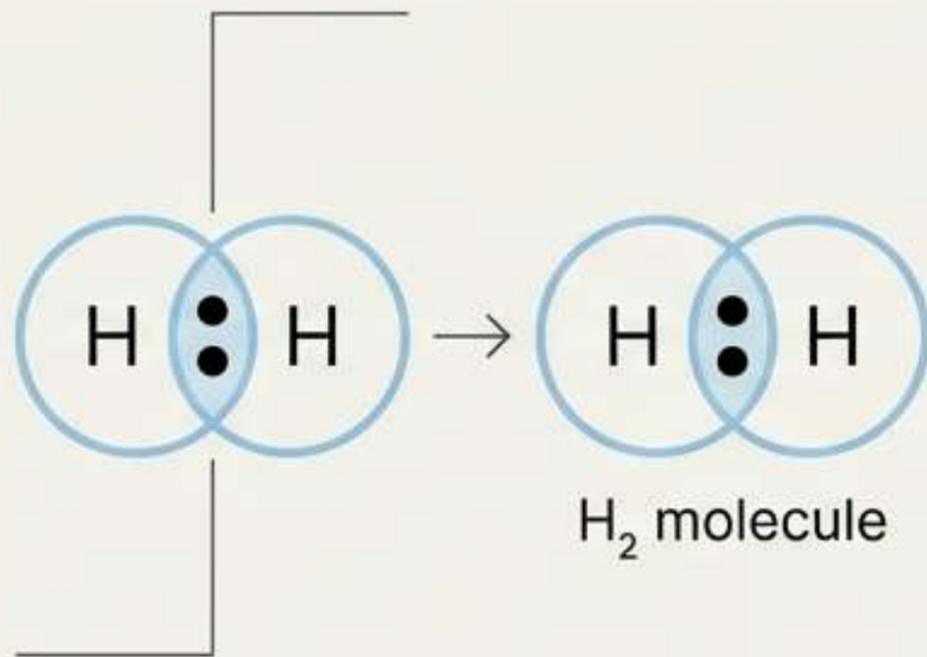


The Dilemma:
Gaining or losing 4
electrons requires
too much energy.

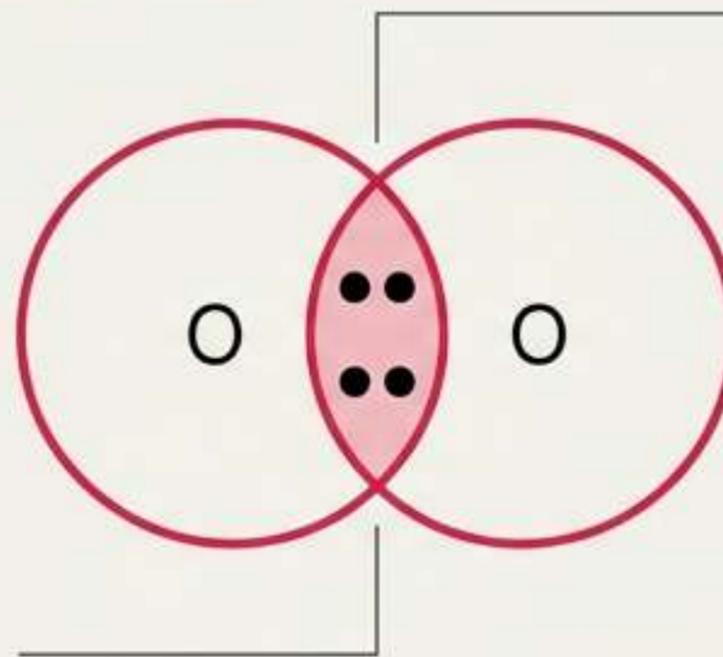
The Solution:
Carbon achieves a
stable noble gas
configuration
exclusively by sharing its
valence electrons with
other atoms.



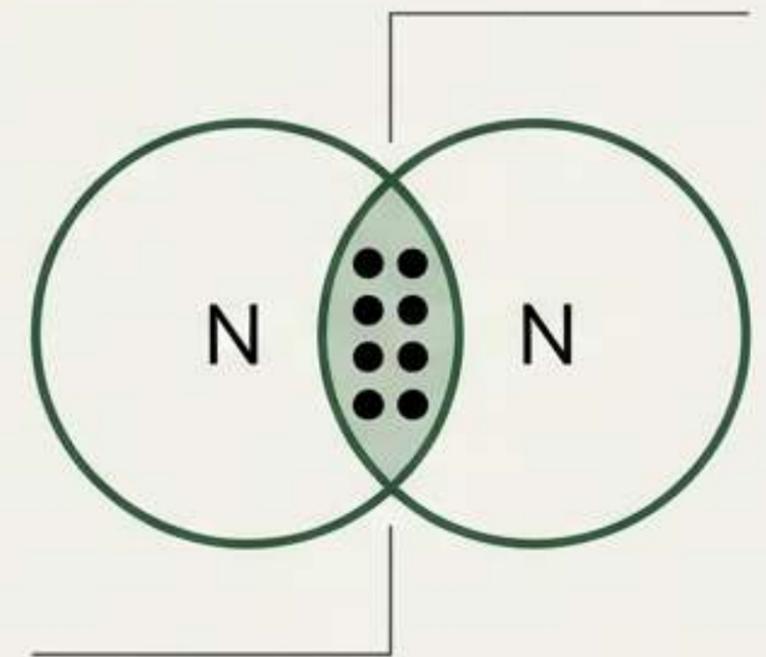
Covalent bonds form when non-metals share pairs of electrons



Single Bond (—)
One shared pair
of electrons.



Double Bond (=)
Two shared pairs
of electrons.



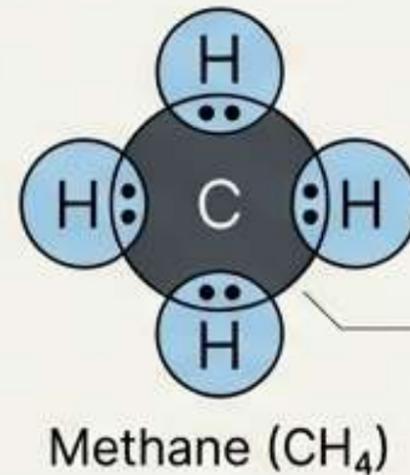
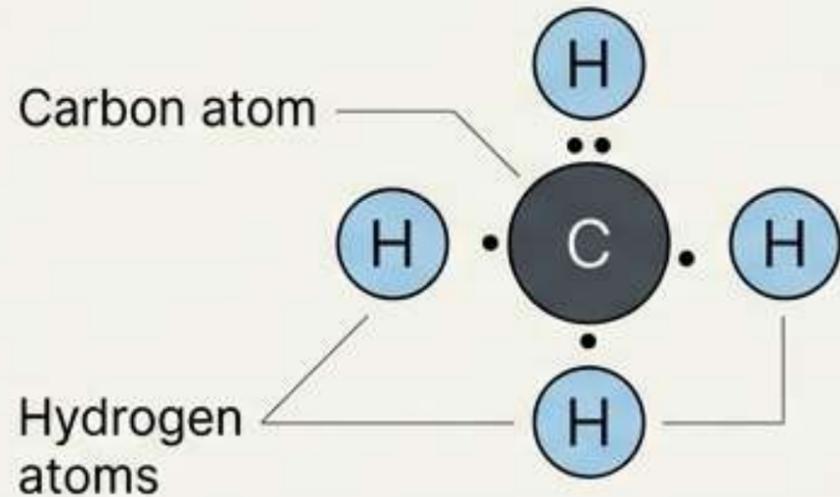
Triple Bond (≡)
Three shared pairs
of electrons.

Each shared pair stabilizes the combining atoms.

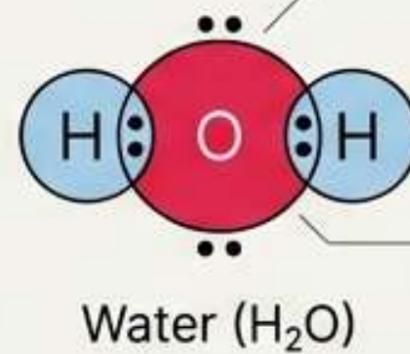
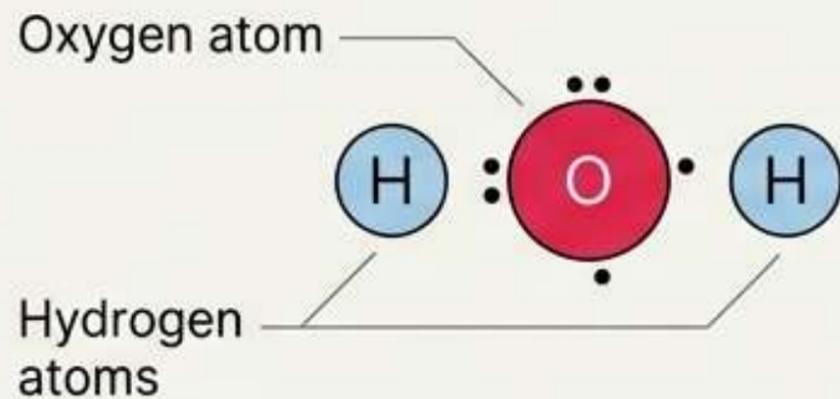
Building stable molecules through structural sharing



Ingredients → Final Build

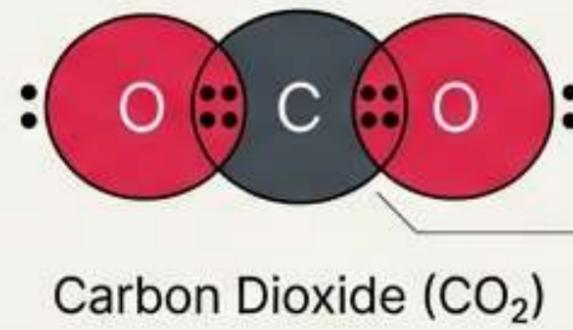
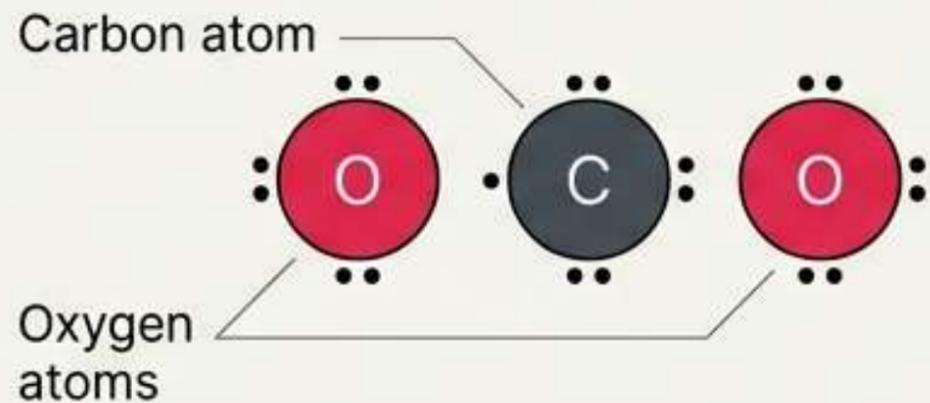


Shared electron pair



Two unshared pair of electron

Shared pair of electron



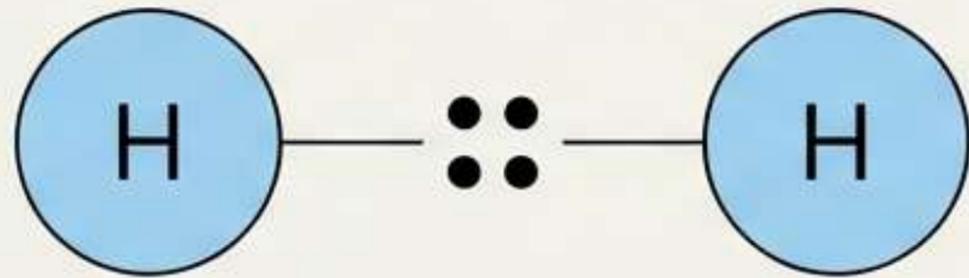
Shared pair of electron





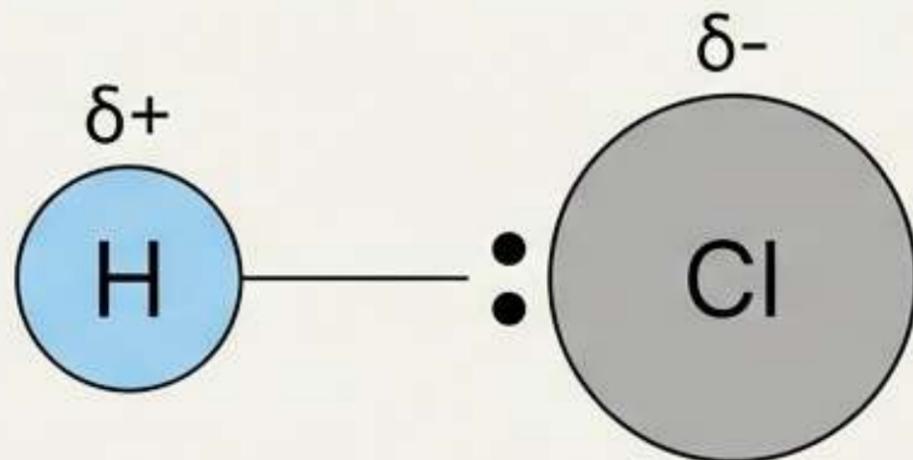
Shared electrons are not always shared equally

Equal Pull (Same Electronegativity)



Non-Polar Covalent Bond: Formed between elements of the same electronegativity.

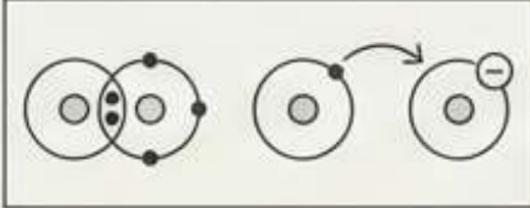
Unequal Pull (Different Electronegativity)



Polar Covalent Bond: Formed between different elements causing unequal sharing of electrons.

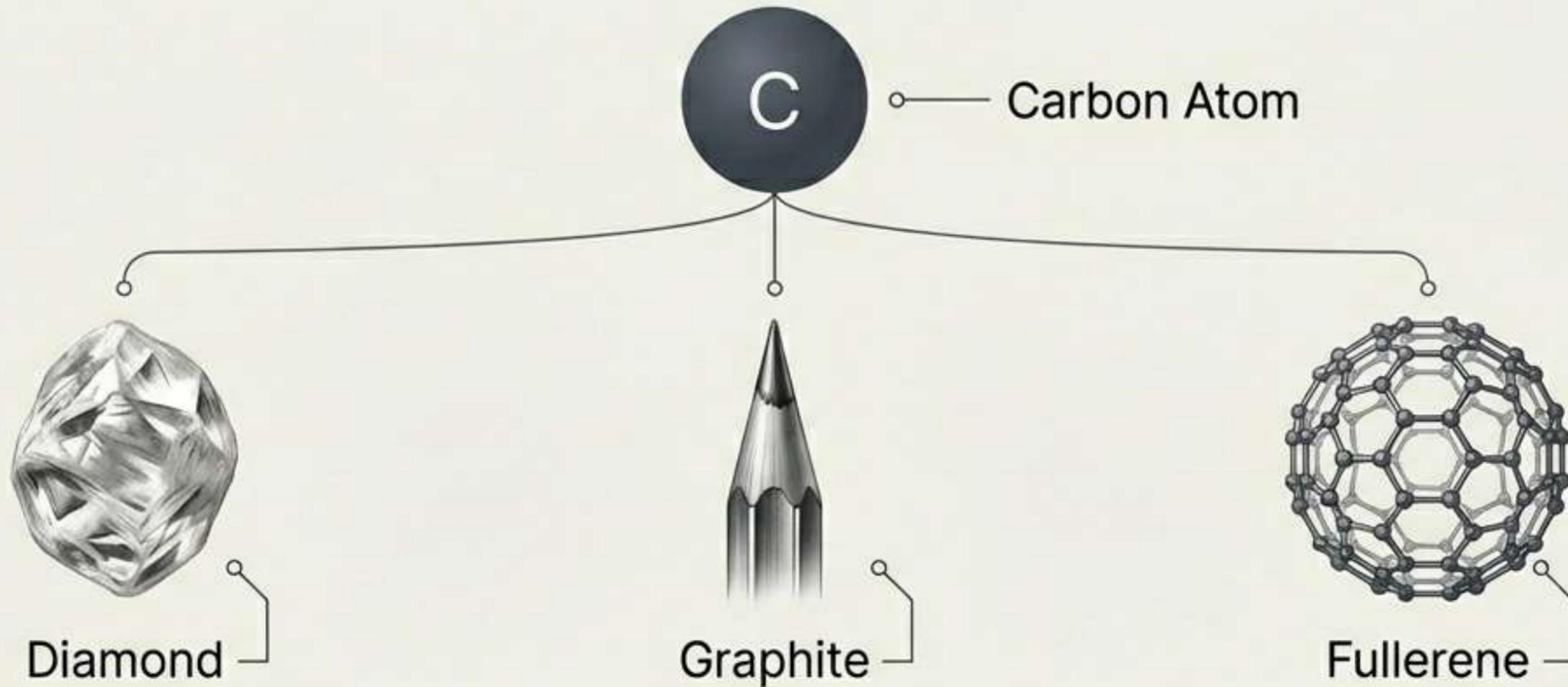


The physical characteristics of Covalent vs. Ionic compounds

	Covalent Compounds	Ionic Compounds
	Usually gases or liquids, low MP/BP	Crystalline solids, high MP/BP
	Soluble in organic solvents, rarely water	Soluble in water
	Non-conductors, no free ions	Conduct electricity in solution or molten state
	Formed by sharing electrons	Formed by transferring electrons



Allotropy allows one element to wear vastly different masks

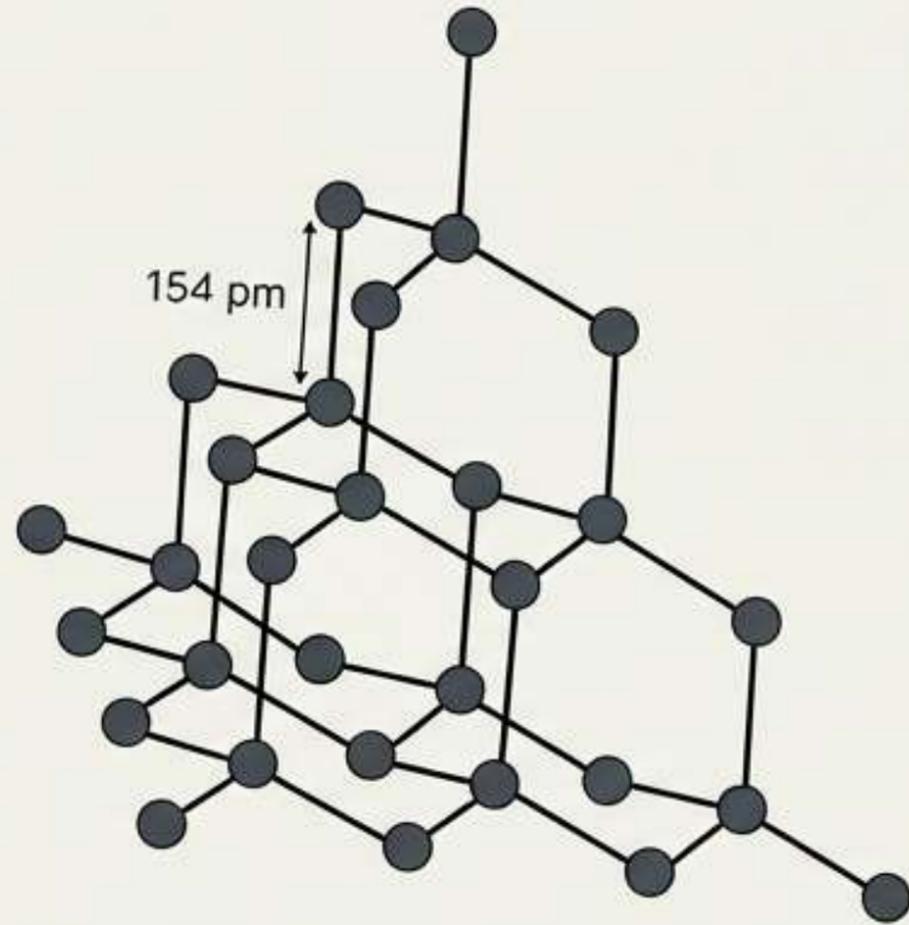


Allotropy: The phenomenon where the same element exists in different physical forms with entirely different physical properties, but almost identical chemical properties.

The structural difference between rigid Diamonds and sliding Graphite



Diamond

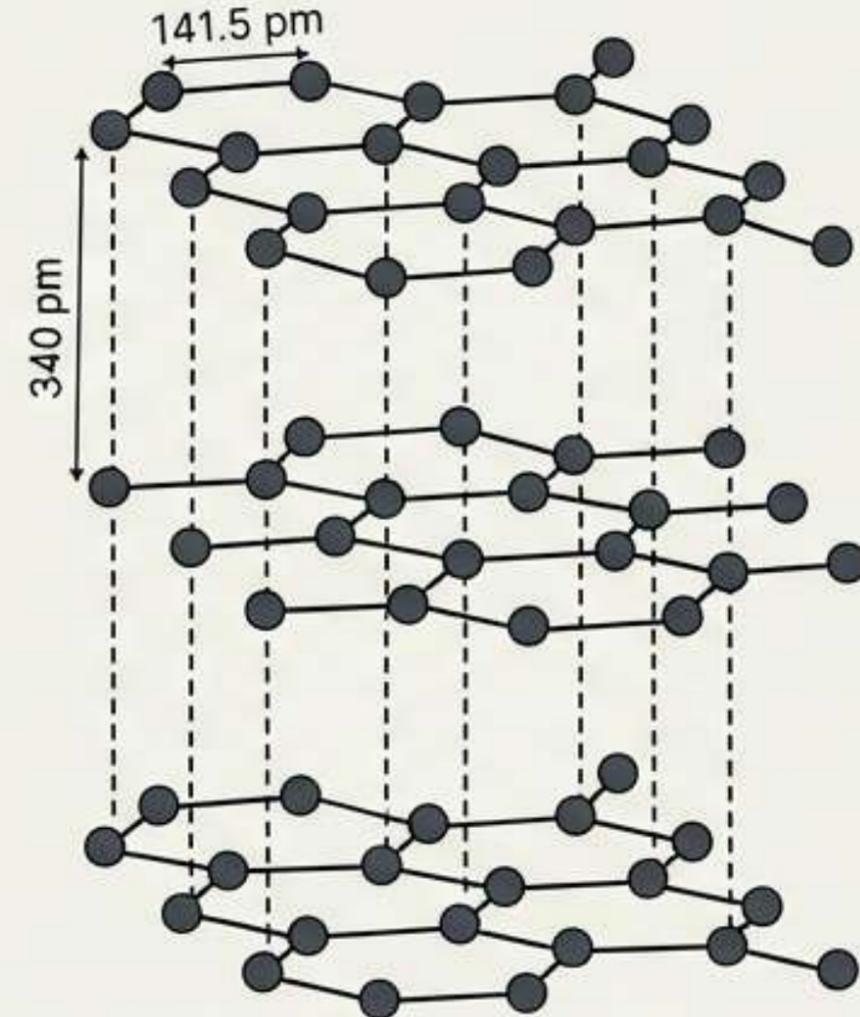


Rigid 4-bond structure creates ultimate hardness



Traps all electrons
(Non-conductor)

Graphite

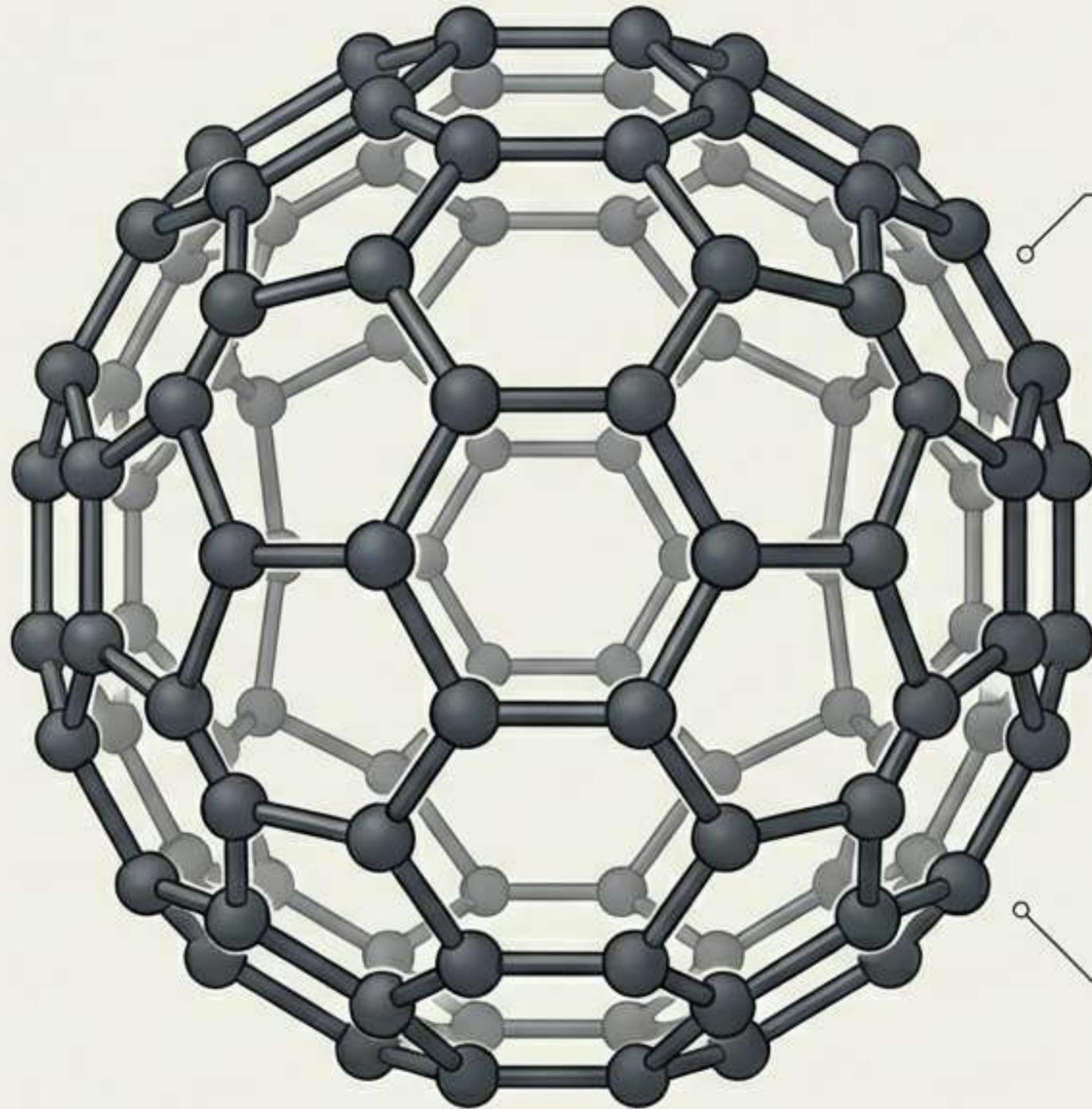


3-bond sheet structure allows layers to slide
(Soft/slippery)



Leaves a free valence electron per carbon
(Good conductor)

Fullerene: The architectural C60 Buckyball



Structure

A hollow, cage-like sphere consisting of 60 carbon atoms forming 12 pentagonal faces and 20 hexagonal faces.

Discovery

Discovered in 1985; named after architect R. Buckminster Fuller for its geodesic dome geometry.

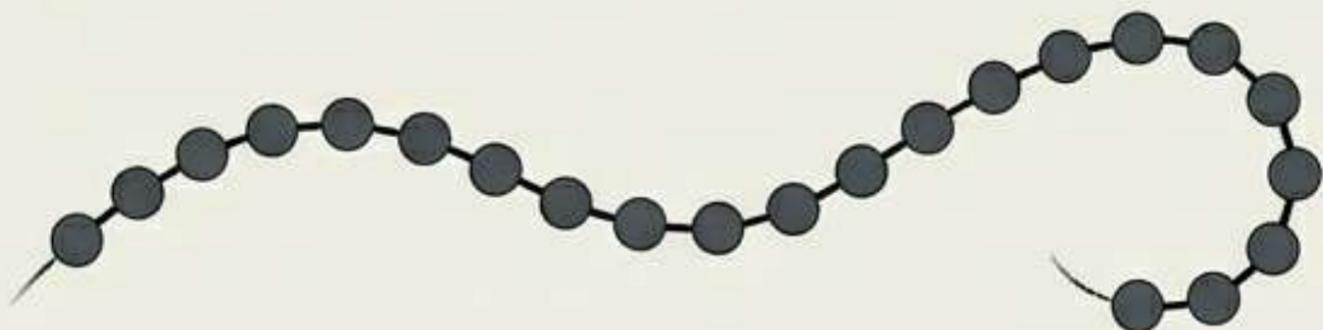
Properties

Soluble in benzene, acts as a semiconductor, and becomes a superconductor when combined with alkali metals.

The four pillars of Carbon's infinite chemical canvas

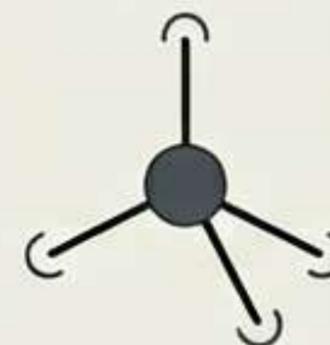


Catenation



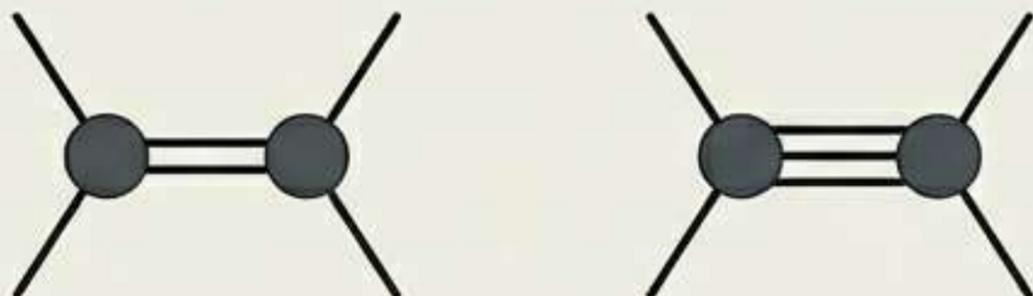
The tendency to form strong carbon-carbon bonds, linking into infinite chains and rings.

Tetravalency



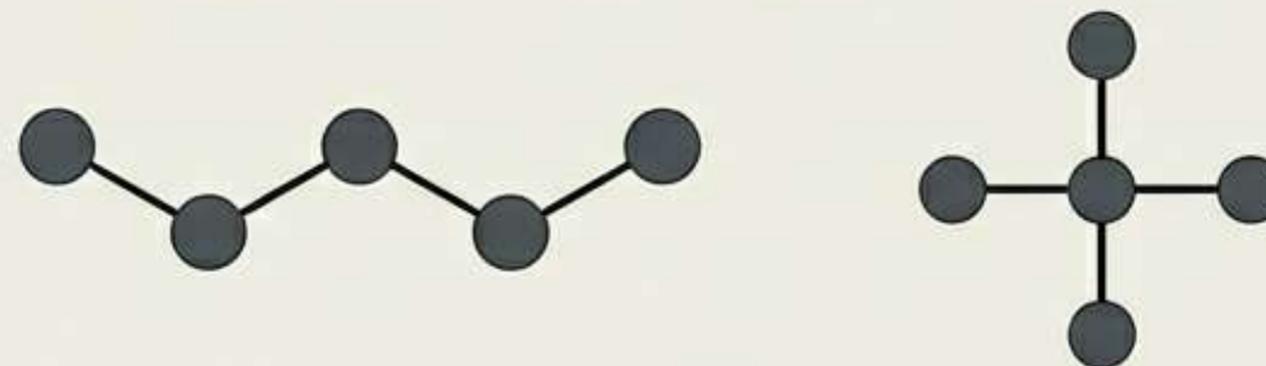
Four available valence electrons, allowing stable bonds with four other atoms simultaneously.

Multiple Bonds



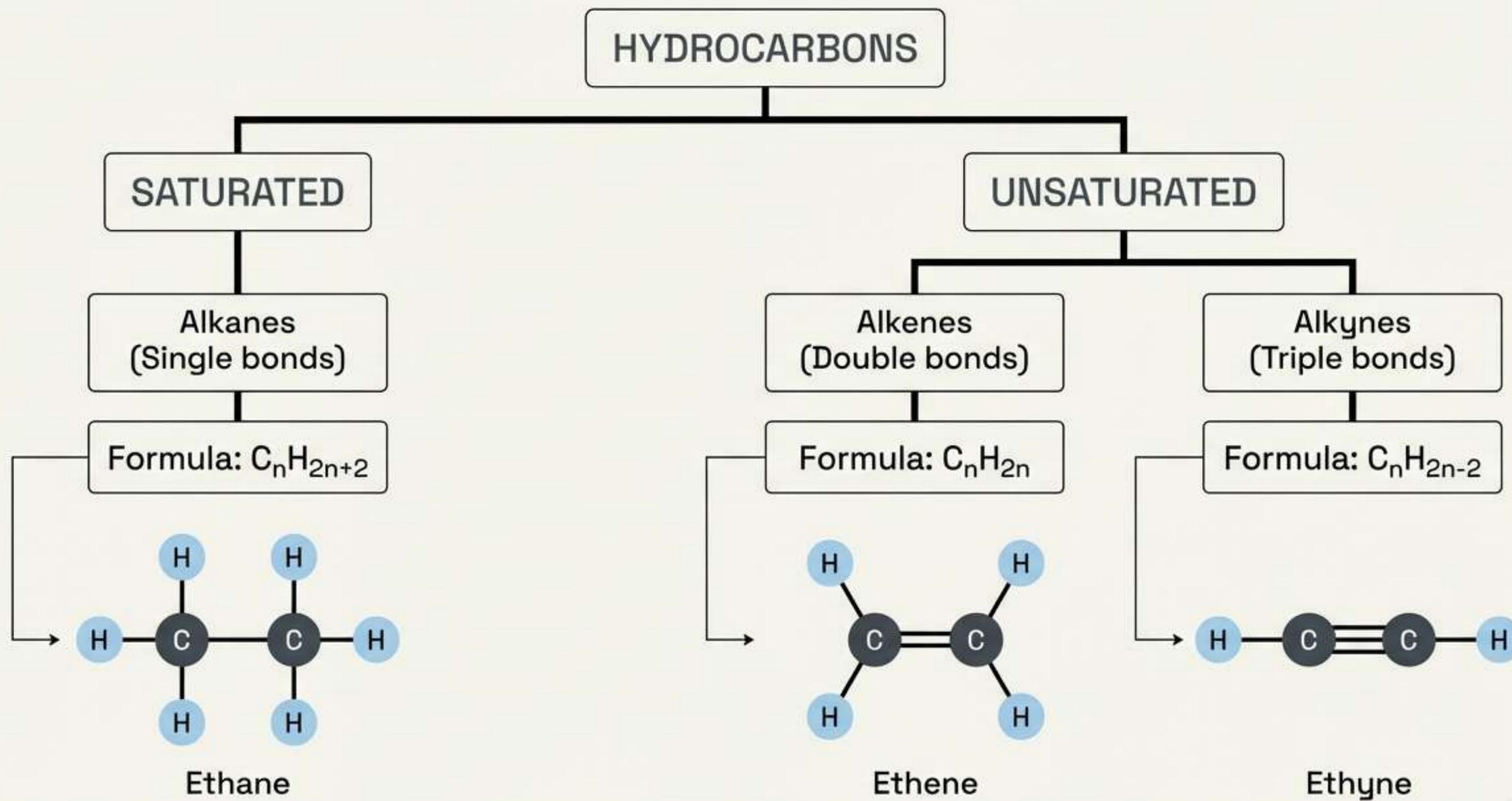
The ability to easily form double or triple bonds with itself and other elements.

Isomerism



Compounds having the exact same molecular formula but completely different structural shapes.

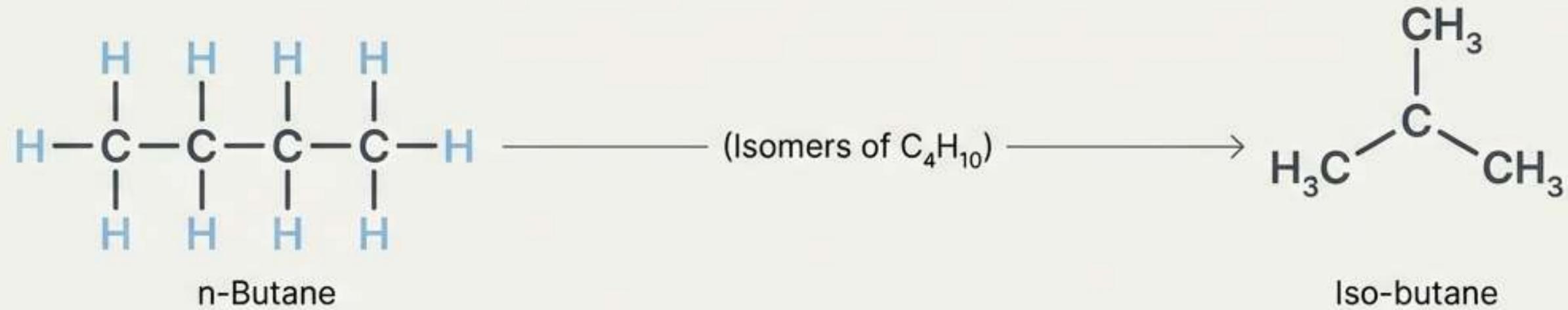
Hydrocarbons: The foundation of organic chemistry



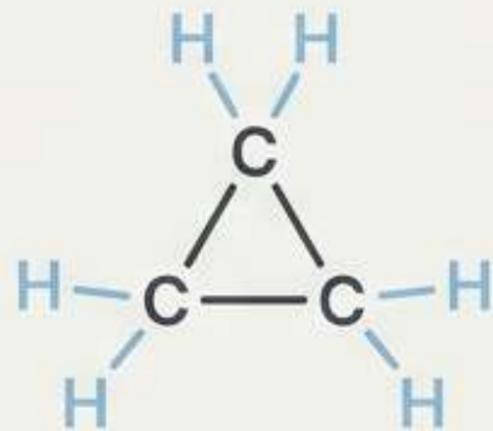
Hydrocarbon architecture: Chains, Branches, and Rings



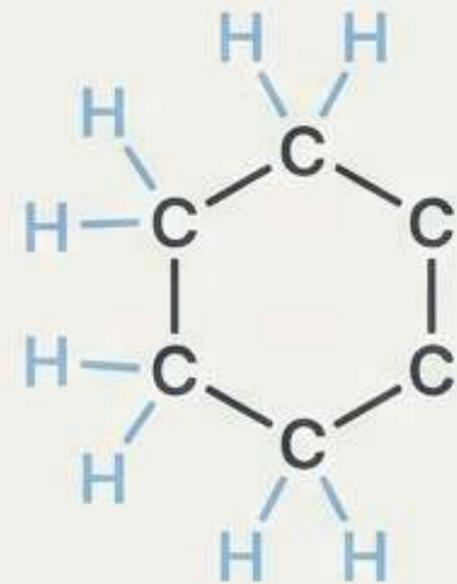
Continuous & Branched Chains



Alicyclic Rings

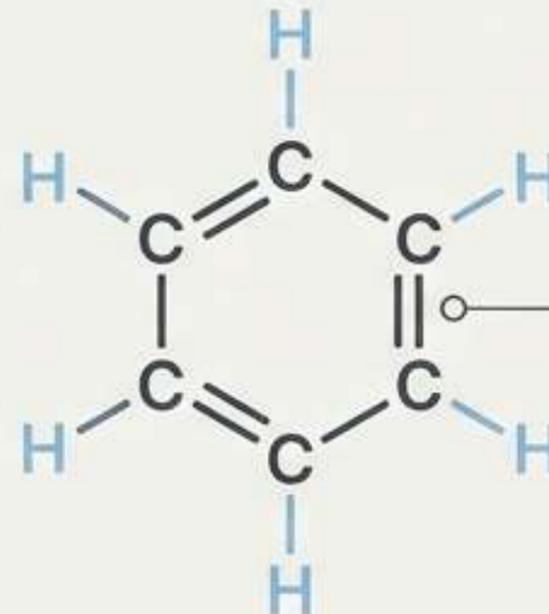


Cyclopropane



Cyclohexane

Aromatic Rings



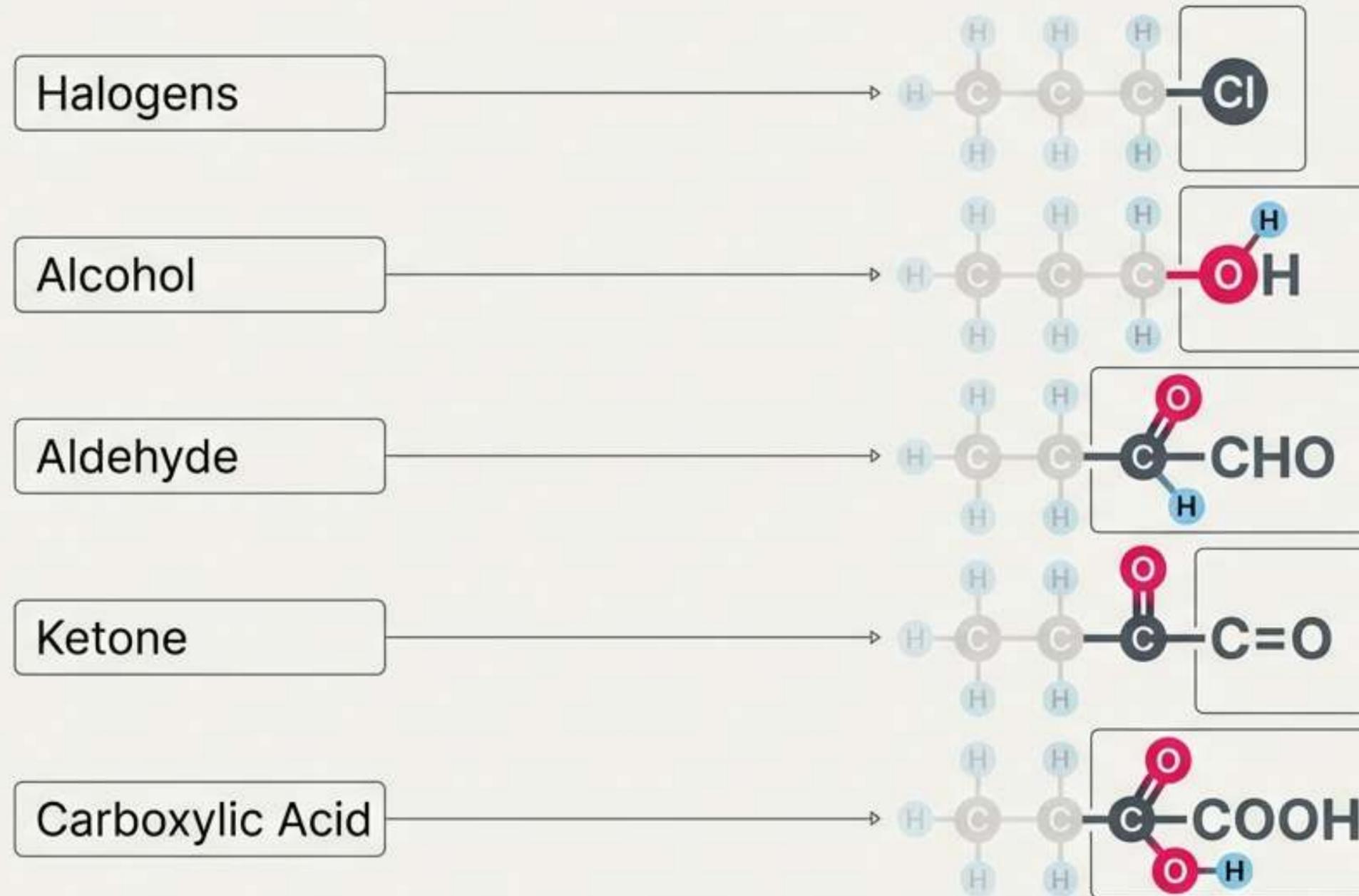
Benzene

Special alternating double bonds

Functional Groups: Modifying the carbon skeleton



Functional Group: Heteroatoms (like O, N, Cl) that replace hydrogen, dictating the chemical properties of the entire molecule regardless of the carbon chain length.





The Homologous Series: Infinite scalability from simple rules

