

CRISPR-Cas9 and the Future of Gene Regulation: Opportunities and Challenges

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Abstract

The advent of CRISPR-Cas9 technology has revolutionized the field of gene regulation, offering unprecedented precision and versatility in genetic manipulation. This powerful tool, derived from bacterial adaptive immunity systems, enables targeted modification of specific DNA sequences, paving the way for transformative advancements in both basic and applied sciences. This review explores the current landscape of CRISPR-Cas9 applications in gene regulation, highlighting its potential to elucidate gene function, model diseases, and develop novel therapeutic strategies. We discuss the technological advancements that have enhanced the efficiency and specificity of CRISPR-Cas9, including improvements in delivery mechanisms and genome editing precision. However, the technology is not without its challenges. Issues such as off-target effects, ethical considerations, and regulatory hurdles present significant barriers to its widespread adoption. We also examine the future directions for CRISPR-Cas9 research,

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