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Opinion Article

# Role of Covalent Bonds and Non-Covalent Interactions in Steroids

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## DESCRIPTION

A class of chemical molecules known as steroids is distinguished by a characteristic four-ring structure. Cholesterol, the most well-known steroid, is a vital part of cell membranes and a precursor to many other steroids, including hormones like testosterone and oestrogen. The covalent bonds that form between the carbon atoms that make up the rings give steroids their distinctive structure. Chemical bonds known as covalent bonds occur when two atoms share two electrons. Covalent bonds between carbon atoms and other elements like hydrogen, oxygen, and nitrogen are frequently found in organic compounds like steroids. Because it forms the core of the four-ring structure of steroids, covalent bonds between carbon atoms are crucial.

Steroids have a four-ring structure made up of three rings with six members each and one with five. The five-membered ring is positioned between two of the six-membered rings in the precise arrangement in which the rings are assembled. Each carbon atom shares one or more electrons with a neighboring carbon atom in the covalent bonds that hold the carbon atoms that make up the rings together. Steroids include a variety of covalent bonds between the carbon atoms, including single bonds, double bonds, and aromatic bonds. When two atoms share one pair of electrons, a single bond is created; when they share two pairs of electrons, a double bond is created. When six carbon atoms are placed in a ring and share electrons to form a sturdy ring structure, aromatic bonds are formed.

With a few notable exceptions, the covalent connections that connect the carbon atoms in the rings of steroids are typically single bonds. In the five-membered ring, for instance, the bond between carbon atoms 1 and 2 is a double bond, whereas the aromatic link between carbon atoms 4 and 5 in the six-membered ring next to the five-membered ring. These many kinds of connections help make the steroid structure tight and stable. The functional groups that are joined to the rings in steroids are likewise caused by the covalent connections between the carbon atoms. Atomic configurations known as functional groups are what give molecules their distinct chemical characteristics. In steroids, the rings are joined to functional groups including hydroxyl (-OH), carbonyl (C=O), and methyl ($-CH_3$) groups via covalent bonds with carbon atoms.

The biological action of steroids is significantly influenced by the functional groups joined to the steroid rings. For instance, cholesterol's function in the construction of cell membranes depends on the hydroxyl group connected to carbon atom 3 of the molecule. The hormone activity of both testosterone and oestrogen is a result of the carbonyl group linked to carbon atom 3. Steroids feature non-covalent interactions in addition to the covalent bonds between the carbon atoms, which contributes to their stability and biological activity. Molecules can interact weakly with one another non-covalently without exchanging electrons. Van der Waals forces, electrostatic interactions, and hydrogen bonding are a few of these interactions.

When an electronegative atom, such as oxygen or nitrogen, in one molecule is attracted to a hydrogen atom in another, a hydrogen bond is formed. The four-ring structure of steroids is stabilized by hydrogen bonds that can form between the hydroxyl groups on neighboring rings. When transient dipoles are produced in molecules as a result of the random movement of electrons, van der Waals forces are produced. These transient dipoles can draw in adjacent molecules, enhancing the stability of those molecules. Van der Waals forces in steroids aid in stabilizing the rings' rigid, planar structure. When negatively charged and positively charged atoms or molecules are drawn to one another, electrostatic interactions take place. In steroid molecules, the positively charged nitrogen atoms in the rings may interact electrostatically.

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