

Green Chemistry: Sustainable Approaches for a Greener Future

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Abstract: Green chemistry is an innovative approach that follows a set of principles to minimize the use and generation of hazardous substances in chemical processes. Instead of remediating pollution, it focuses on designing eco-friendly chemical reactions that prevent environmental damage. The twelve principles of Green Chemistry encompass key concepts such as pollution prevention, atom economy, less hazardous chemical synthesis, safer solvents and auxiliaries, energy-efficient processes, renewable feedstock, catalysis, and degradation-friendly design. This field integrates into various branches, including organic chemistry, inorganic chemistry, biochemistry, analytical chemistry, and physical chemistry.

With increasing concerns over environmental pollution, green materials are classified into green reagents (e.g., dimethyl carbonate, polymer-supported reagents), green catalysts (e.g., acid catalysts, oxidation catalysts, photocatalysts, biocatalysts), and green solvents (e.g., supercritical CO₂, water, ionic liquids). Additionally, modern advancements in green chemistry involve emerging techniques like photochemistry, microwave chemistry, sonochemistry, and electrochemistry, which enhance energy efficiency and waste minimization. By emphasizing sustainable practices, non-toxic reagents, and renewable resources, green chemistry promotes environmentally benign and resource-efficient chemical processes, ensuring a sustainable future for industrial and scientific applications.

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