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(Metal-)Organic Nanopharmaceuticals for the Transport of Biomolecules across Cellular Barriers

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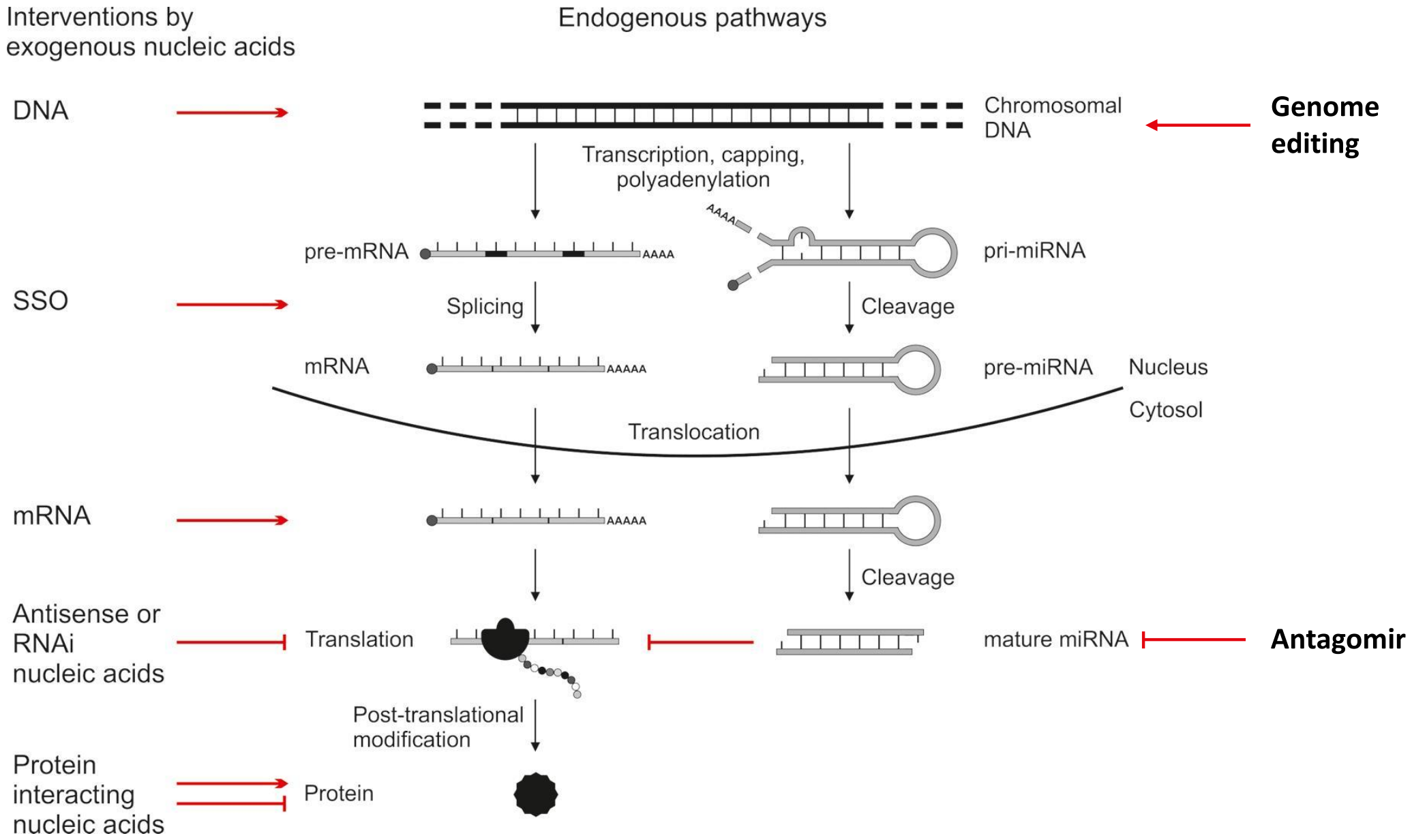
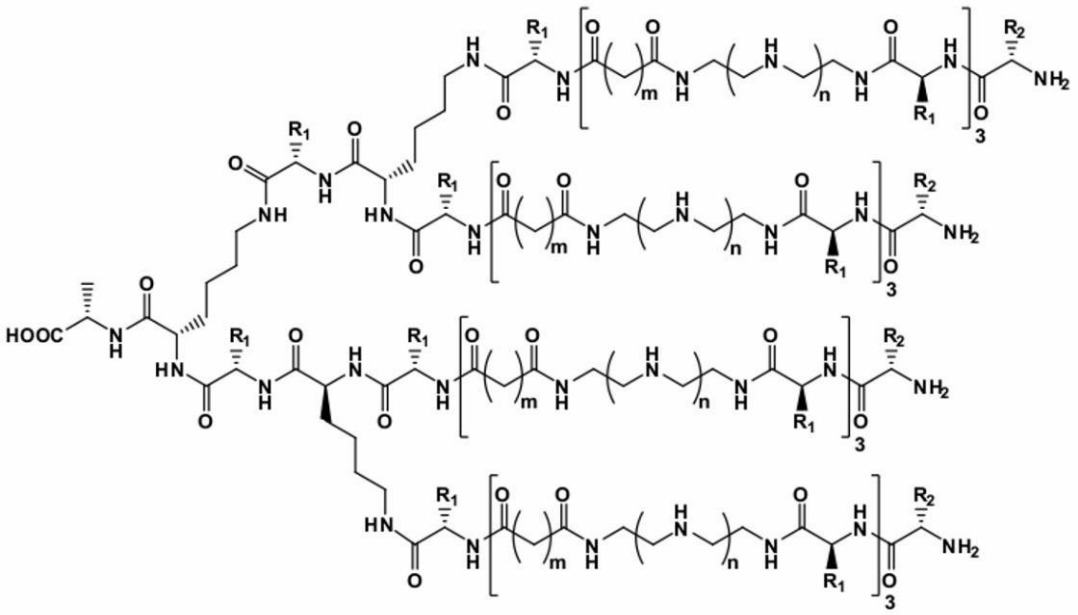
University of Vienna
Department of Pharmaceutical Sciences
Division of Pharmaceutical Technology & Biopharmaceutics

Therapeutic Biomolecules

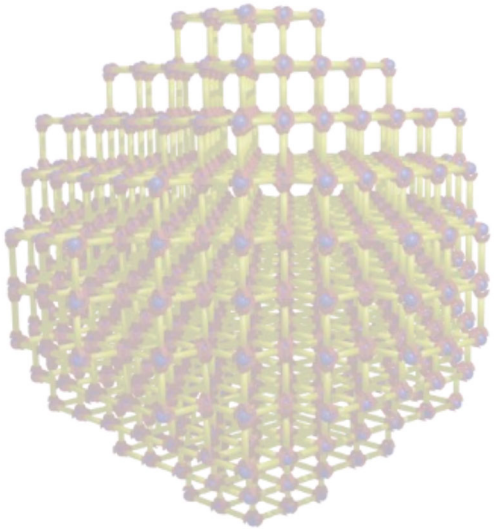


Lächelt & Wagner, *Chem. Rev.*, **2015**, 115, 11043.

Nanomaterials

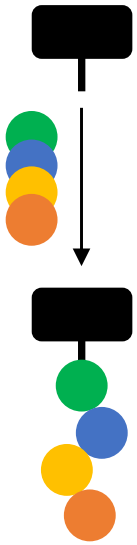


Artificial peptides

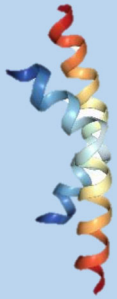


Metal-organic nanoparticles

Nanomaterials



Peptides



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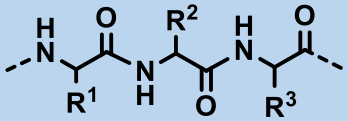
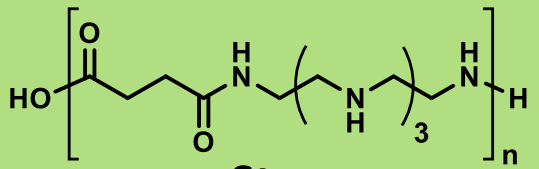


Melittin, TAT,
Penetratin, PepFect, Pip,…

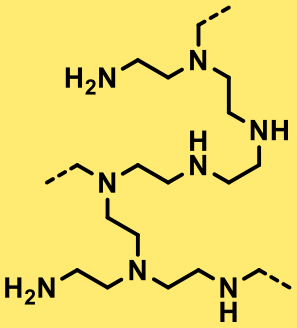
Oligoamino amides

“artificial peptides“

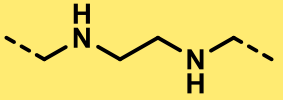


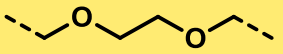
Stp_n

Polymers



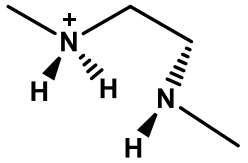
PEI



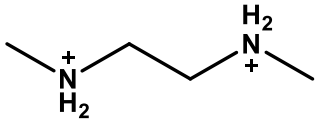


PEG

pH 7.4



H^+

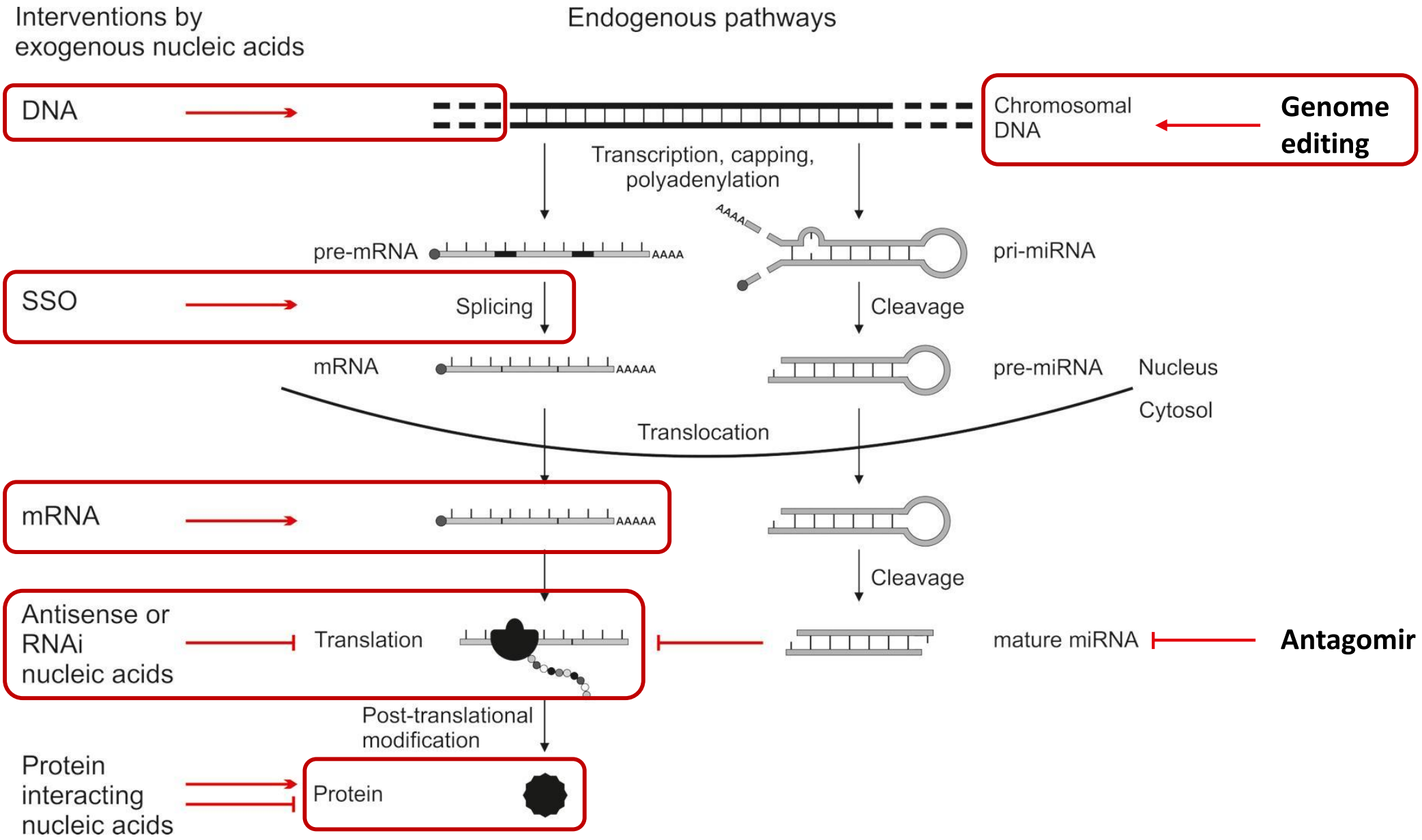


pH 5

- **High chemical precision and reproducibility**
- **Automatable and scalable synthesis**
- **High design flexibility**
- **Clear-cut structure-activity relationships**

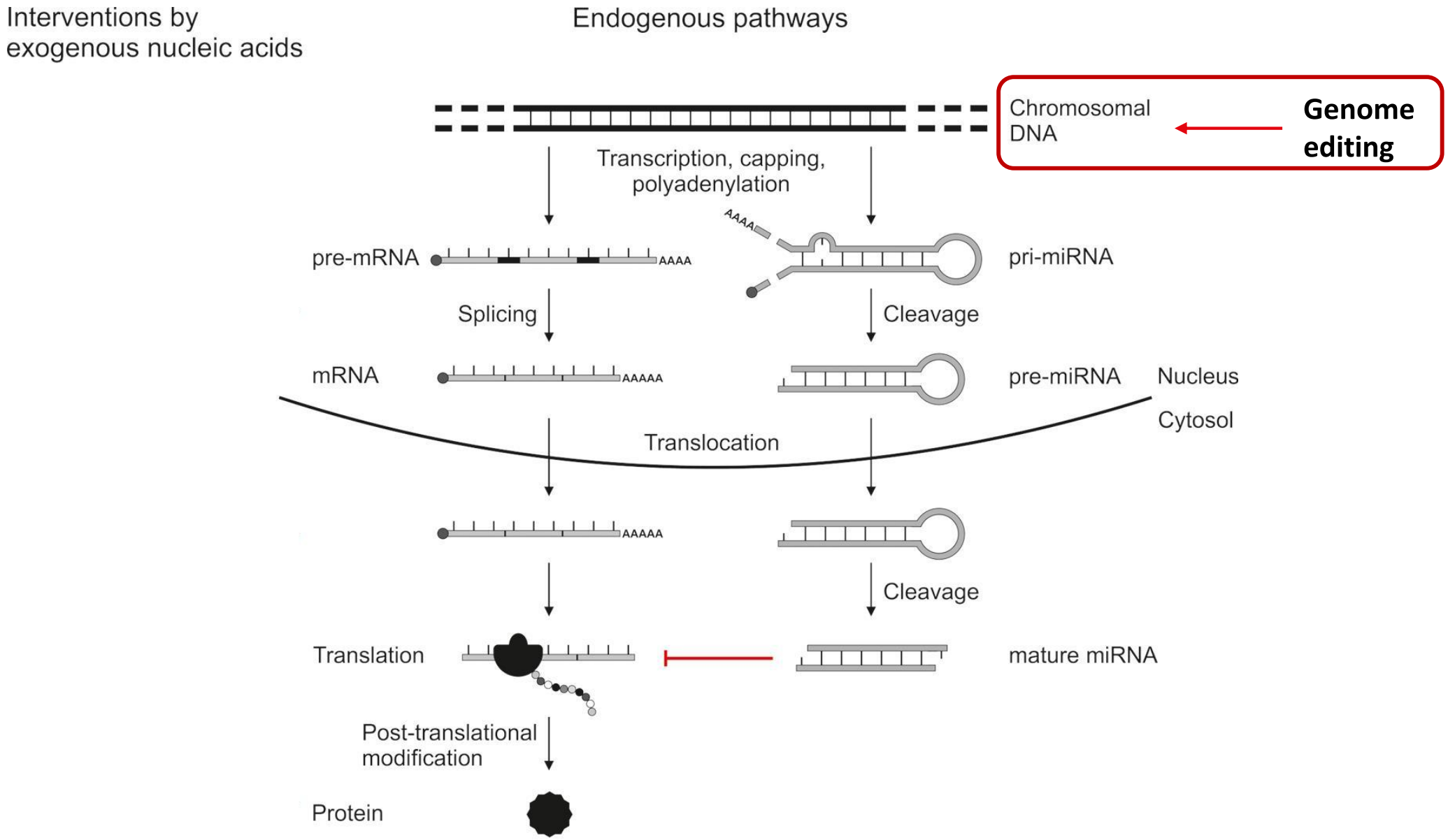
* DOI: 10.2210/pdb2MLT/pdb

Therapeutic Biomolecules



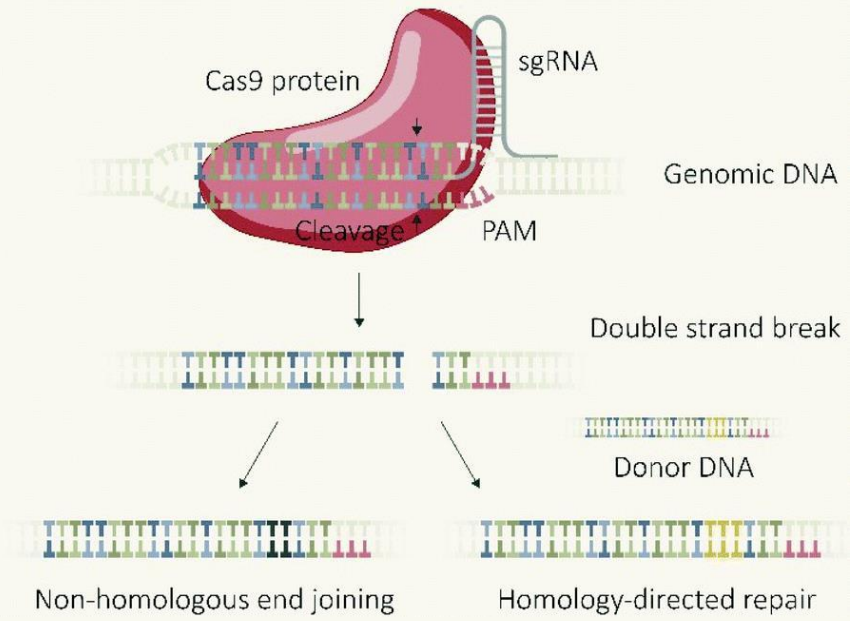
Lächelt & Wagner, *Chem. Rev.*, **2015**, 115, 11043.

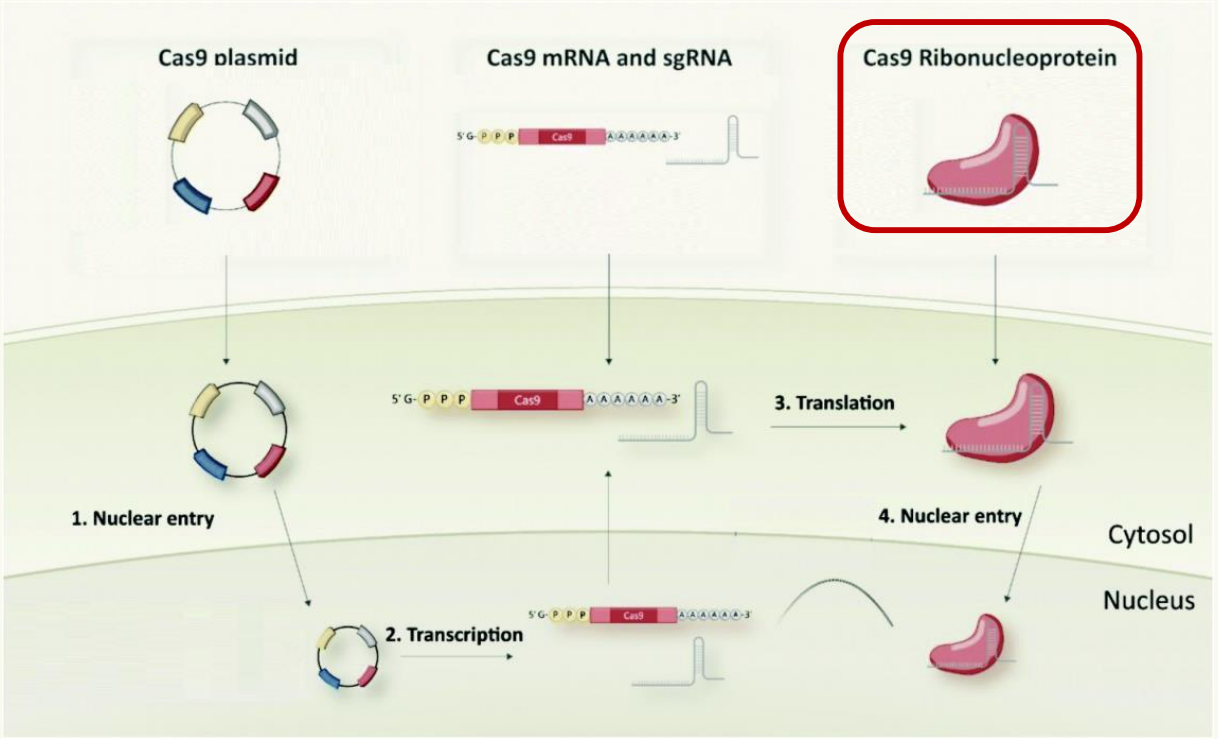
Therapeutic Biomolecules



Lächelt & Wagner, *Chem. Rev.*, **2015**, 115, 11043.

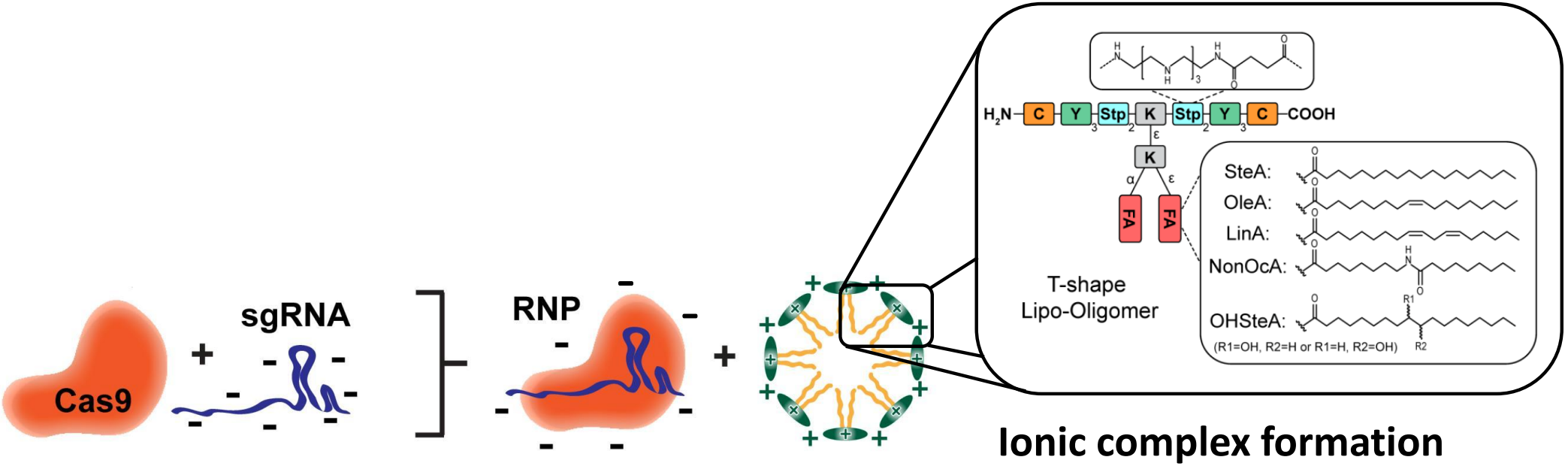
CRISPR/Cas

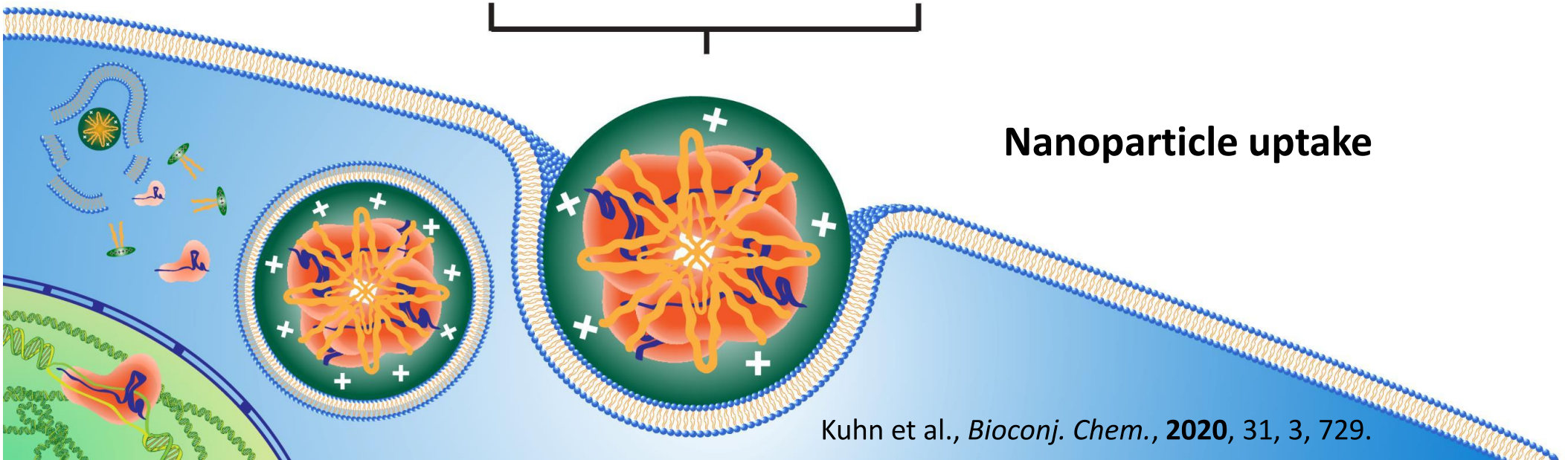




Lin et al., *Biomater. Sci.*, **2022**, 10, 1166-1192.

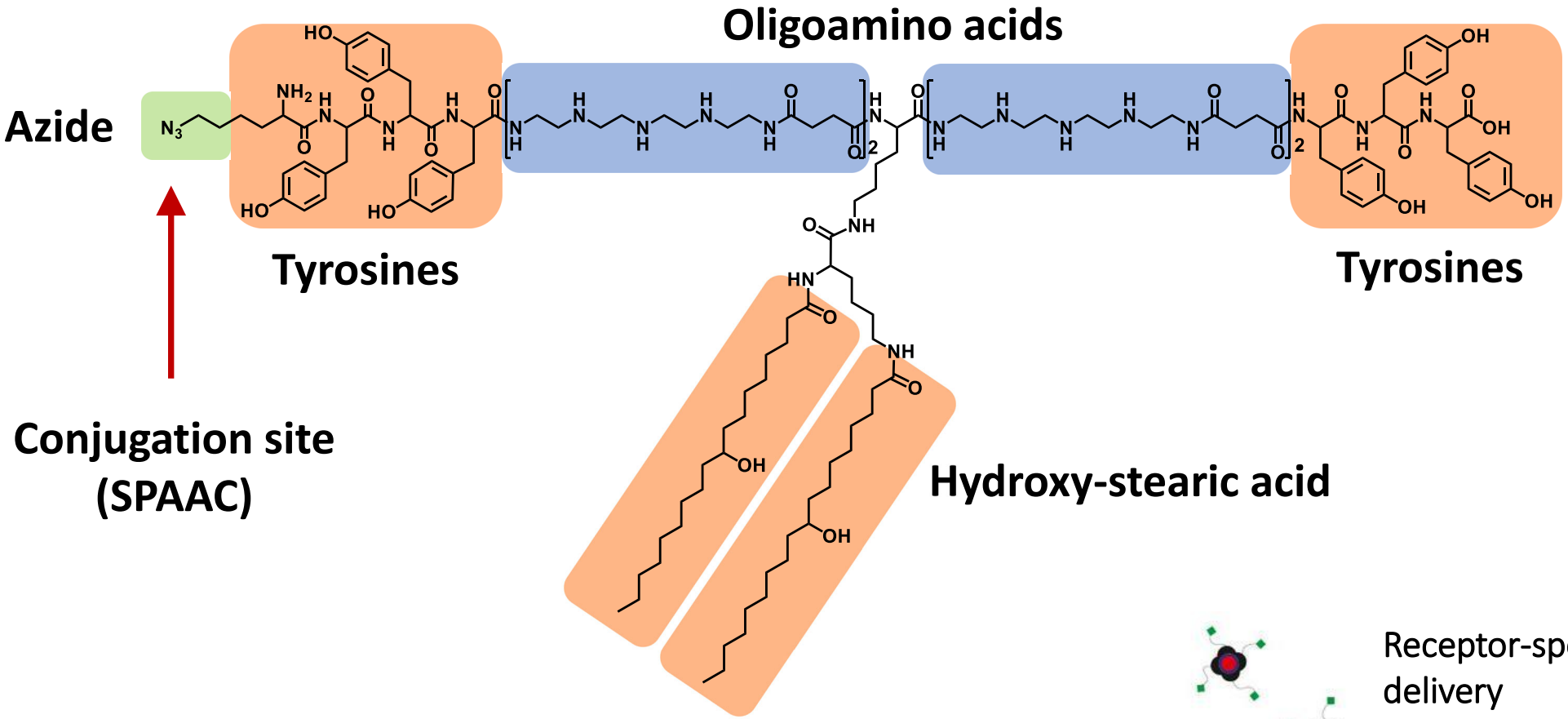
Cas9 RNP delivery





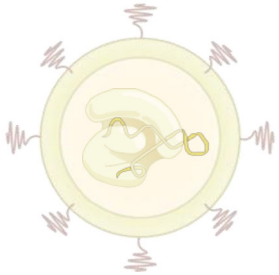
Kuhn et al., *Bioconj. Chem.*, **2020**, 31, 3, 729.

Receptor Targeting

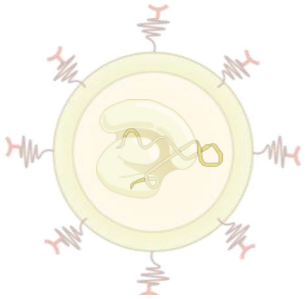




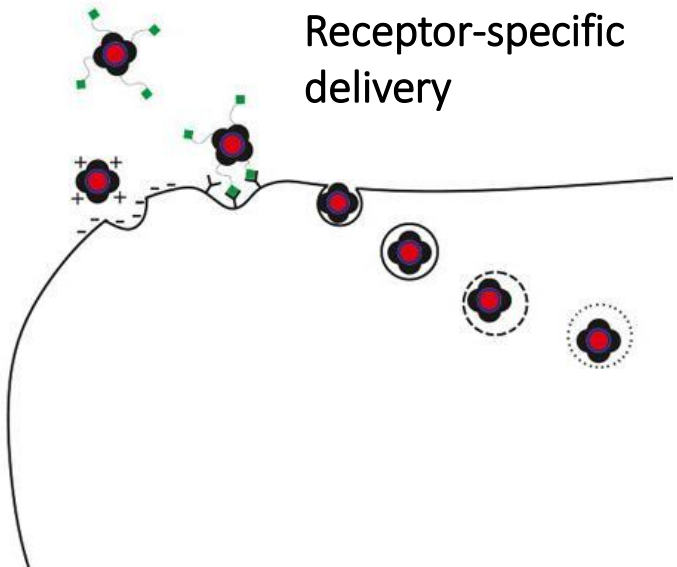
unmodified



PEG_{24}-DBCO

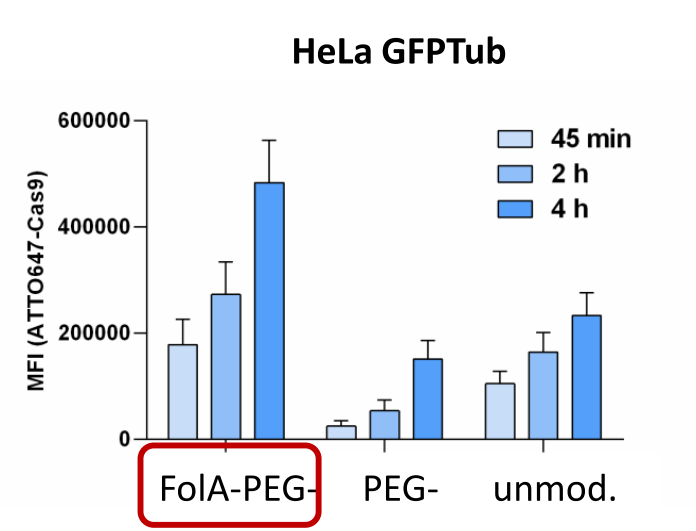


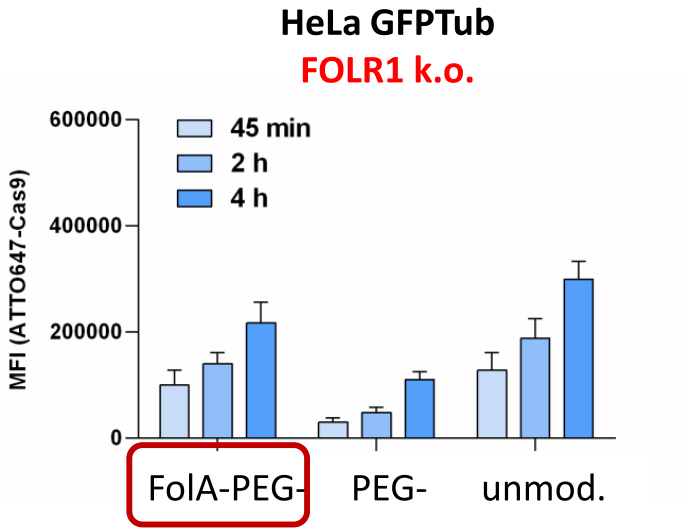
FolA-PEG_{24}-DBCO



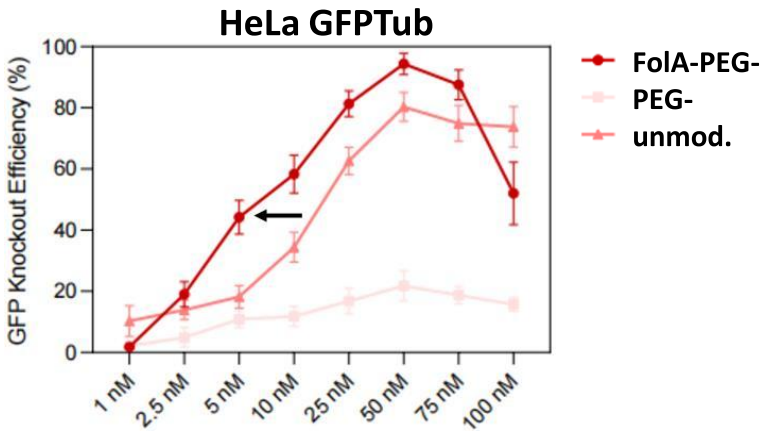
FRα targeting

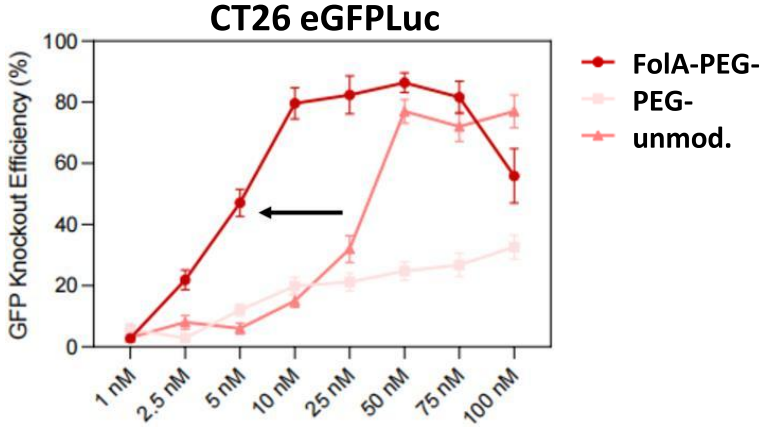
A647-Cas9 uptake





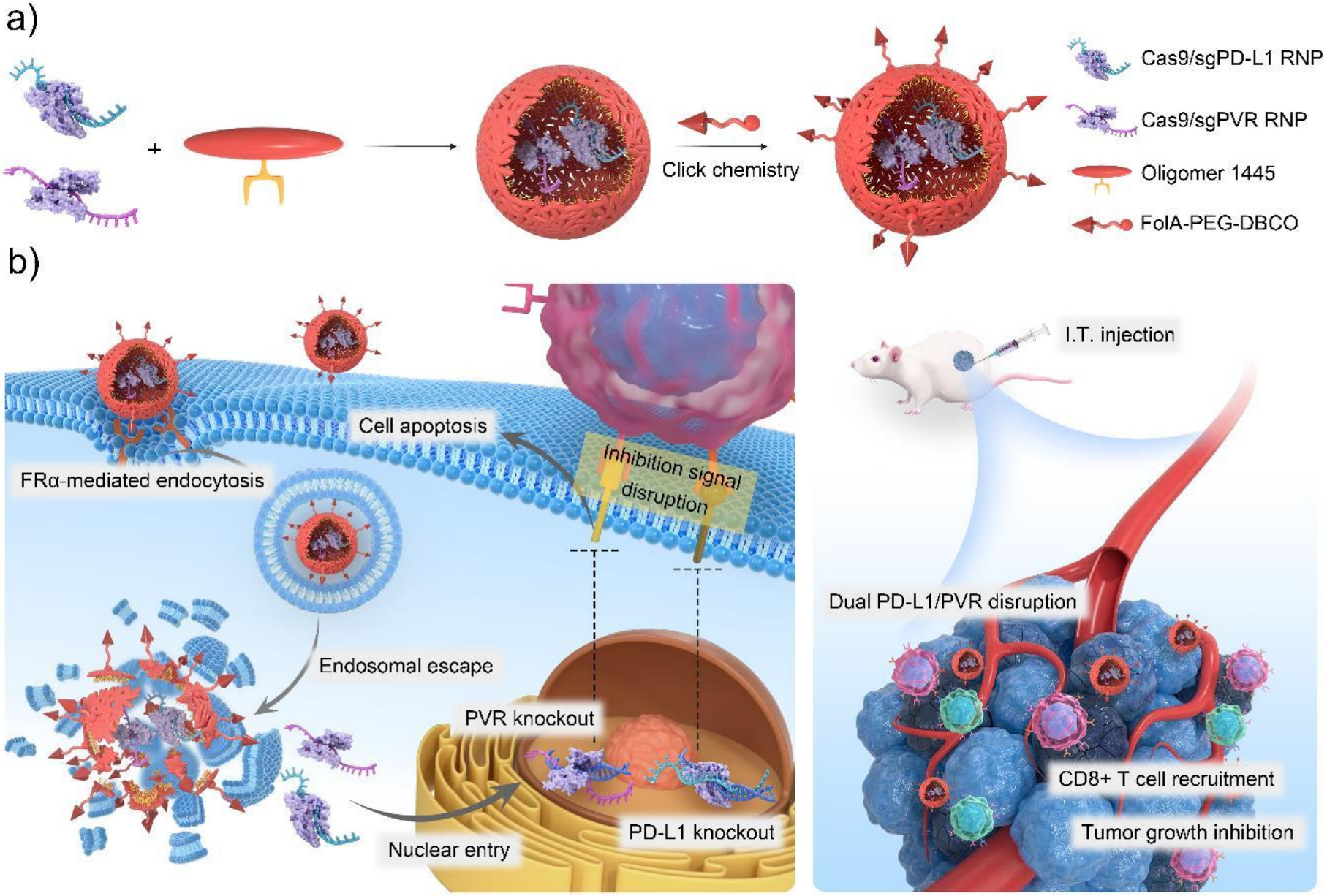
Gene editing potency





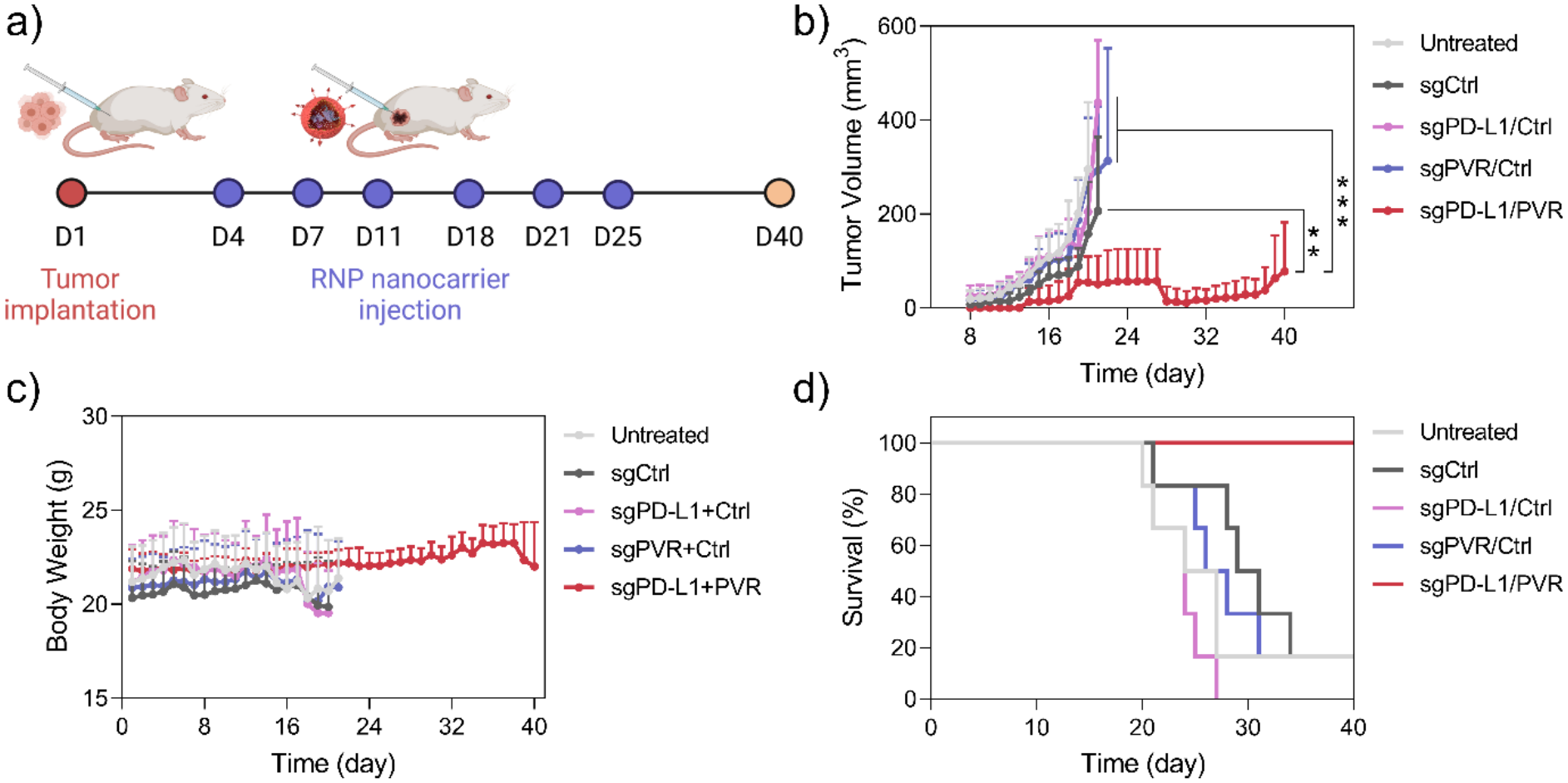
Lin et al., *Small*, **2023**, 19, 2, 2205318.

Cancer immunotherapy



Lin et al., *Small*, **2023**, 19, 2, 2205318.

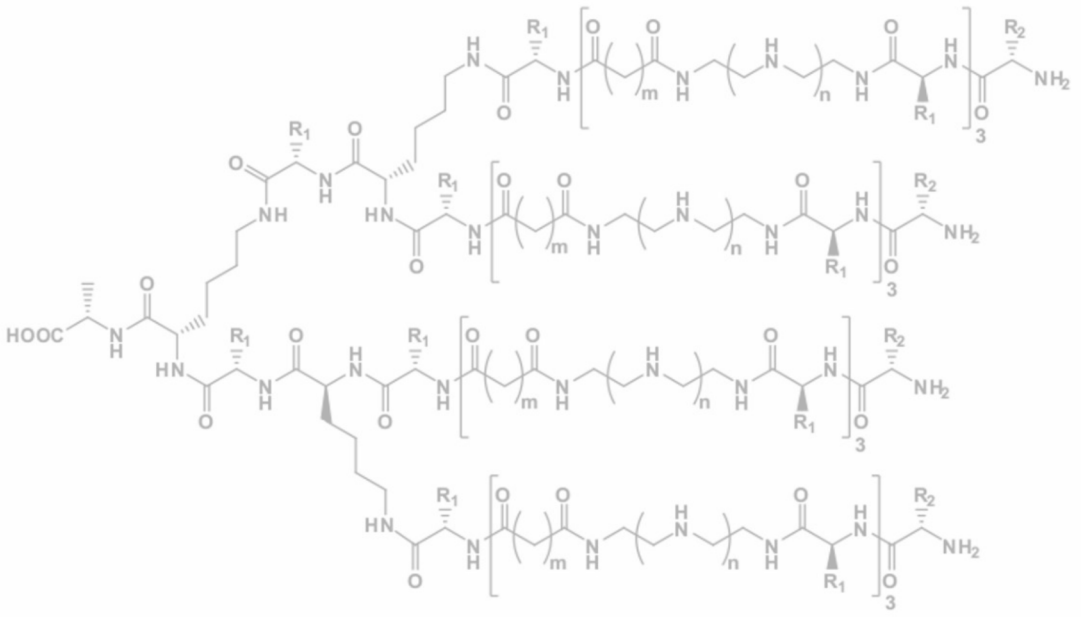
Cancer immunotherapy



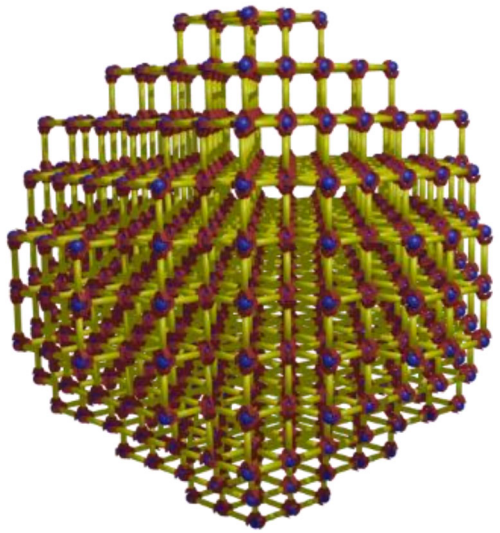
Dual immune-checkpoint disruption (PD-L1 and PVR) in tumor cells induces immune cell infiltration and inhibits tumor growth.

Lin et al., *Small*, **2023**, 19, 2, 2205318.

Nanomaterials

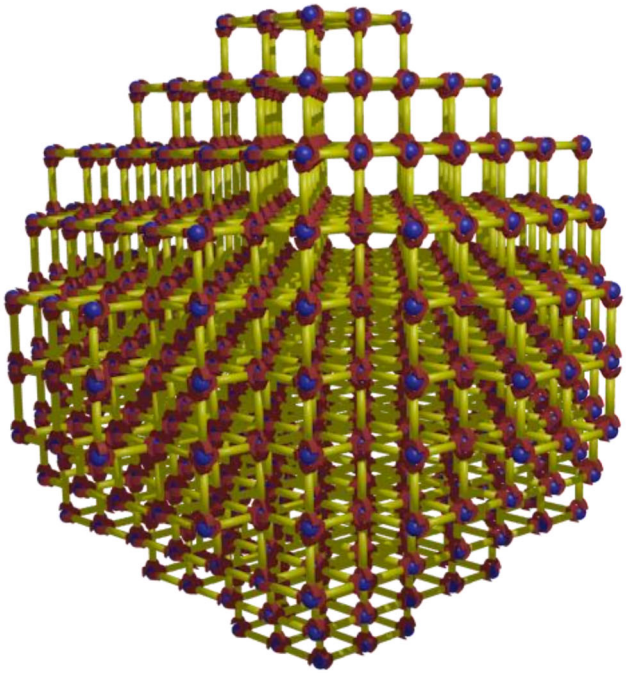


Artificial peptides



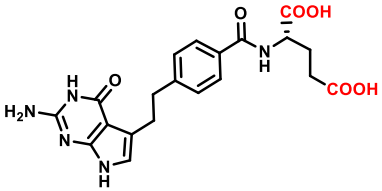
Metal-organic nanoparticles

Bioactive nanoparticles



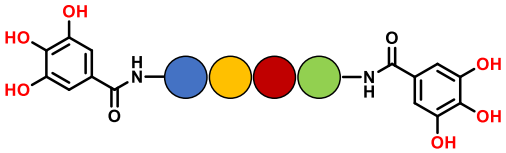


Bioactive linker



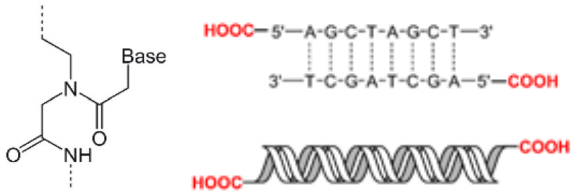
Small molecules

Steinborn et al., *Adv. Therap.*, 2019.



Peptides

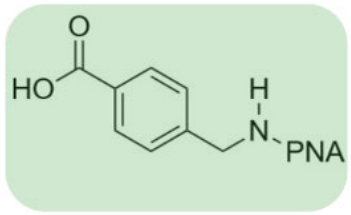
Shen et al., *Pharmaceutics*, 2023.



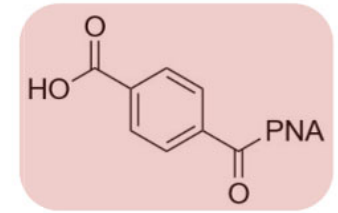
Peptide nucleic acids (PNA)

Öztürk et al., *Sci. Rep.*, 2023.

Metal-PNA nanoparticles



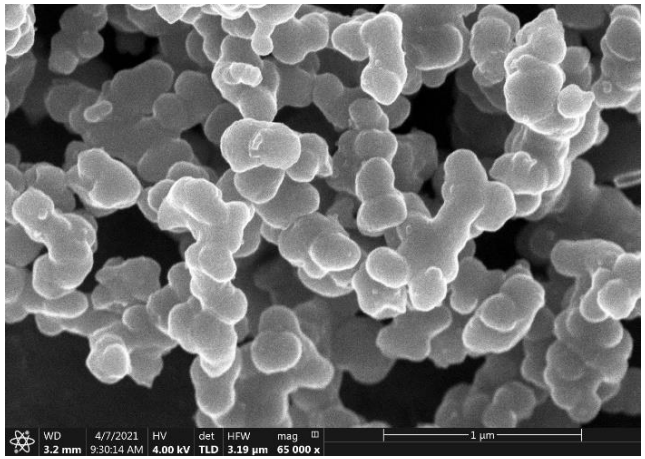
TPA



PAMBA

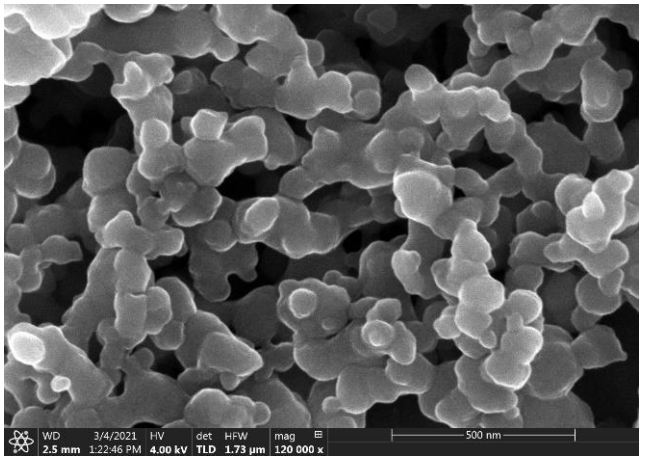


GCATGC-TPA



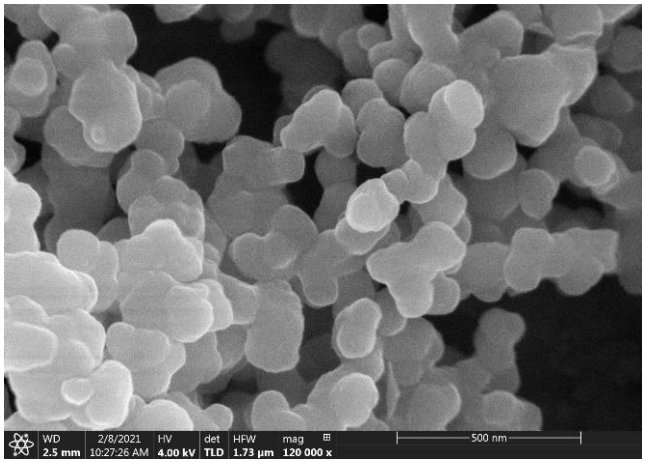


CGTGAC-TPA + GTCACG-TPA



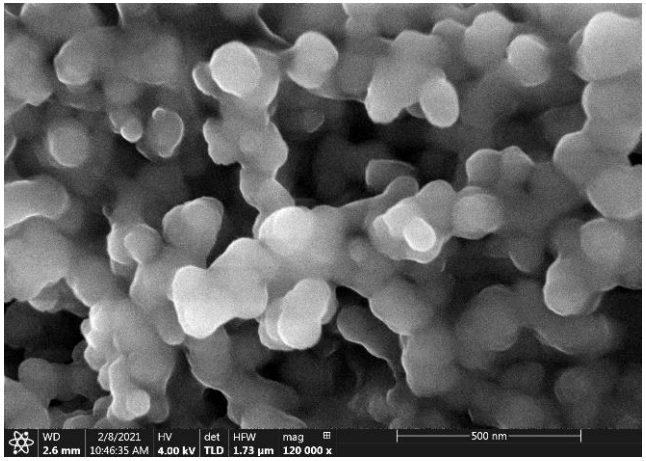


PAMBA-CGTGAC-TPA



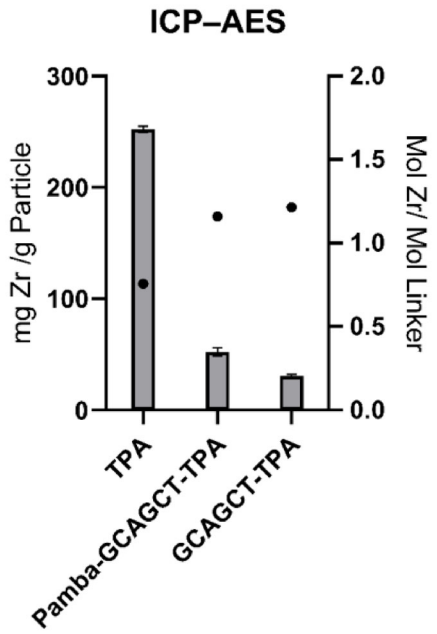


PAMBA-CGTGAC-TPA + GTCACG

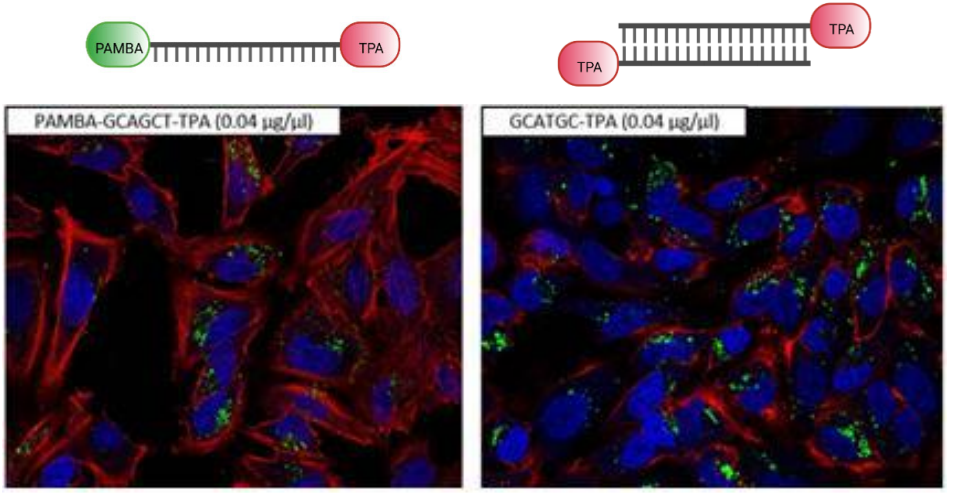


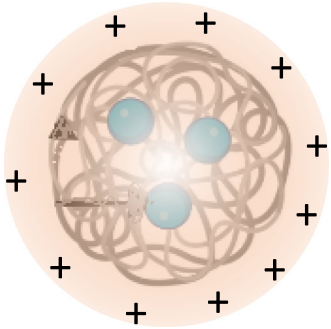
Öztürk et al., *Sci. Rep.*, **2023**, 13, 14222.

Metal-PNA nanoparticles

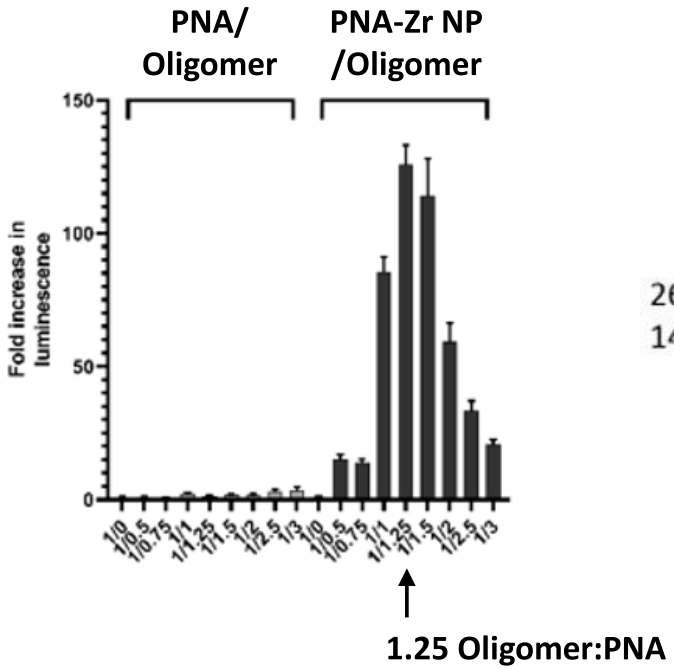


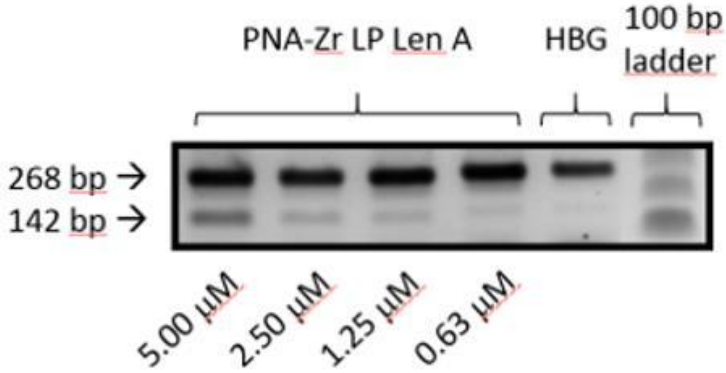
> 95 % w/w
PNA content





Splice-switching
PNA-Zr NPs
+ oligomer coating





Öztürk et al., *Sci. Rep.*, **2023**, 13, 14222.

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Dr. Ulrich Wilk

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Dr. Nader Danaf

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