

Top 5 Gene Silencing Tools

siRNA (Small Interfering RNA)

Application / Use Case	Delivery Method	Duration of Effect	Strengths	Limitations
Transient gene knockdown in cultured cells	Lipid nanoparticles, transfection reagents (e.g., siTran)	Short (2-7 days)	- Widely available - Cost-effective - High specificity	- Transient effect - Off-target effects - In vivo delivery challenging

shRNA (Short Haripin RNA)

Application / Use Case	Delivery Method	Duration of Effect	Strengths	Limitations
Stable knockdown in dividing & non-dividing cells	Viral vectors (lentivirus, retrovirus), plasmids	Long-term (weeks to stable)	- Sustained knockdown - Works in hard-to-transfect cells - Useful for stable cell line creation	- Requires viral or plasmid delivery - Integration risks - More complex to produce

CRISPR Interference (CRISPRi)

Application / Use Case	Delivery Method	Duration of Effect	Strengths	Limitations
Precise, programmable gene repression	dCas9 + sgRNA (plasmid, mRNA, RNP, viral delivery)	Long-term / reversible	- Highly specific - Tunable & reversible - Multiplexable (target many genes at once)	- Delivery of Cas9/sgRNA is complex - Requires design & validation of sgRNAs

Antisense Oligonucleotides (ASOs)

Application / Use Case	Delivery Method	Duration of Effect	Strengths	Limitations
Silencing disease genes; therapeutic use	Direct oligonucleotide delivery, LNPs, chemical modifications	Moderate (days to weeks)	- Clinically validated - Effective in vivo - Chemically stable when modified	- Delivery barriers (tissue specificity) - Off-target effects - Cost of synthesis

miRNA Mimics & Inhibitors

Application / Use Case	Delivery Method	Duration of Effect	Strengths	Limitations
Studying natural miRNA regulation; pathway modulation	Synthetic mimics or inhibitors via lipid reagents, viral delivery	Variable (days to weeks)	- Modulate endogenous regulatory networks - Therapeutic potential	- One miRNA regulates many genes - Risk of unintended off-targets