

Lateral elements in chemistry
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Central and peripheral are core concepts in several interrelated scientific disciplines, such as biotechnology, material engineering and nanoscience. More specifically, in chemistry, the relationship between a central part of a molecule and its outskirts is a key concept.

A molecule consists of a "main chain", a central chemical conglomerate, to which several peripheral groups, called "side chain" or "backbone", are bonded. This specific structure and the relationship between the core of the molecule and its marginal groups is what characterises two of the critical components for the functioning of the human body: proteins and amino acids.

Proteins are macro molecules essential for the organism's regularity and are made of hundreds of smaller units called amino acids. The amino acids (natural proteinogenic amino acids in particular), are made, in turn, of three other groups: an amino functional group (-NH₂), a carboxylic acid group (-COOH) and a lateral R group that are all bonded to a main carbon atom (α -carbon).

Each amino acid, therefore, comprises a specific lateral R group, that represents one of the main forces within the molecule. The R group is, in fact, what shapes the protein's tertiary structure (a three-dimensional shape that determines its function and biological activity), as the amino acid's chemical properties affect the classification of the amino acid in acid, basic, hydrophilic (polar) or hydrophobic (nonpolar).

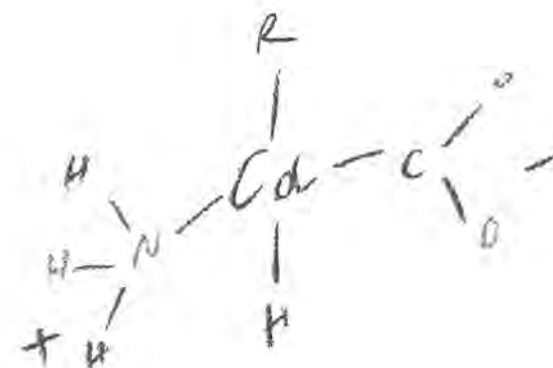
Thus, the peripheral R group is what defines the centre of the amino acid and regulates some of its pivotal functions. If proteins would not have the lateral groups, they would not have their particular structure, lacking some of the fundamental factors for the deployment of human life. The "peripheral" nature of a molecule, therefore, plays an

essential role, as it influences the core properties and characteristics of the molecule itself.

For example, when a lateral group bonds to a gold or silver nanoparticle, it changes its properties, making it soluble in water and biocompatible. An additional function of "peripheral" entities occurs when activated together with specific antigens. This reaction enables the recognition of nanoparticles by human antibodies and its application is currently launching new possibilities in medicine, such as in the case of diagnosis (bio-sensing) and anti-tumour treatments.¹

Ultimately, lateral groups can confer a variety of physical and chemical properties on a molecule, a polymer, a particle or a particle aggregate. "Peripheral" groups can alter solubility, optical properties, polarity, pH and biocompatibility, or they can shift a molecule's nature from carcinogenic to innocuous to the human body. The "peripheral" is not merely a foundational aspect of chemistry: it contributes to this science's extraordinary constitutive and functional versatility.

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¹ KC Bantz et al, "Recent progress in SERS biosensing" in *Physical Chemistry Chemical Physics* (2011).