

Supplementary Information

to the manuscript:

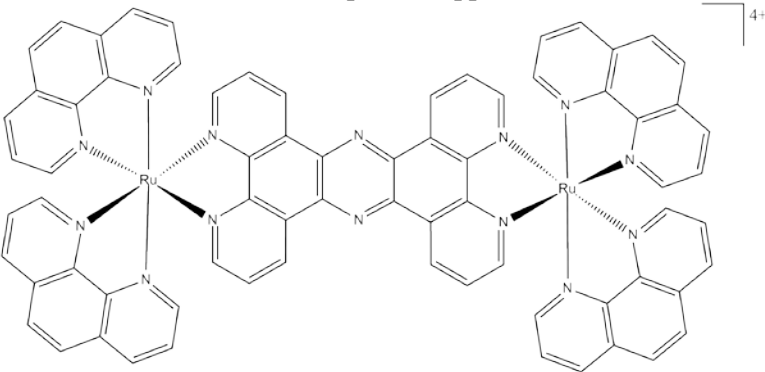
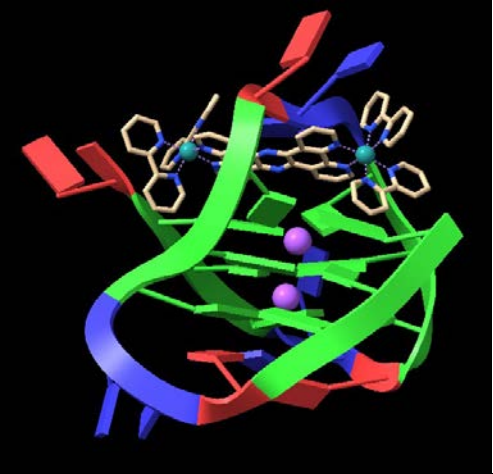
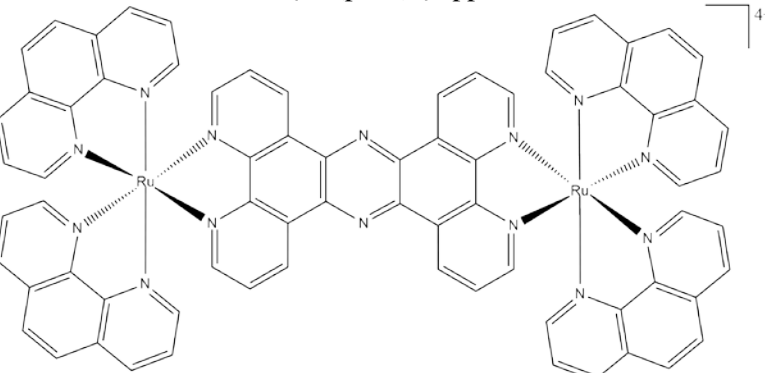
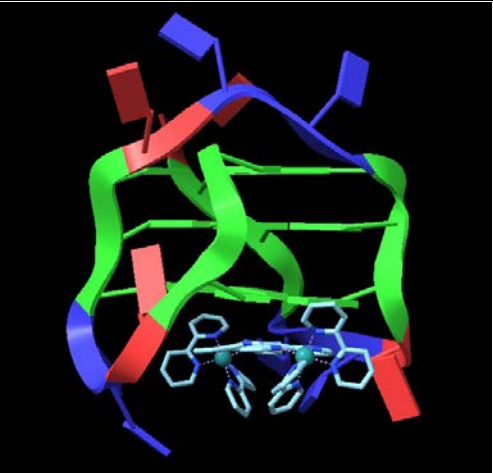
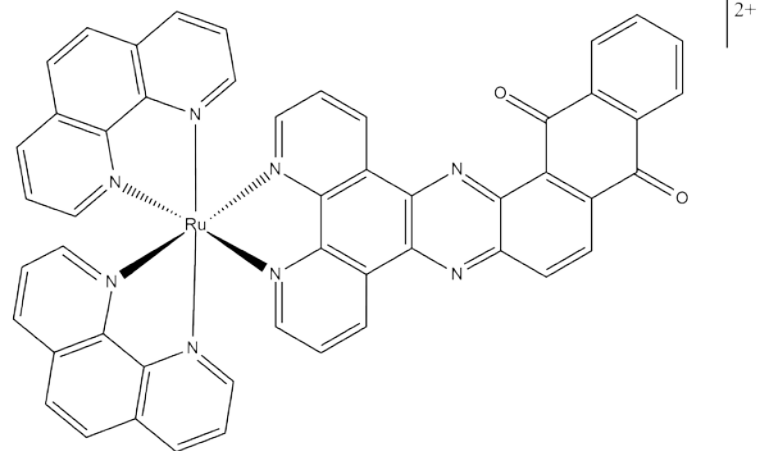
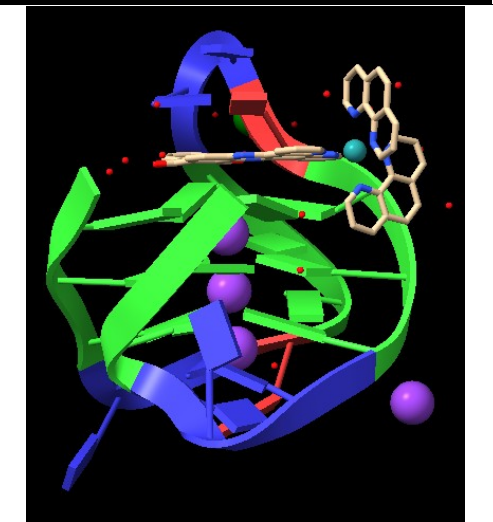
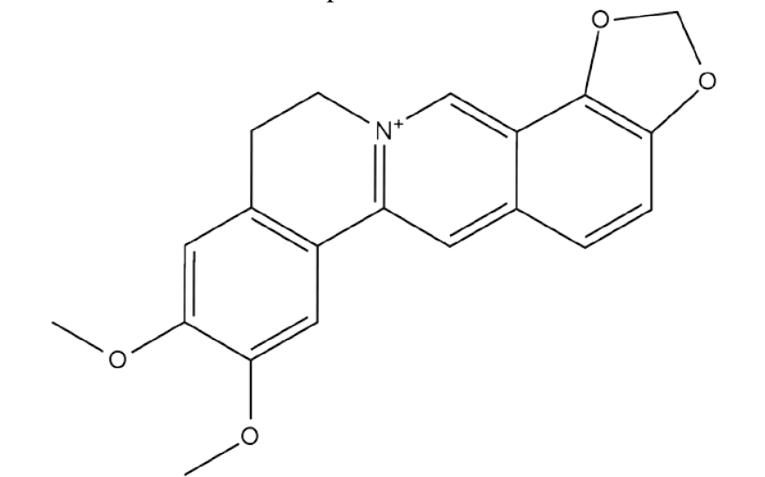

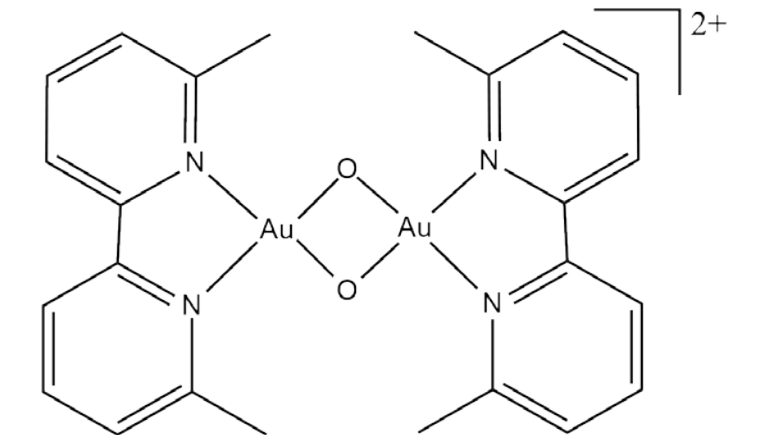

Insights into the small molecule targeting of biologically relevant G-quadruplexes: an overview of NMR and crystal structures

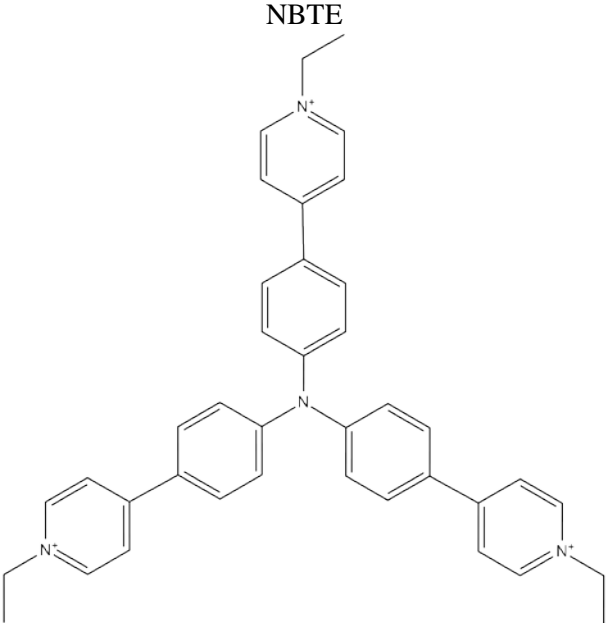
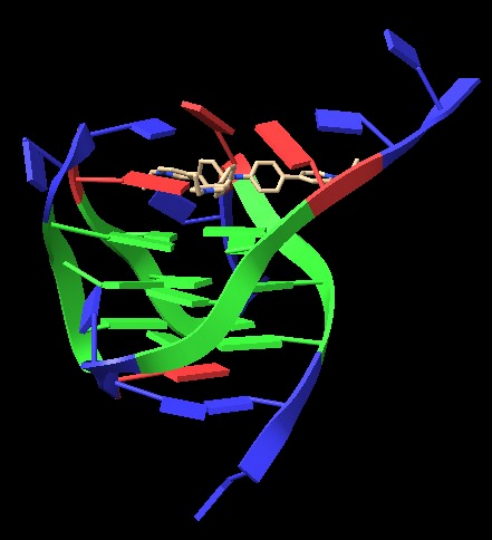
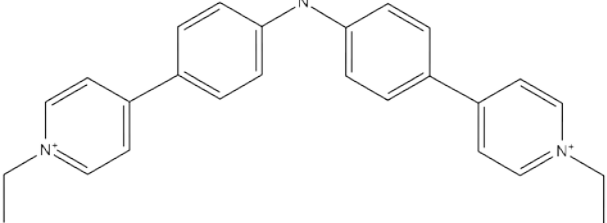
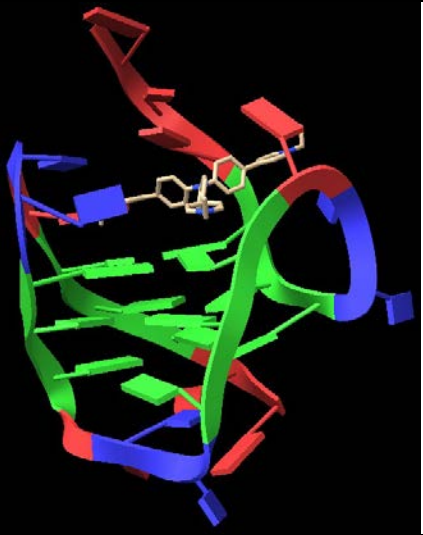
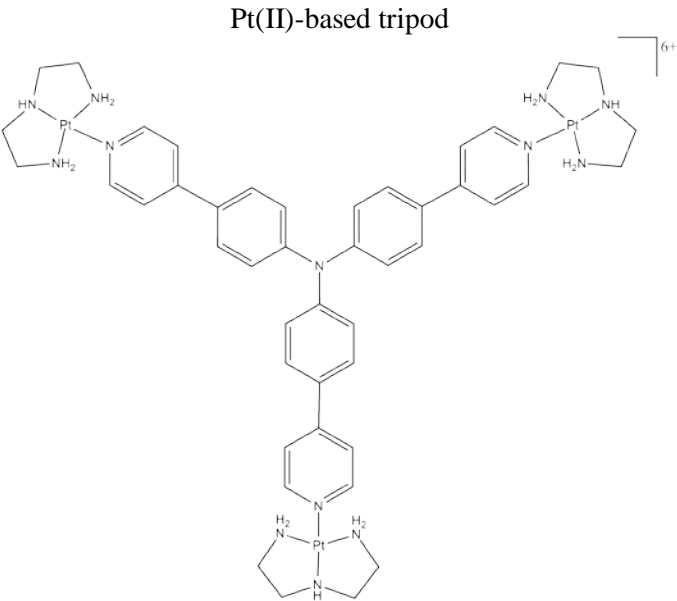
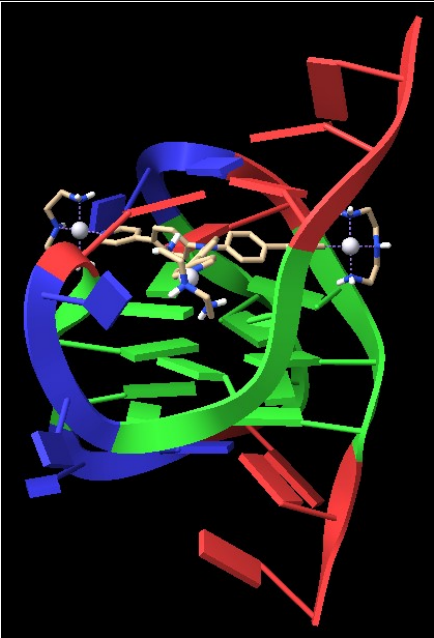
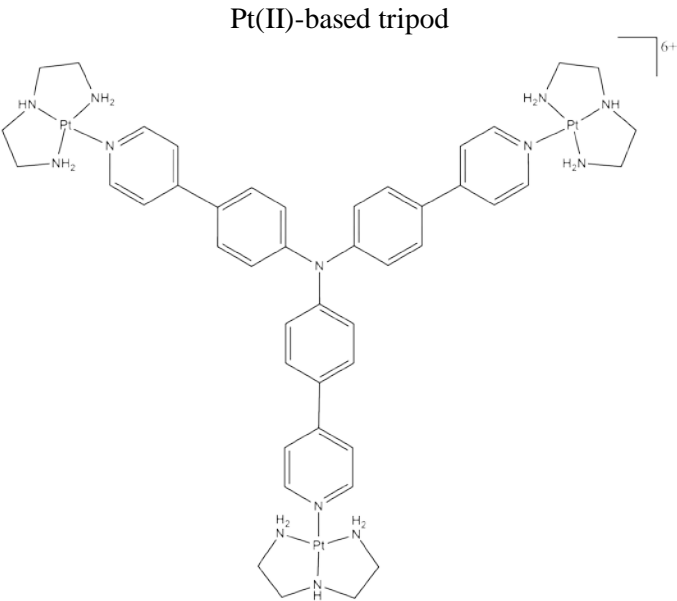

Andrea Criscuolo¹, Ettore Napolitano¹, Claudia Riccardi¹, Domenica Musumeci^{1,2}, Chiara Platella^{1,*}
and Daniela Montesarchio¹

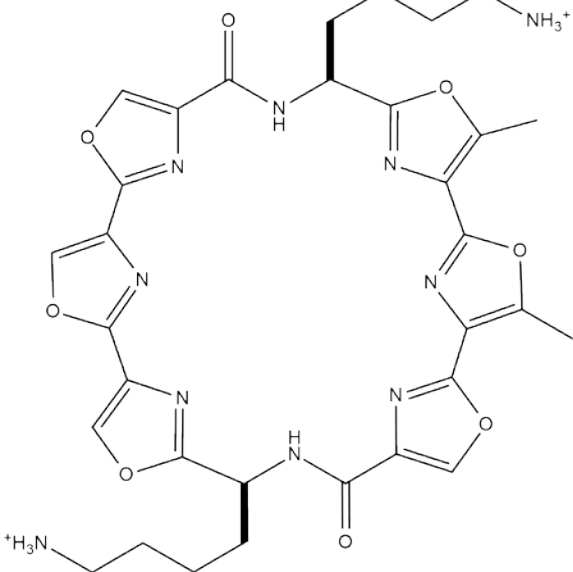
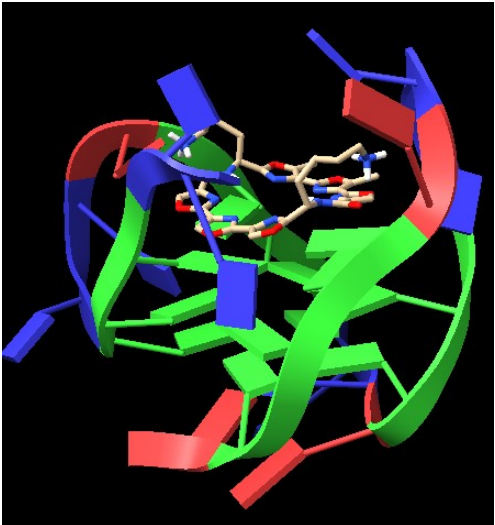
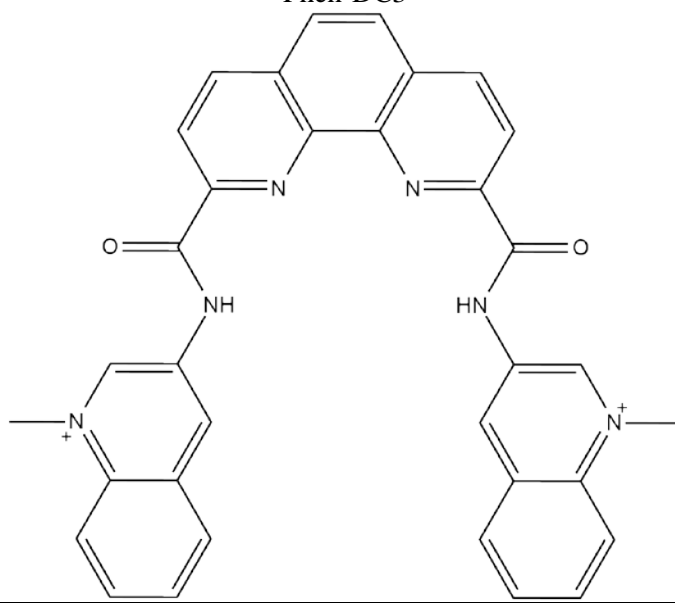
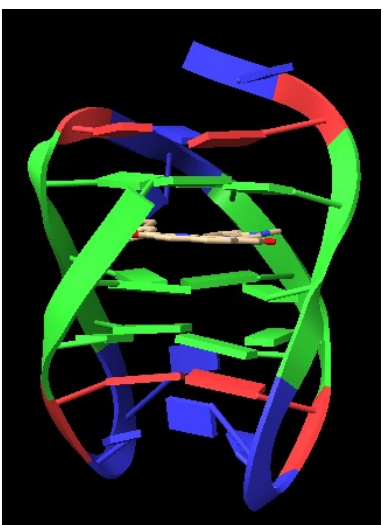
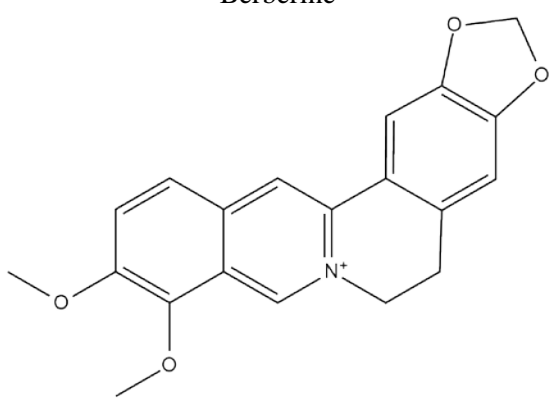
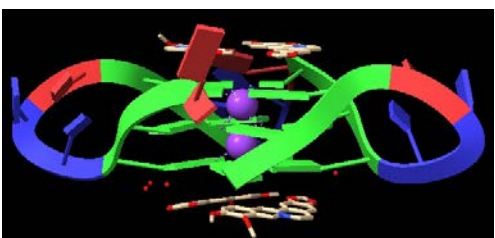
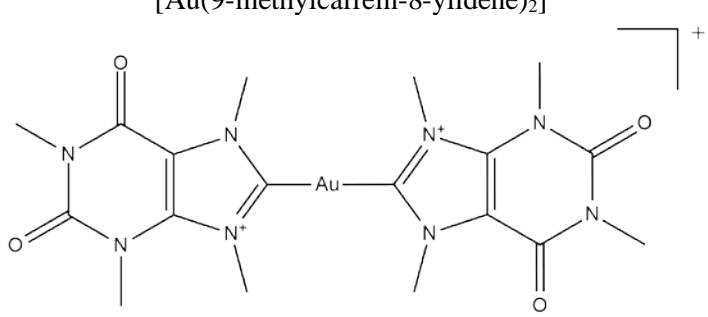
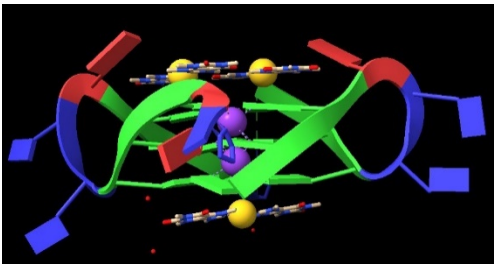
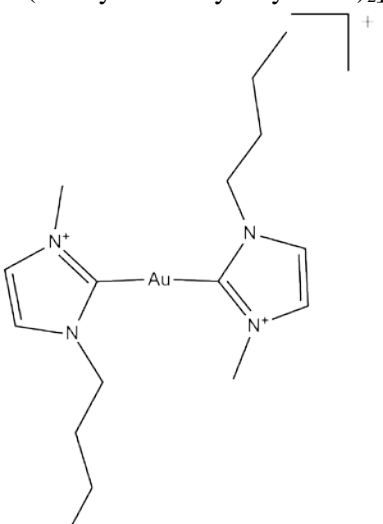
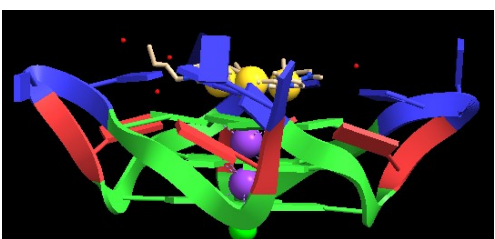
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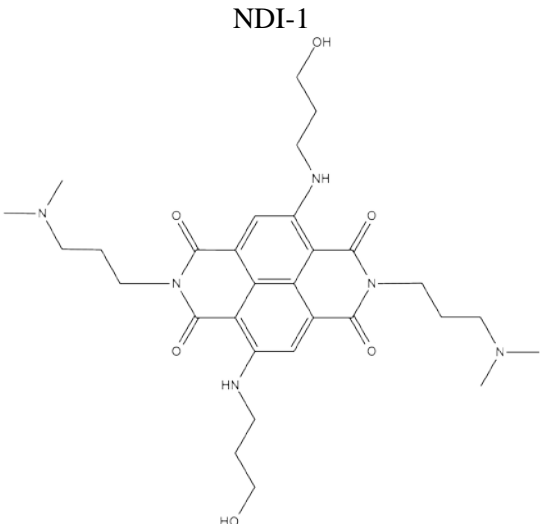
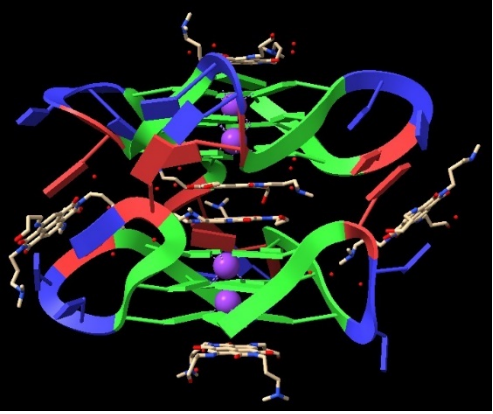
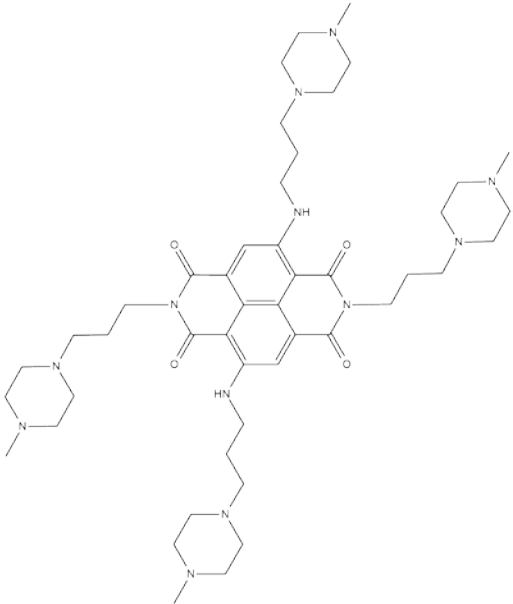
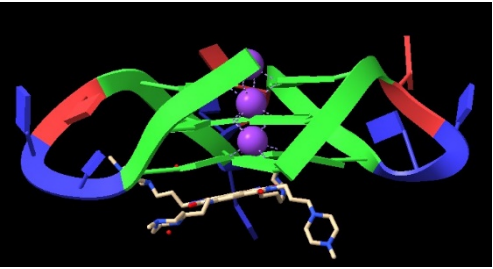
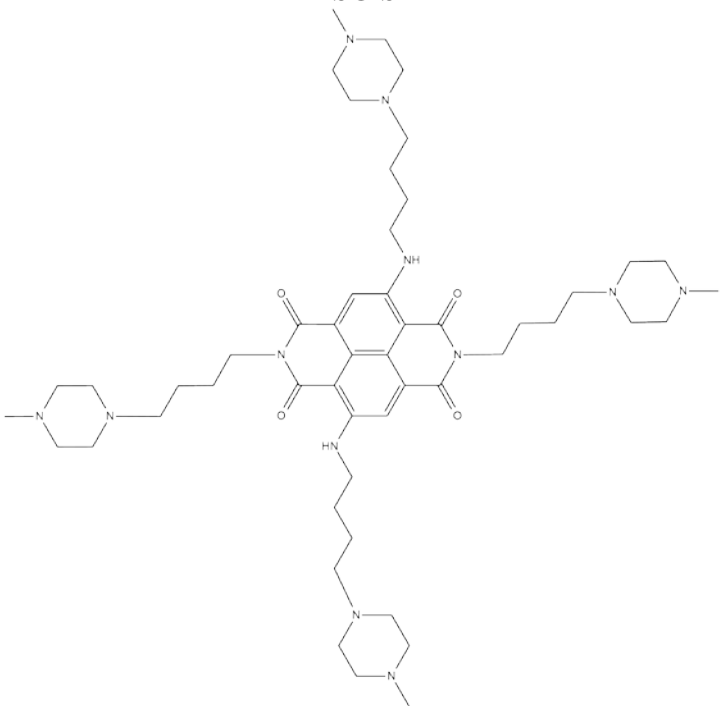
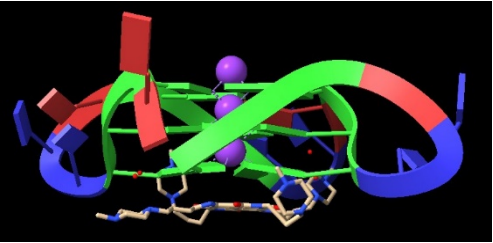
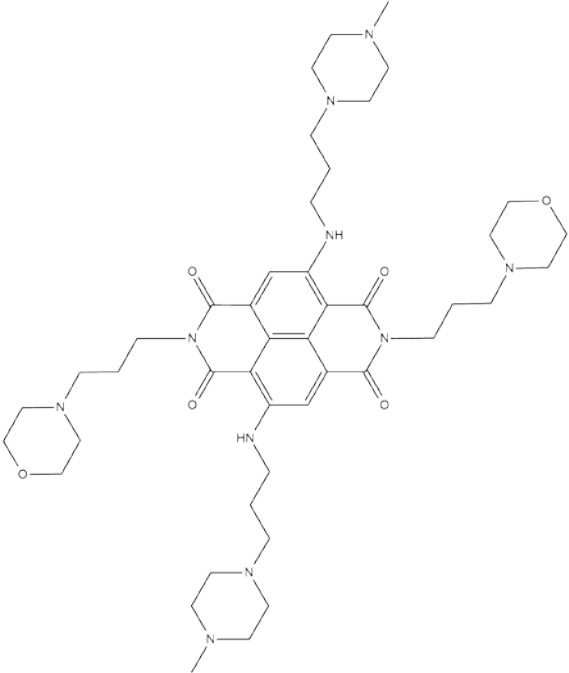
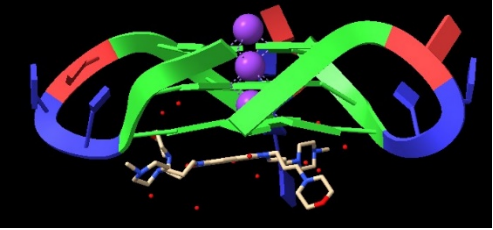
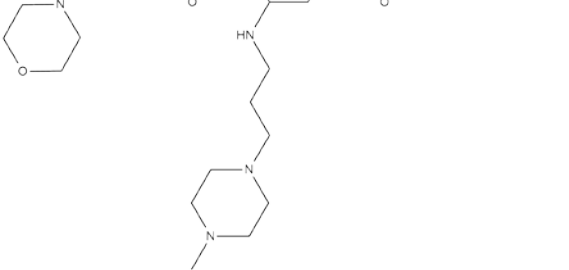
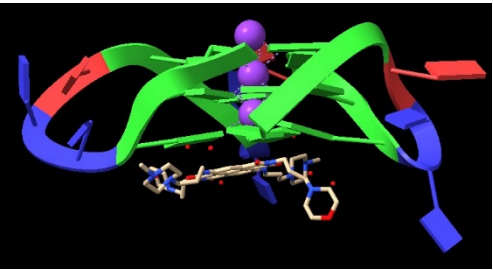
²Institute of Biostructures and Bioimages, CNR, 80134 Naples, Italy

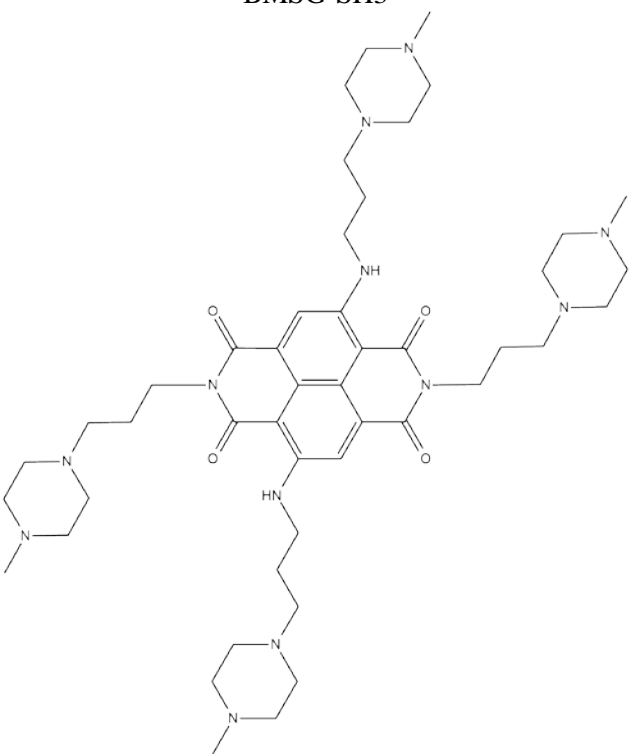
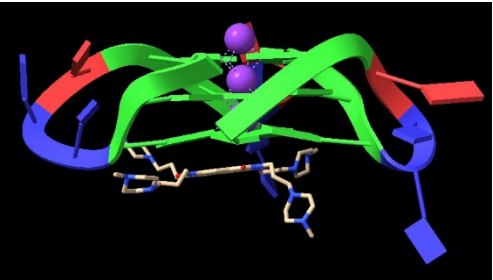
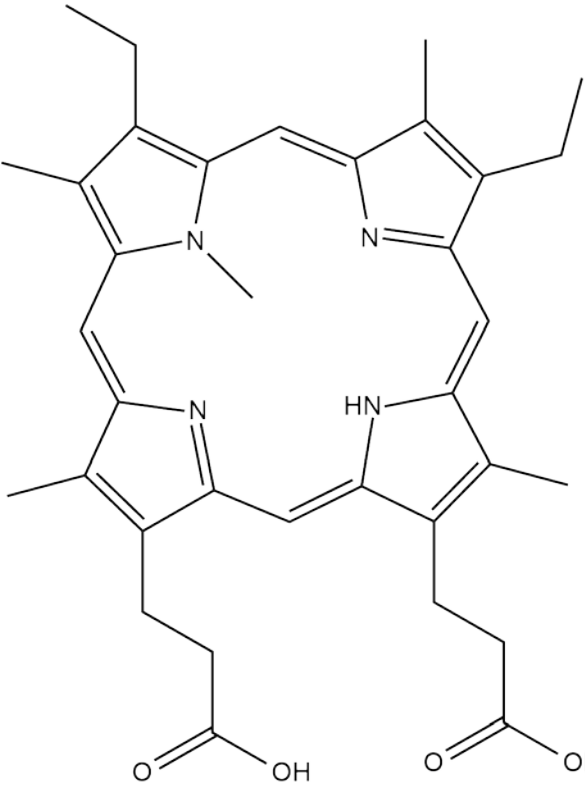
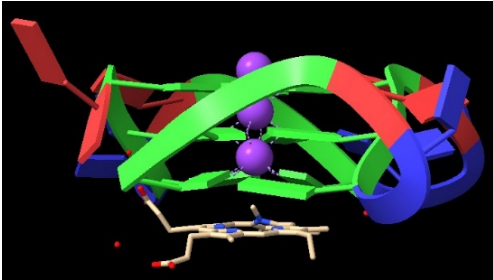
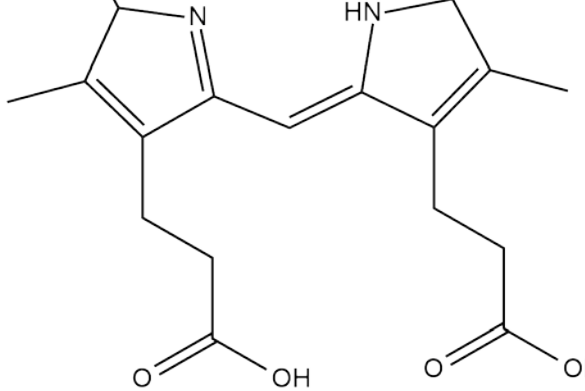
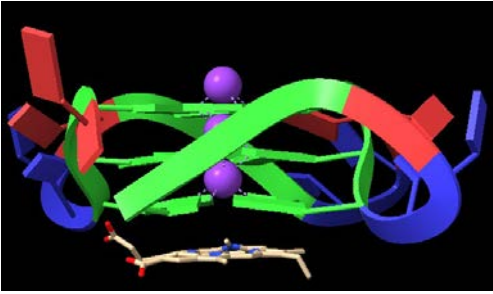
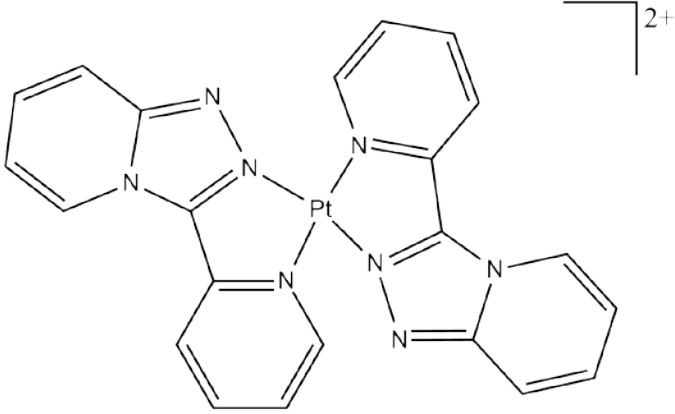
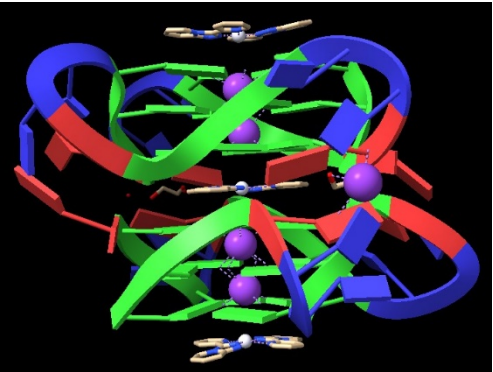
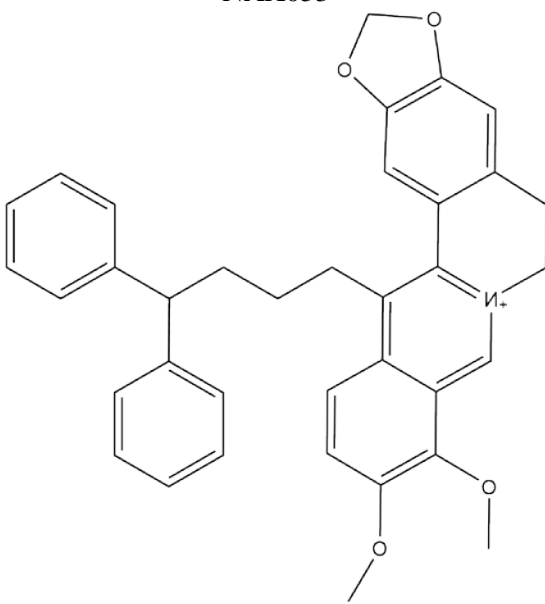
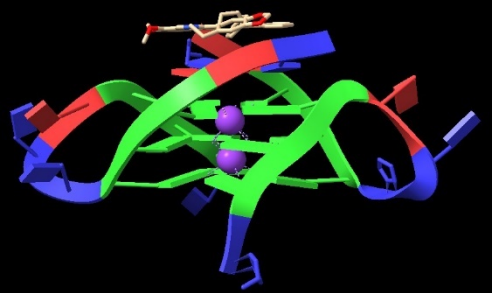
*Correspondence: chiara.platella@unina.it

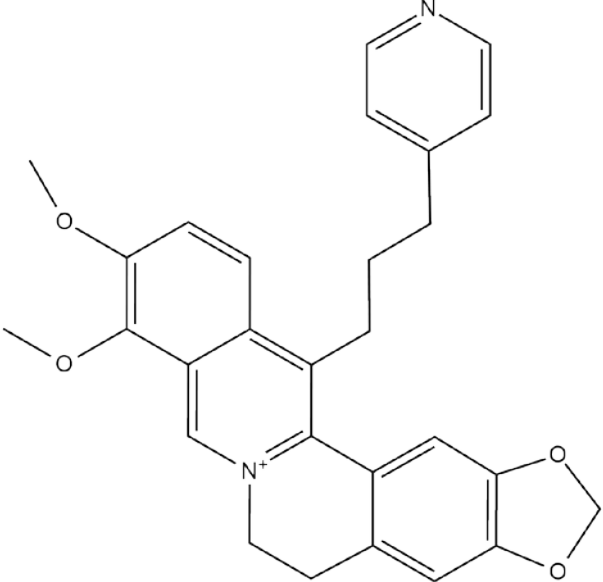
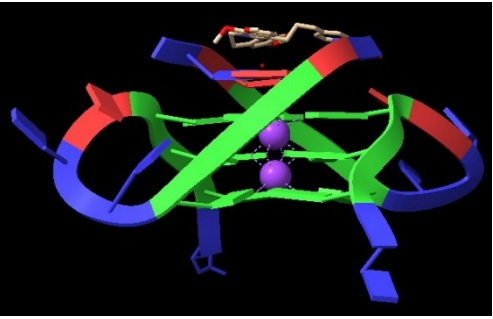
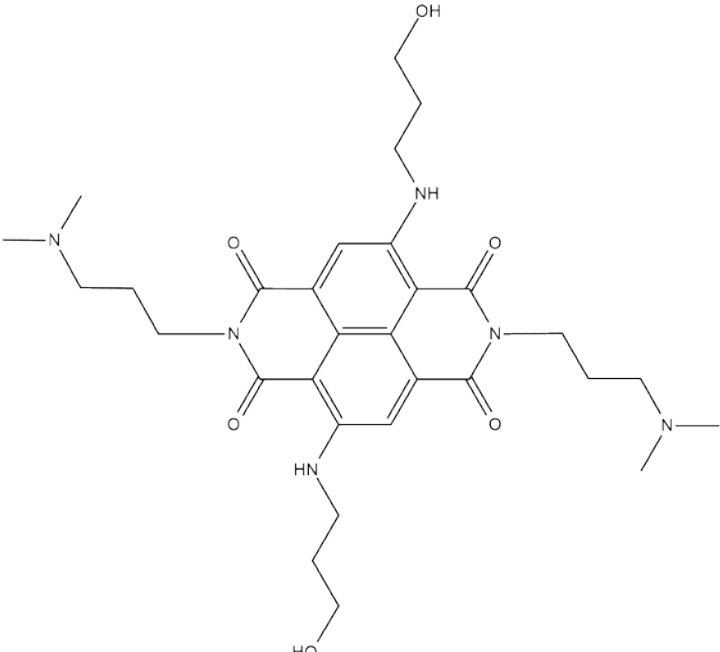
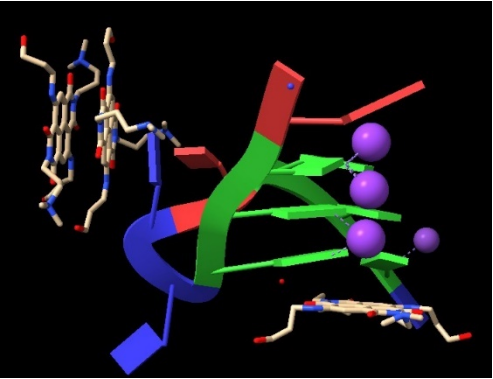
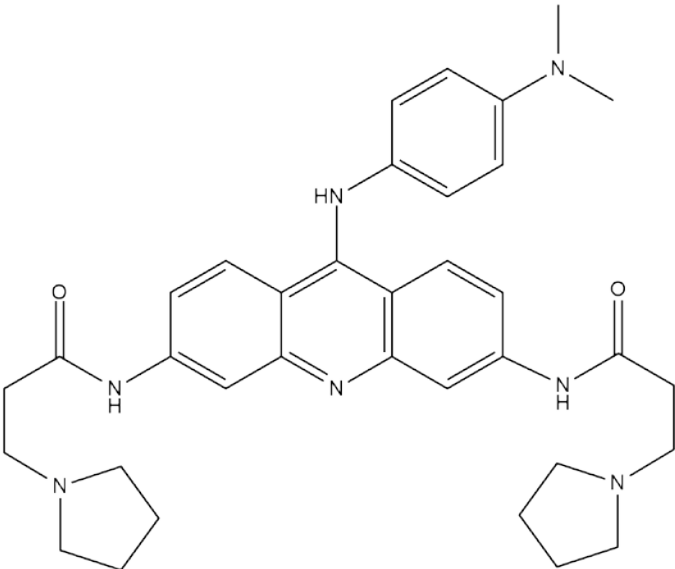
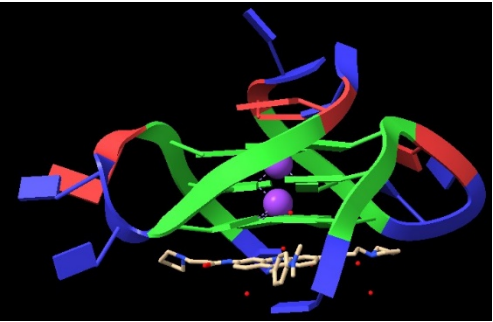
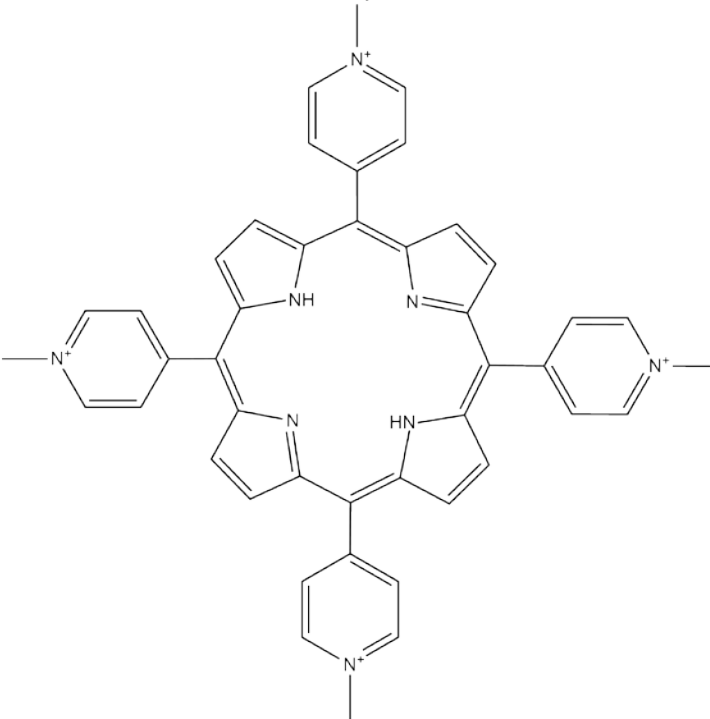
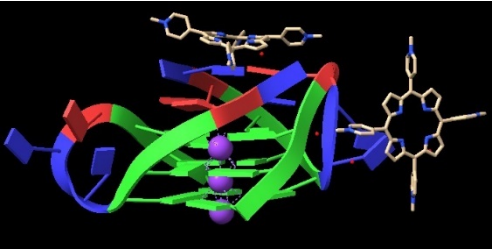
Table S1. Chemical structures of the ligands, and structures of the G-quadruplex/small-molecule ligand complexes solved thus far by NMR and X-ray crystallography.				
PDB ID	Ligand features: Name Chemical structure	G-quadruplex features: Molarity Topology Sequence	Structure of the G-quadruplex/ligand complex	Refs.
Telomeric G-quadruplexes				
Human telomeric unimolecular antiparallel G-quadruplexes				
2MCO	$\Delta\Delta\text{-}[\{\text{Ru}(\text{phen})_2\}_2\text{tpphz}]^{4+}$ 	Unimolecular Antiparallel basket d[AGGG(TTAGGG) ₃]		[1]
2MCC	$\Delta\Delta\text{-}[\{\text{Ru}(\text{phen})_2\}_2\text{tpphz}]^{4+}$ 	Unimolecular Antiparallel basket d[AGGG(TTAGGG) ₃]		[1]
7OTB	$\Lambda\text{-}[\text{Ru}(\text{phen})_2(\text{qdppz})]^{2+}$ 	Unimolecular Antiparallel chair d[GGG(TTAGGG) ₂ TTTGGG]		[2]
Human telomeric unimolecular hybrid G-quadruplexes				
6CCW	Epiberberine 	Unimolecular Hybrid-2 d[(TTAGGG) ₄ TT]		[3]
5MVB	Auoxo6 	Unimolecular Hybrid-2 d[(TTAGGG) ₄ TT]		[4]

6KFJ		Unimolecular Hybrid-2 d[(TTAGGG) ₄ TT]		[5]
6KFI		Unimolecular Hybrid-1 d[AAAGGG(TTAGGG) ₃ AA]		[5]
5Z80		Unimolecular Hybrid-1 d[AAAGGG(TTAGGG) ₃ AA]		[6]
5Z8F		Unimolecular Hybrid-1 d[AAAGGG(TTAGGG) ₃ AA]		[6]

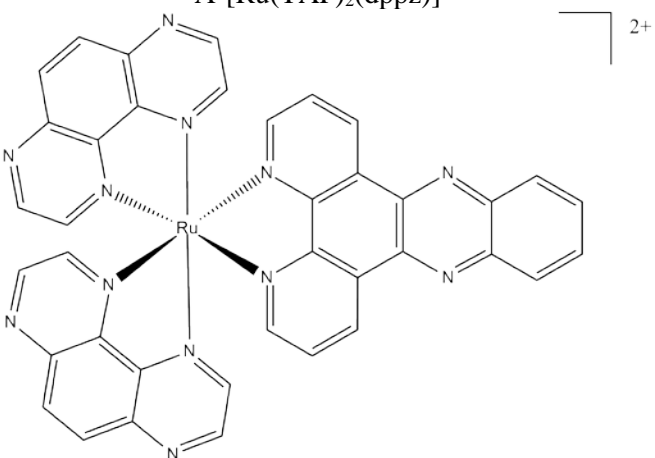
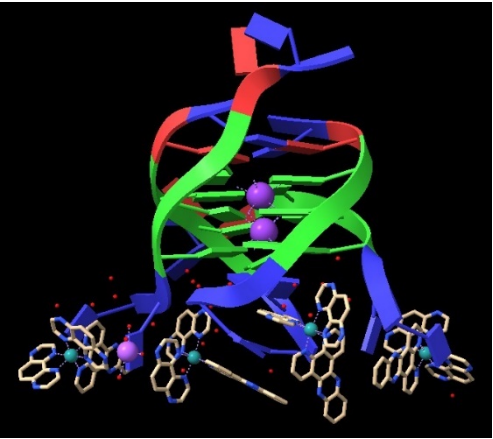
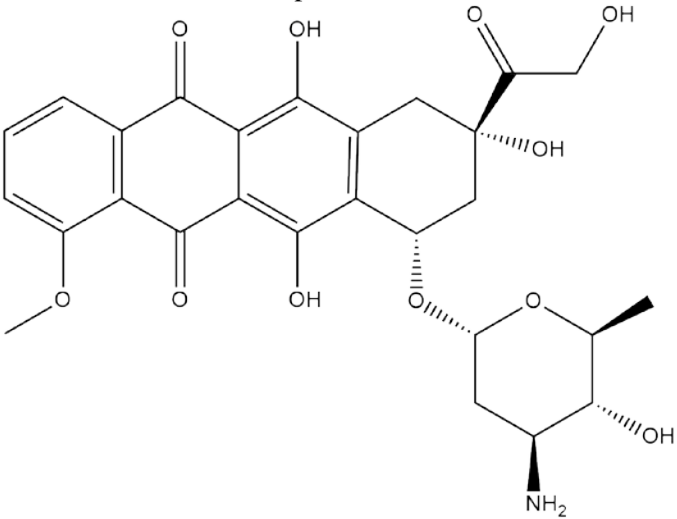
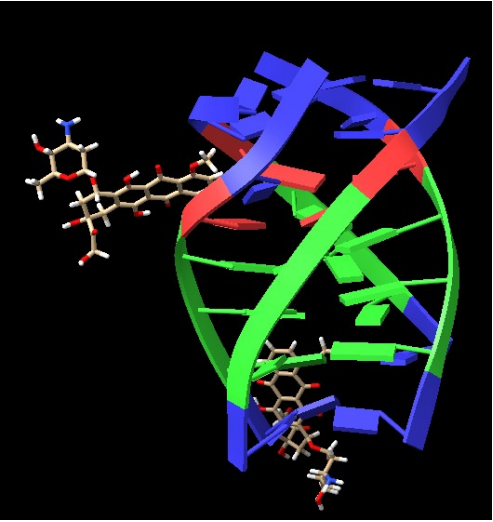
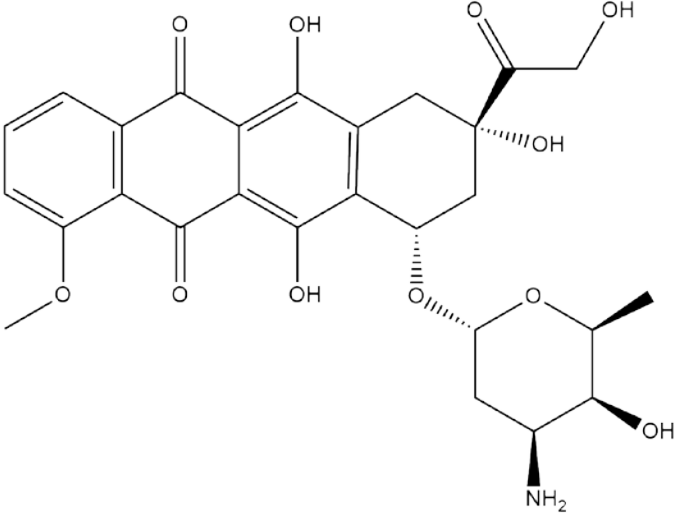
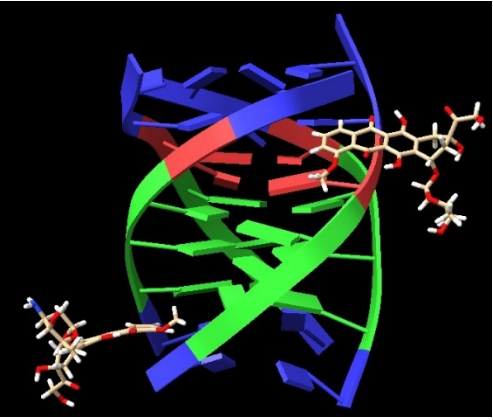
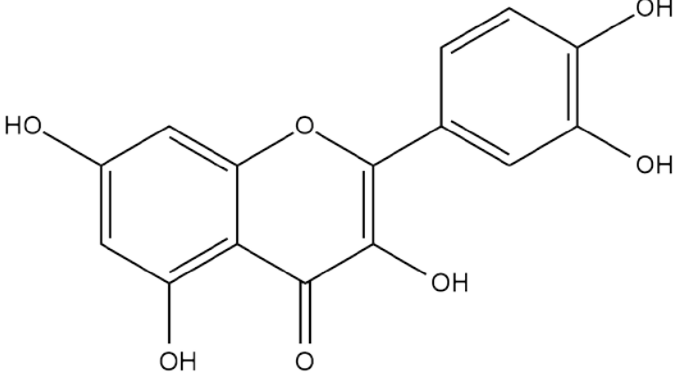
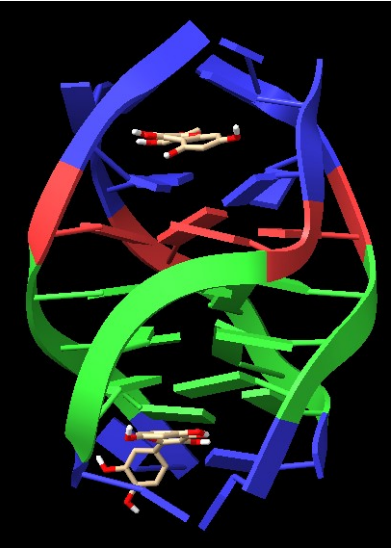
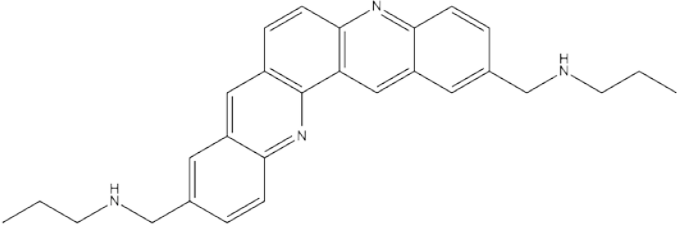
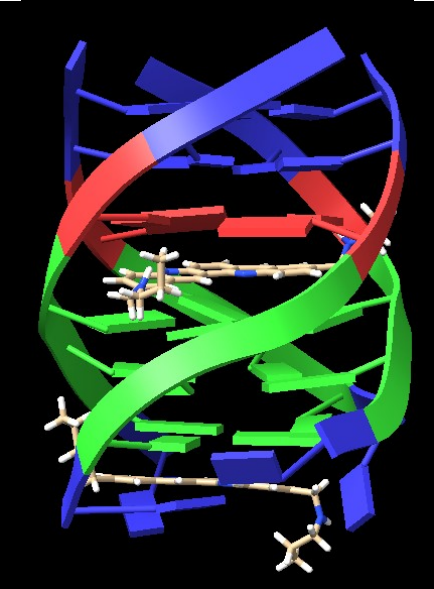
2MB3	<p>L2H2-6M(2)OTD</p> 	<p>Unimolecular Hybrid-1 d[TTGGG(TTAGGG)₃A]</p>		[7]
7Z9L	<p>Phen-DC3</p> 	<p>Unimolecular From Hybrid-1 to Antiparallel chair d[TAGGG(TTAGGG)₃]</p>		[8]
Human telomeric unimolecular parallel G-quadruplexes				
3R6R	<p>Berberine</p> 	<p>Unimolecular Parallel d[TAGGG(TTAGGG)₃]</p>		[9]
5CCW	<p>[Au(9-methylcafein-8-ylidene)₂]⁺</p> 	<p>Unimolecular Parallel d[TAGGG(TTAGGG)₃]</p>		[10]
6H5R	<p>[Au(1-butyl-3-methyl-2-ylidene)₂]⁺</p> 	<p>Unimolecular Parallel d[TAGGG(TTAGGG)₃T]</p>		[11]

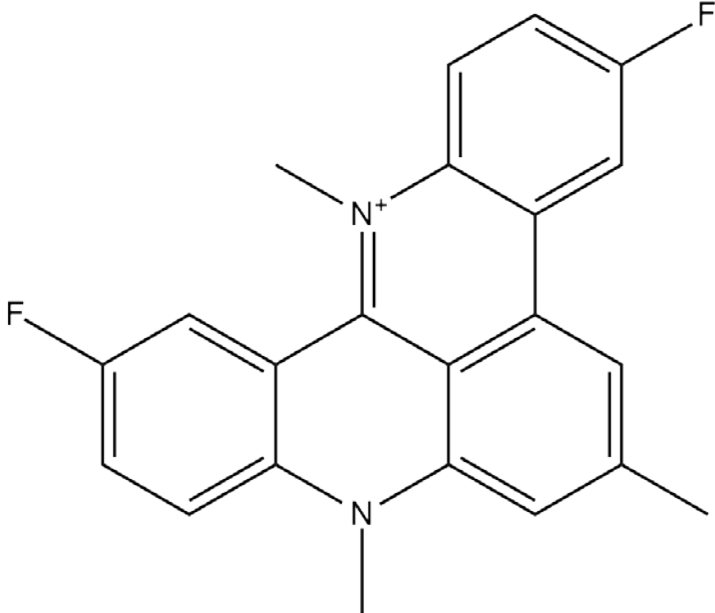
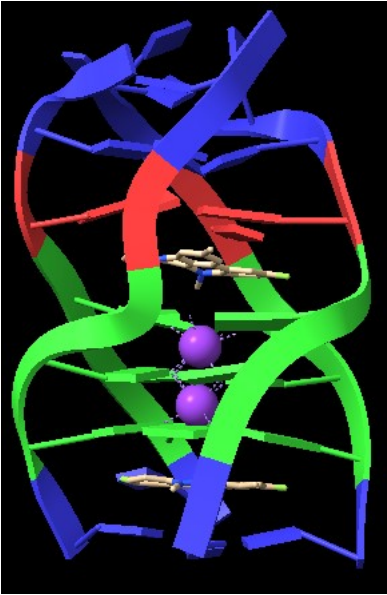
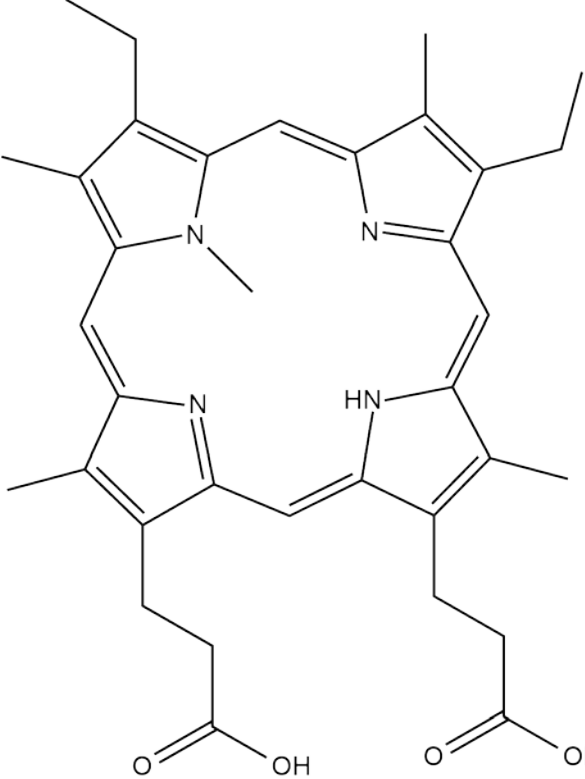
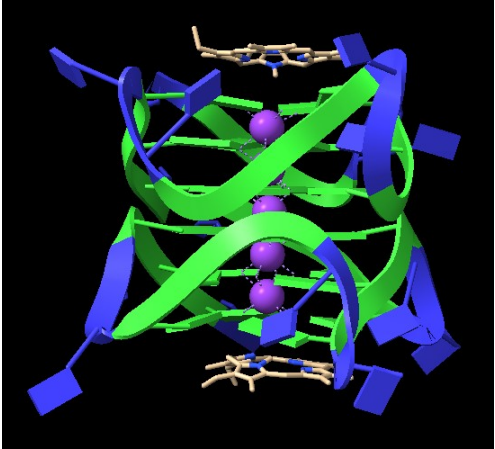
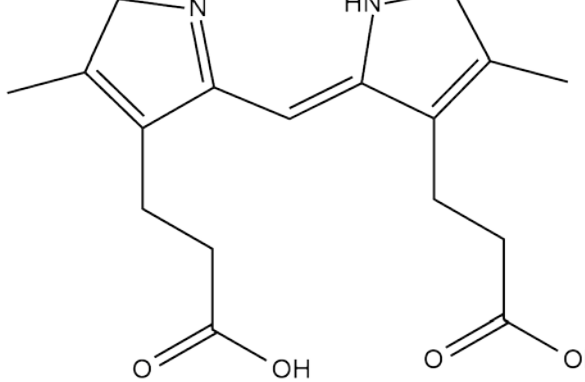
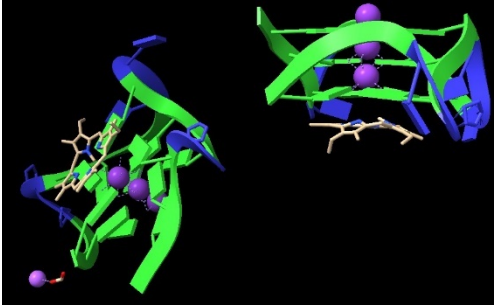
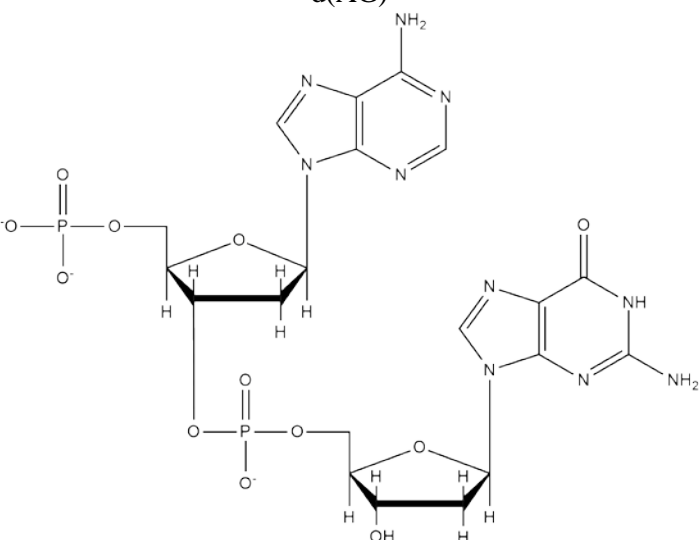
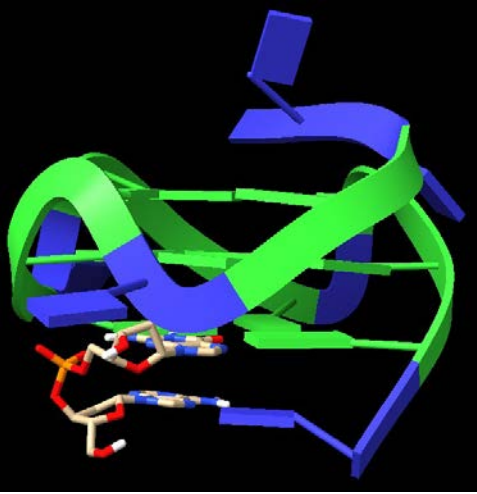
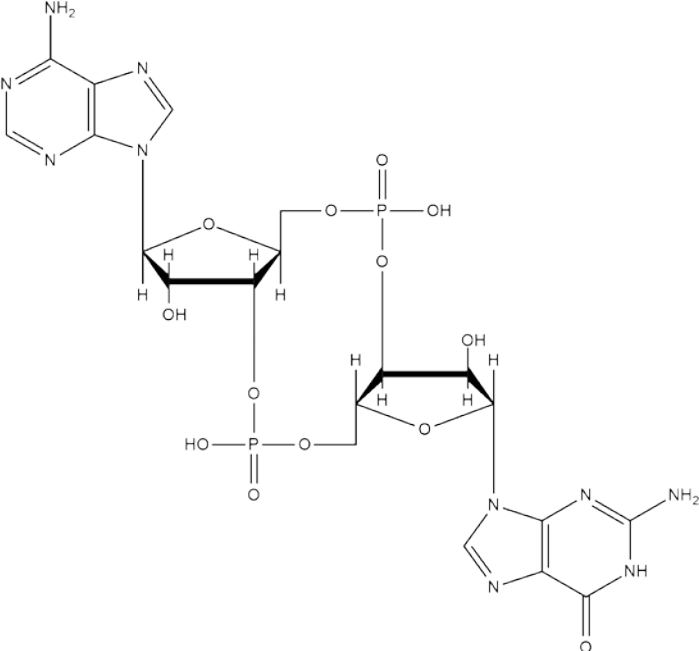
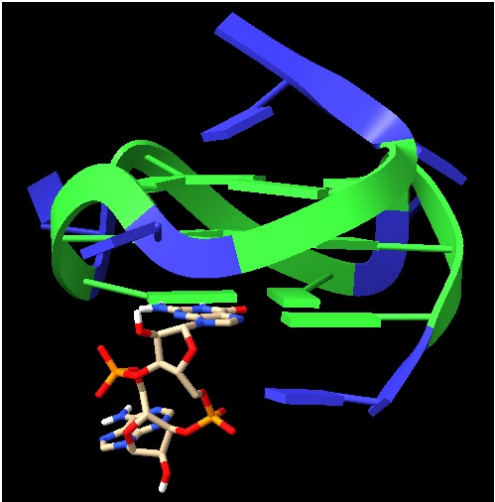
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3SC8	<p>BMSG-SH3</p> 	<p>Unimolecular</p> <p>Parallel</p> <p>d[AGGG(TTAGGG)₃]</p>		[13]
3T5E	<p>BMSG-SH4</p> 	<p>Unimolecular</p> <p>Parallel</p> <p>d[AGGG(TTAGGG)₃]</p>		[13]
3UYH	<p>3d</p> 	<p>Unimolecular</p> <p>Parallel</p> <p>d[AGGG(TTAGGG)₃]</p>		[14]
4DA3		<p>Unimolecular</p> <p>Parallel</p> <p>d[GGG(TTAGGG)₃]</p>		[14]

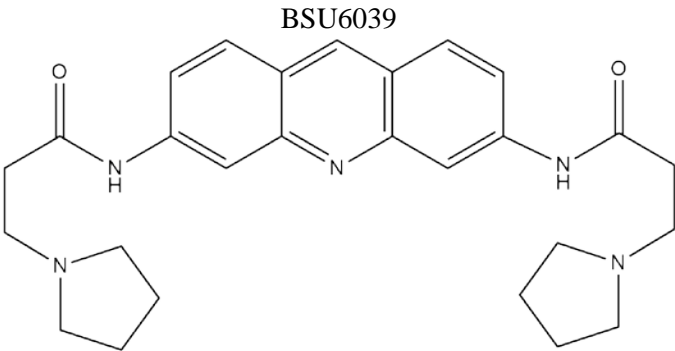
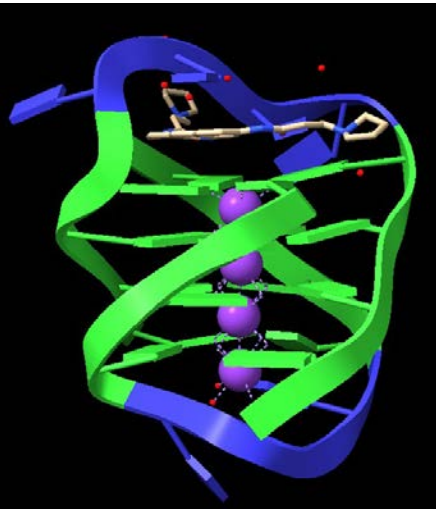
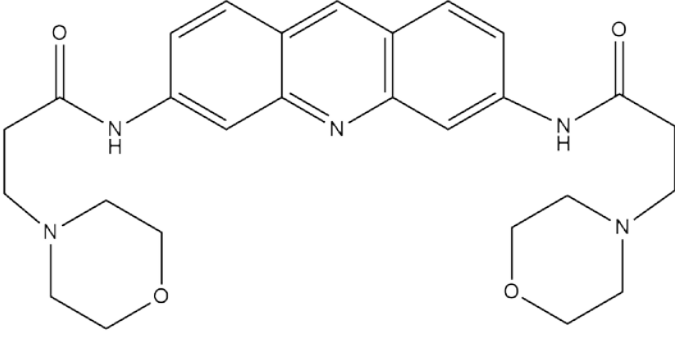
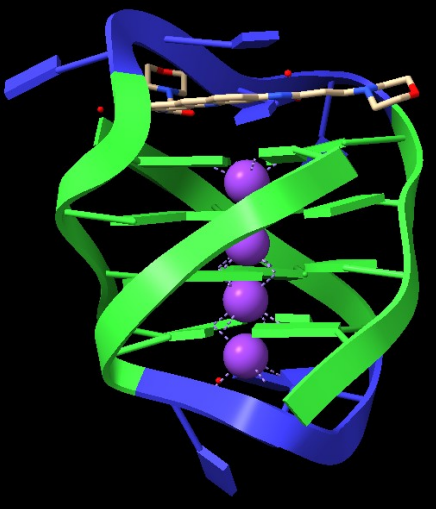
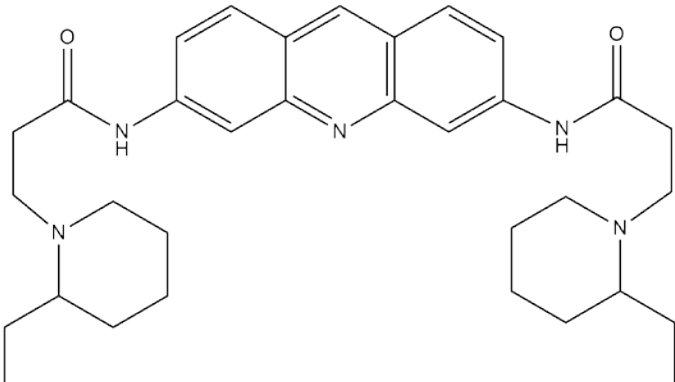
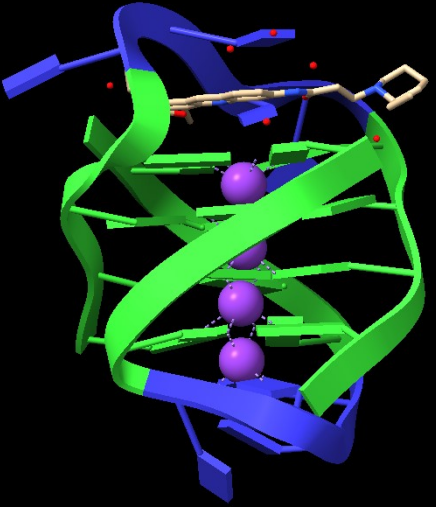
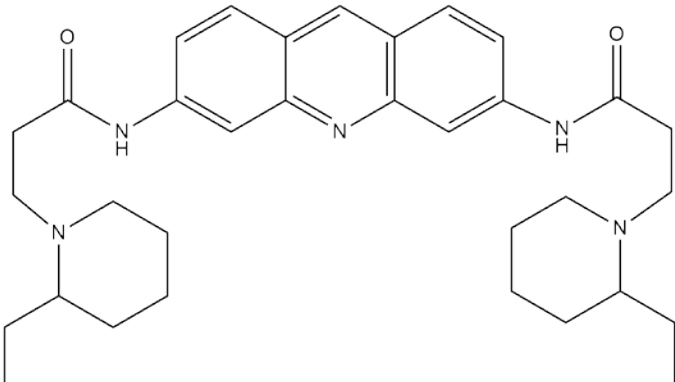

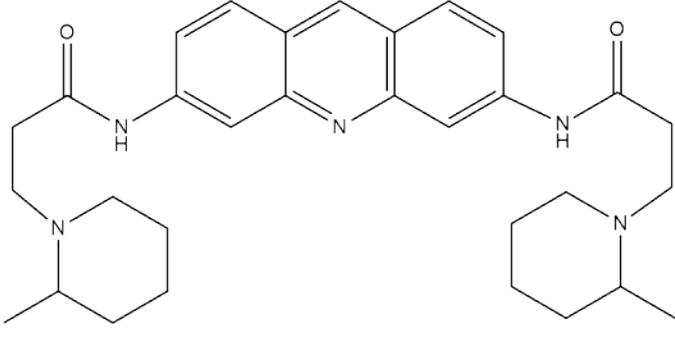
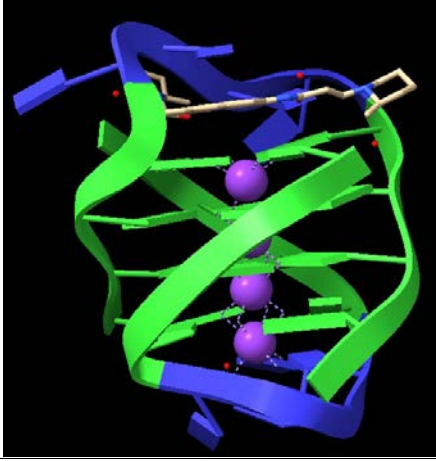
4DAQ	<p>BMSG-SH3</p> 	<p>Unimolecular Parallel d[GGG(TTAGGG)₃]</p>		[14]
4FXM	<p><i>N</i>-methyl mesoporphyrin IX</p> 	<p>Unimolecular Parallel d[AGGG(TTAGGG)₃]</p>		[15]
4G0F		<p>Unimolecular Parallel d[AGGG(TTAGGG)₃]</p>		[15]
6XCL	<p>Pt(II)-based ligand</p> 	<p>Unimolecular Parallel d[AGGG(TTAGGG)₃]</p>		[16]
Human telomeric bimolecular parallel G-quadruplexes				
5CDB	<p>NAX053</p> 	<p>Bimolecular Parallel d(TAGGGTTAGGGT)</p>		[17]

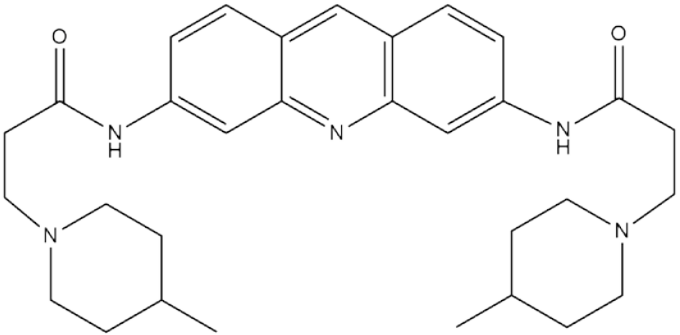
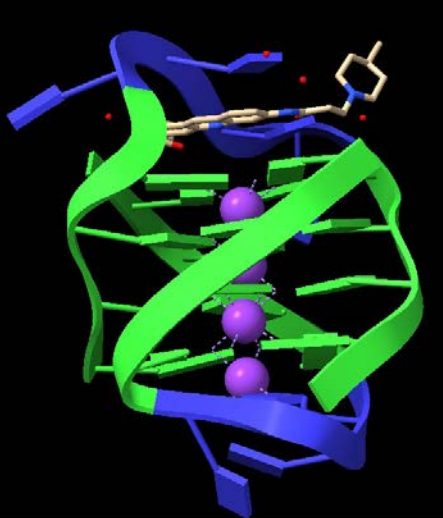
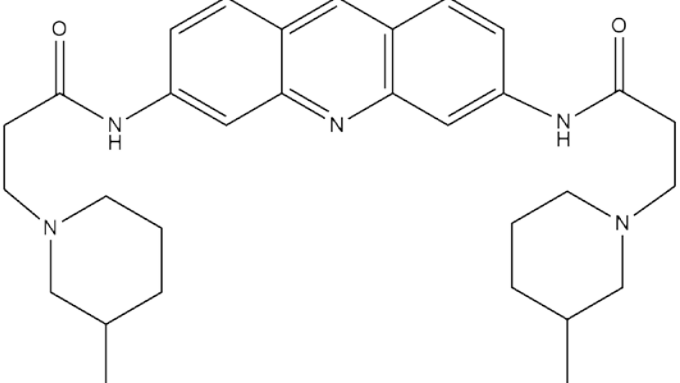
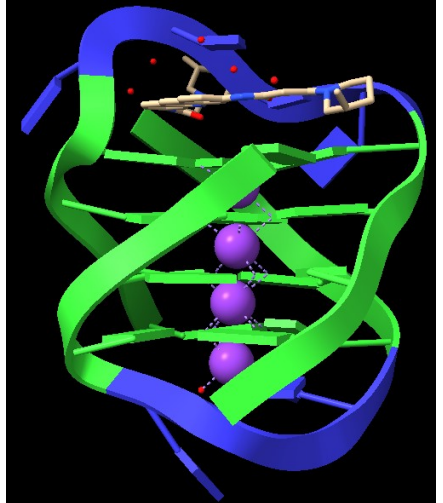
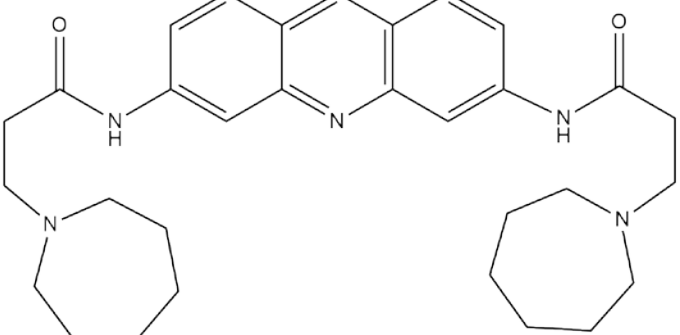
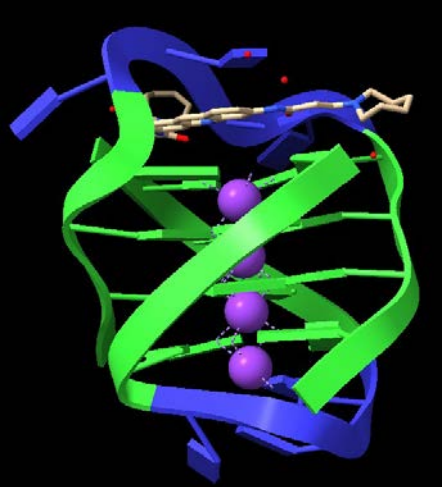
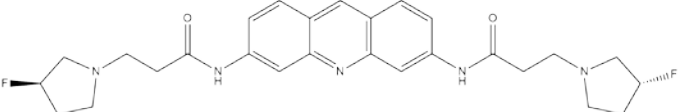
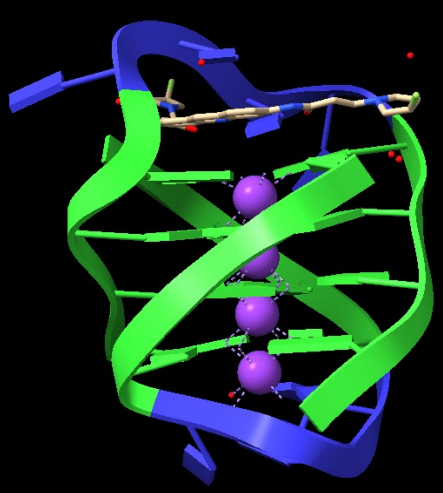
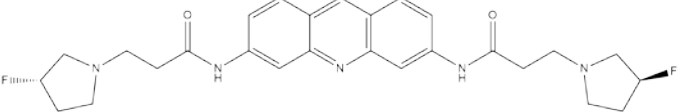
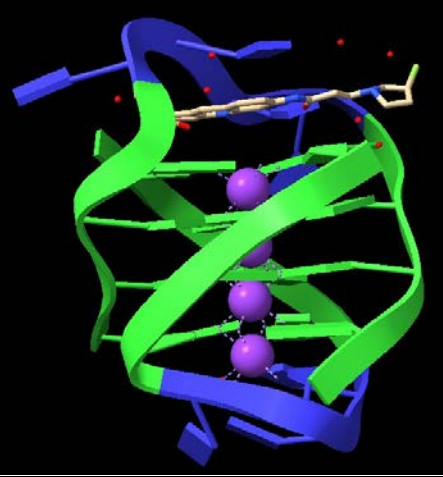
6S15	<p>13-alkylpyridine berberine</p> 	<p>Bimolecular</p> <p>Parallel</p> <p>d(TAGGGTTAGGGT)</p>		[18]
3CCO	<p>NDI-1</p> 	<p>Bimolecular</p> <p>Parallel</p> <p>d(TAGGGTTAGGGT)</p>		[12]
3CE5	<p>BRACO-19</p> 	<p>Bimolecular</p> <p>Parallel</p> <p>d(TAGGGTTAGGGT)</p>		[19]
2HRI	<p>TMPyP4</p> 	<p>Bimolecular</p> <p>Parallel</p> <p>d(TAGGGTTAGGG)</p>		[20]

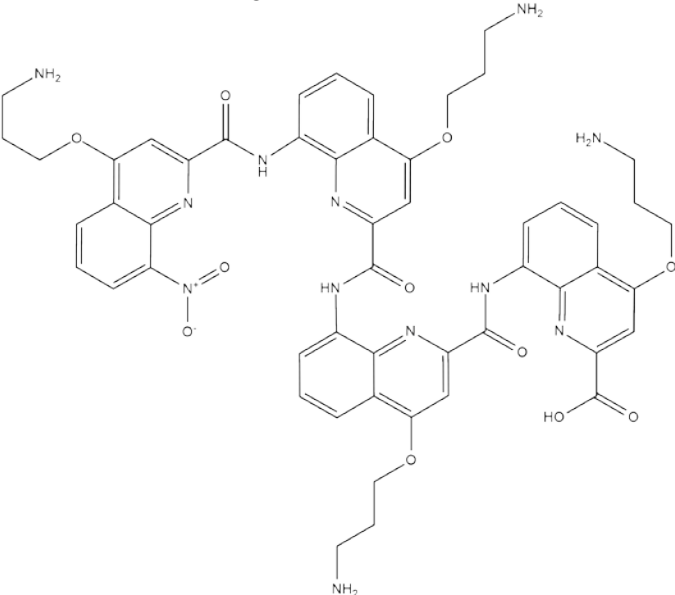
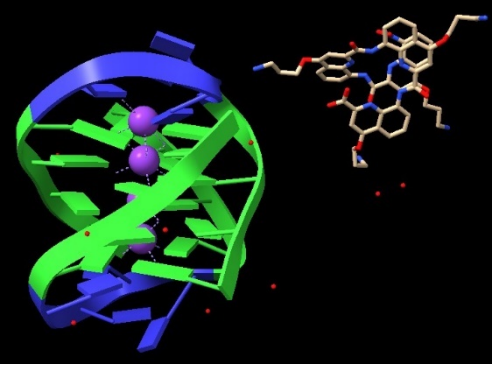
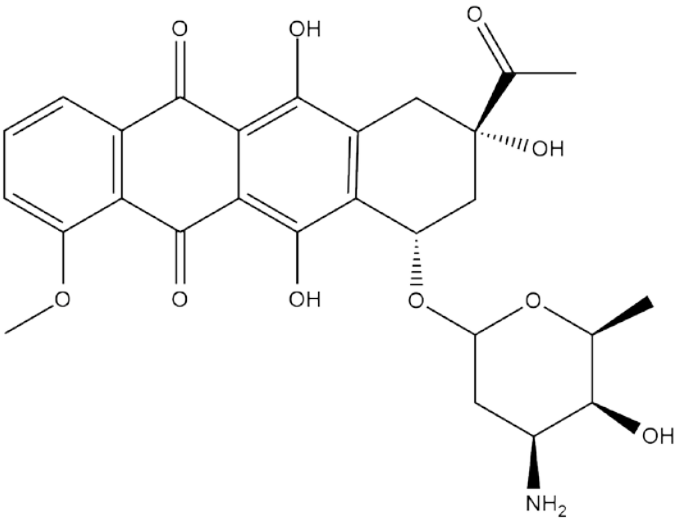
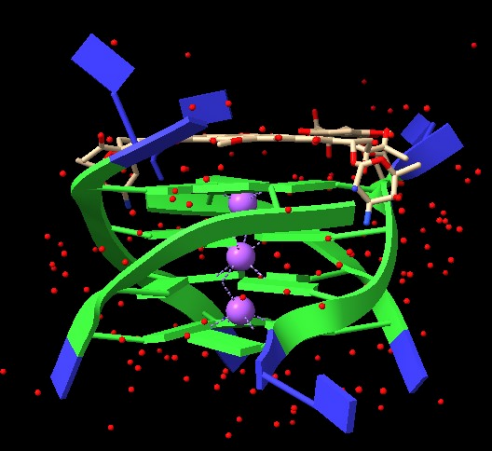
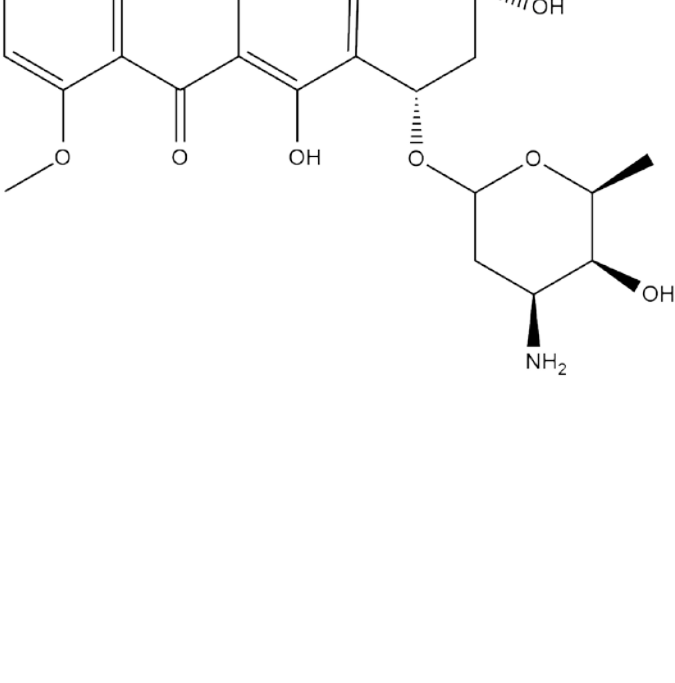
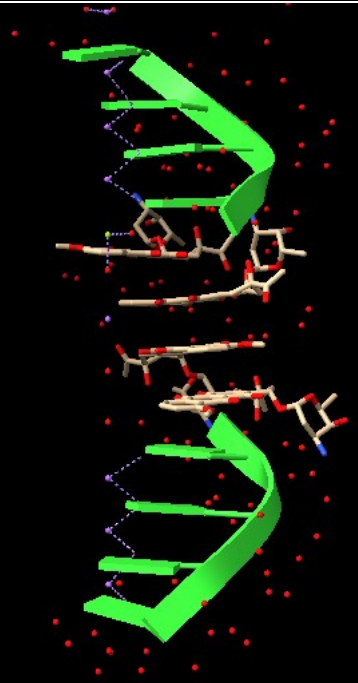
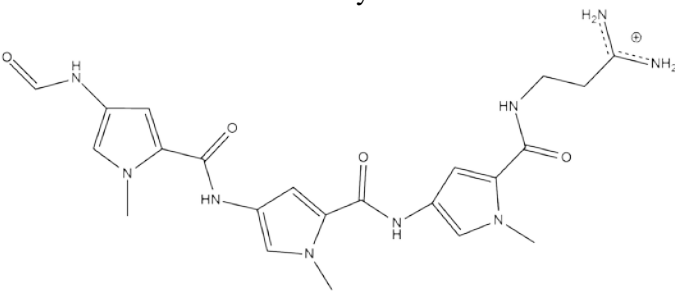
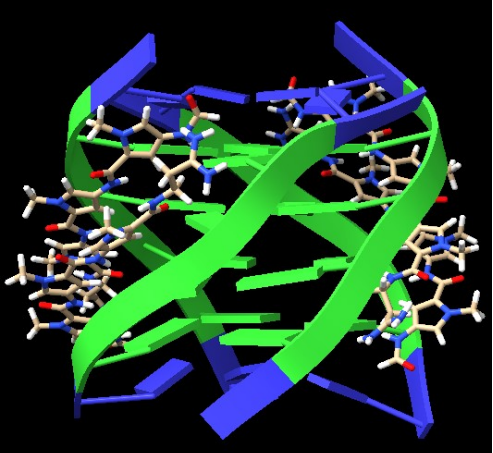
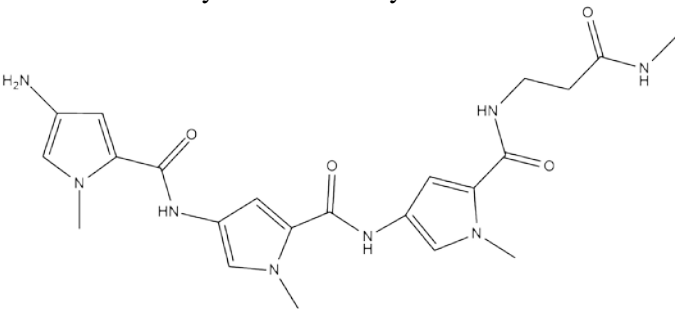
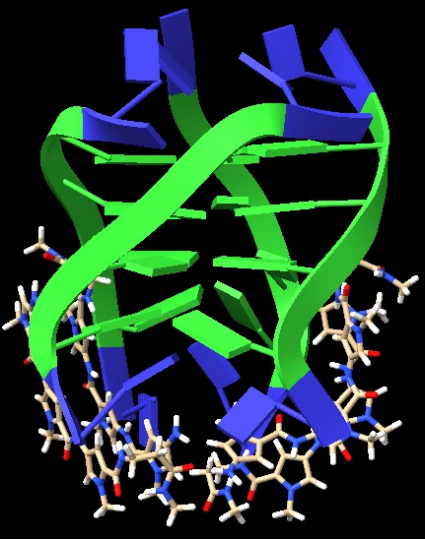
3QSC	<p>Cu(II) salphen metal complex 2+</p>	<p>Bimolecular Parallel d(AGGGT^{Br}UAGGTT)</p>		[21]
3QSF	<p>Ni(II) salphen metal complex 2+</p>	<p>Bimolecular Parallel d(AGGGT^{Br}UAGGTT)</p>		[21]
Human telomeric tetramolecular parallel G-quadruplexes				
5LS8	<p>Λ/Δ-[Ru(TAP)₂(11-CN-dppz)]²⁺ 2+</p>	<p>Tetramolecular From Parallel to Antiparallel d(TAGGGTTA)</p>		[22]

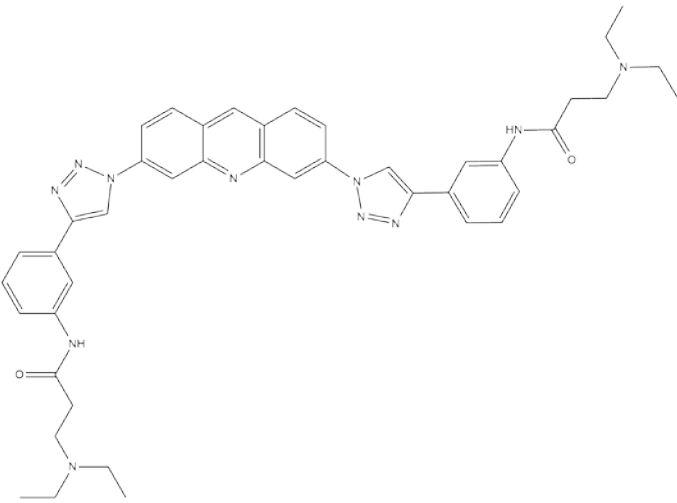
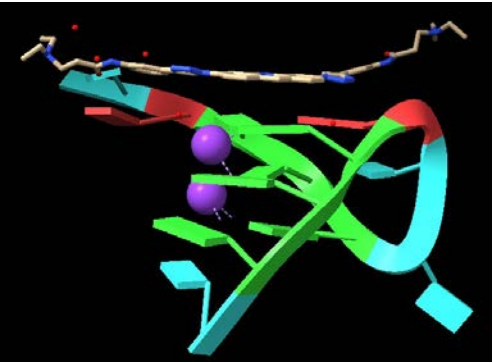
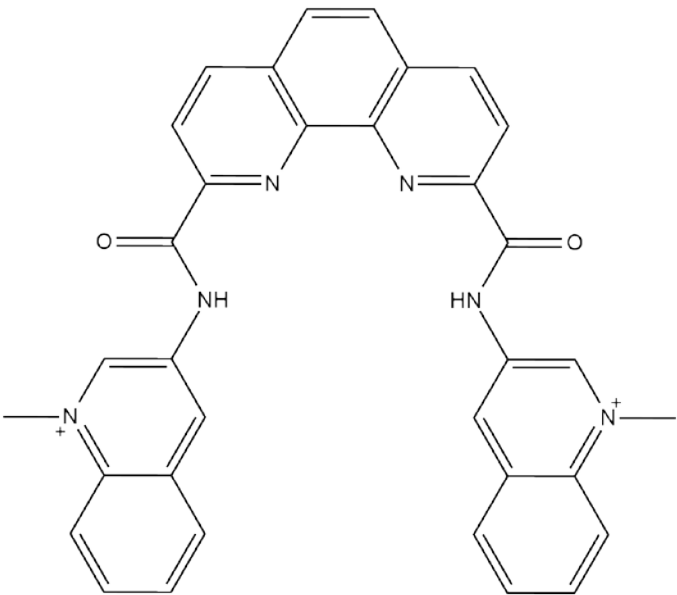
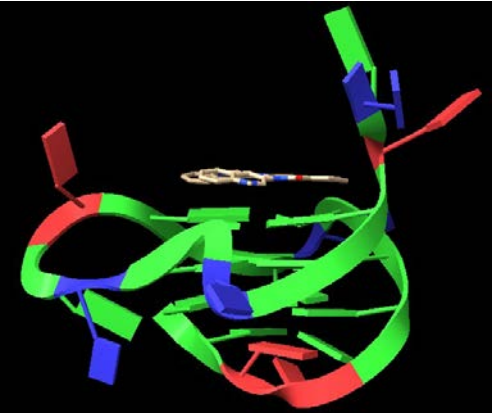
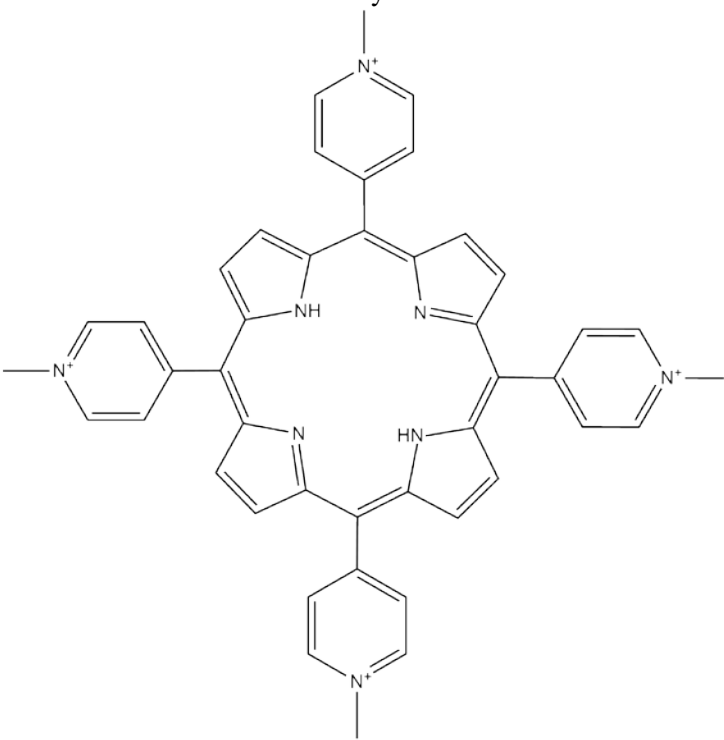
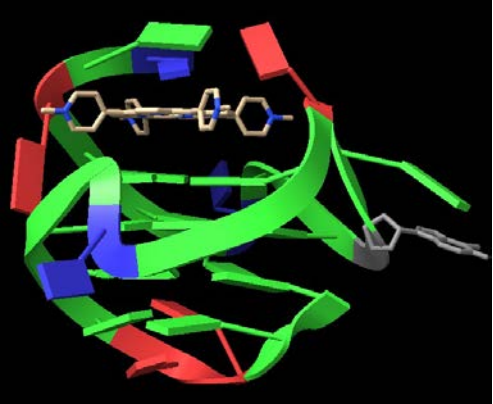
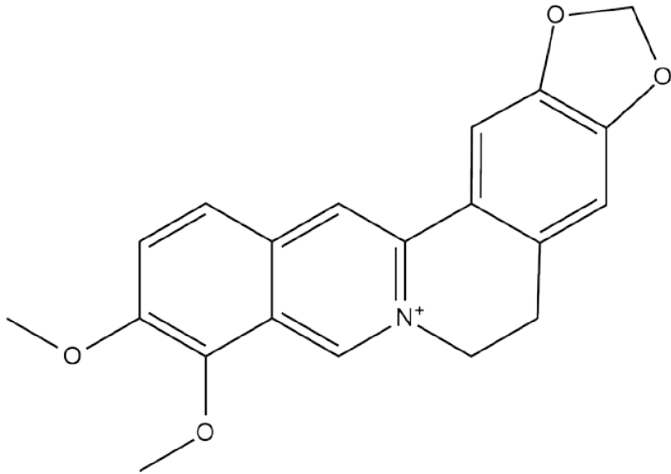
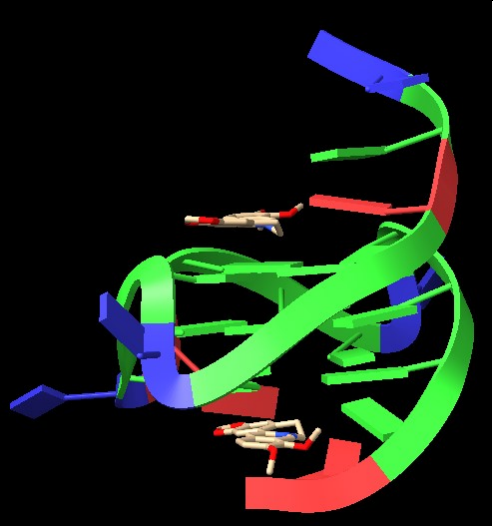
6RNL	<p>Δ-[Ru(TAP)₂(dppz)]²⁺</p> 	<p>Tetramolecular Parallel d(TAGGGTT)</p>		[23]
6KXZ	<p>Epirubicin</p> 	<p>Tetramolecular Parallel d(TTAGGGT)</p>		[24]
6KN4	<p>Adriamycin</p> 	<p>Tetramolecular Parallel d(TTAGGGT)</p>		[25]
2MS6	<p>Quercetin</p> 	<p>Tetramolecular Parallel d(TTAGGGT)</p>		[26]
2JWQ	<p>MMQ₁</p> 	<p>Tetramolecular Parallel d(TTAGGGT)</p>		[27]

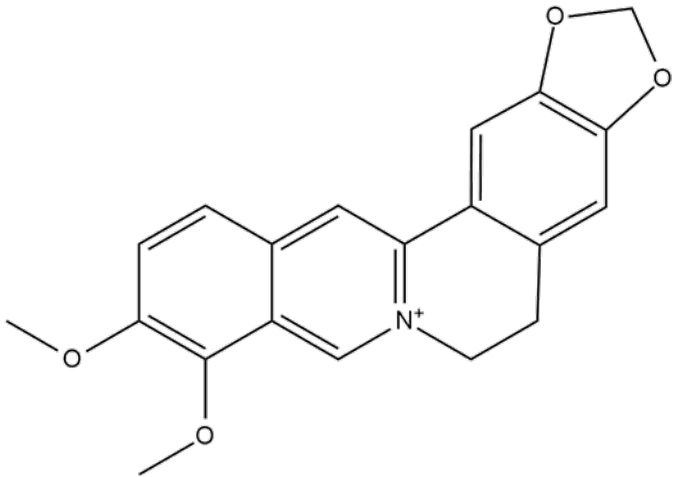
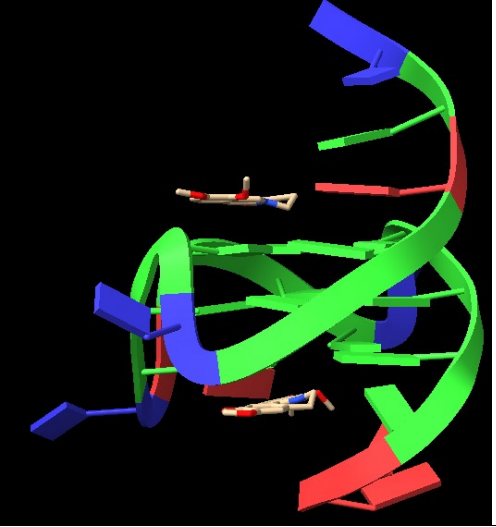
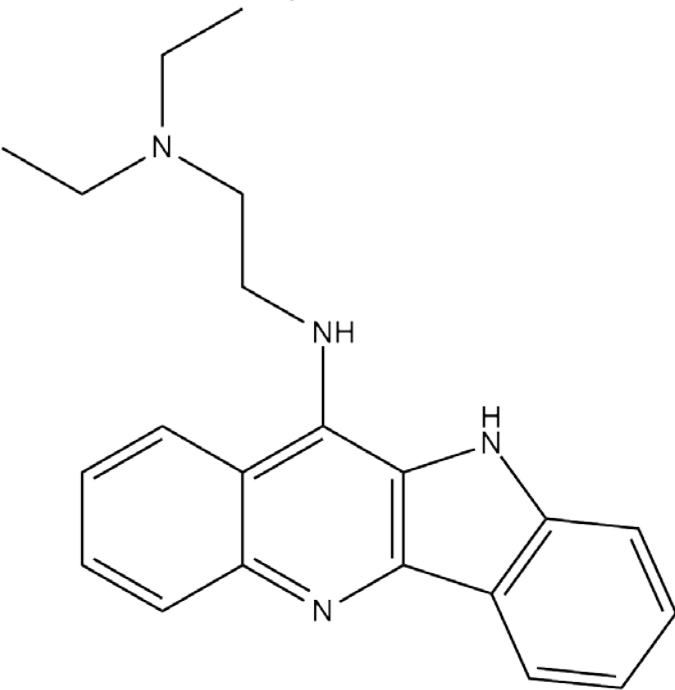
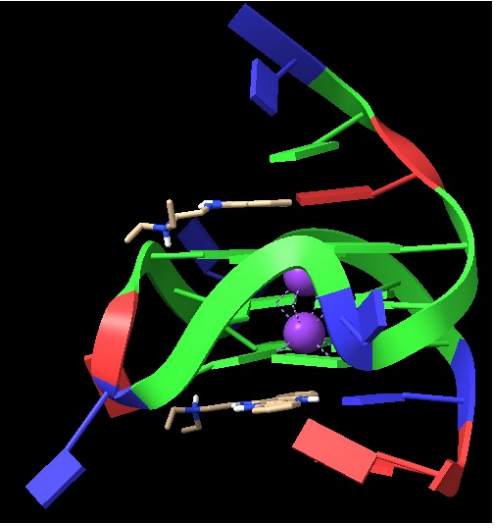
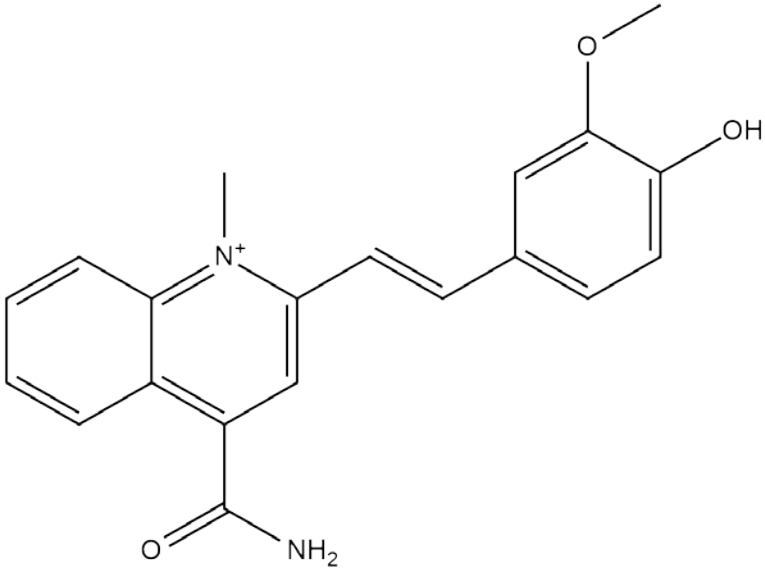
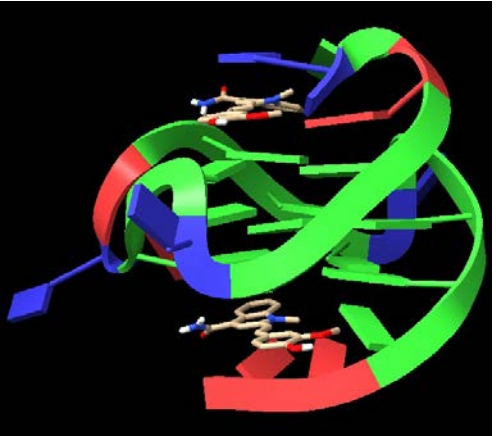
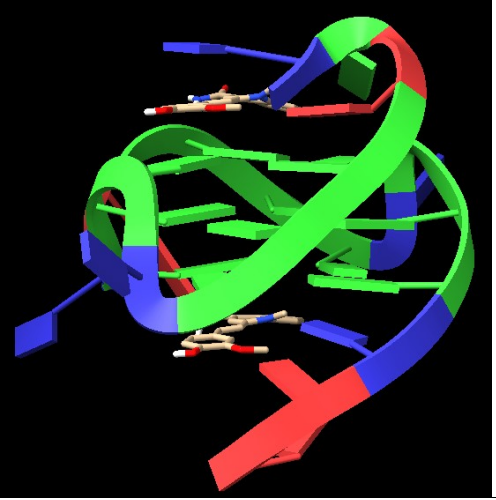
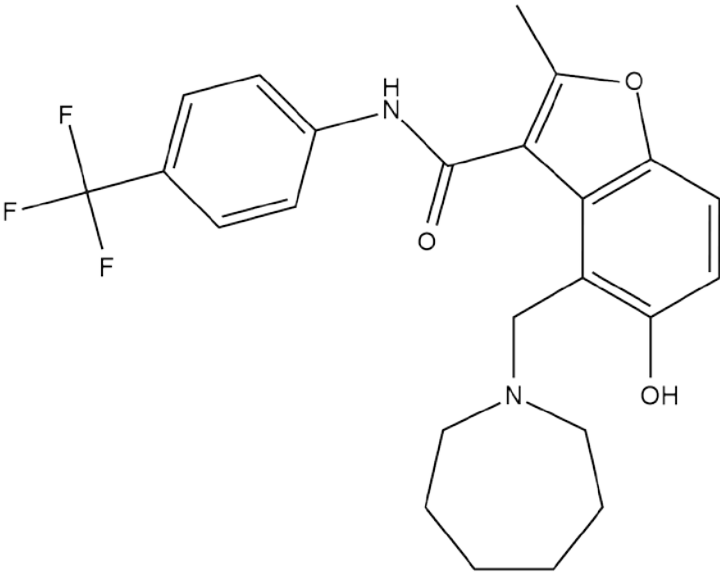
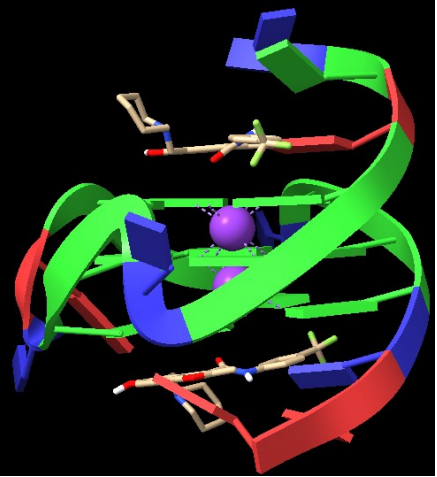
1NZM	<p>RHPS4</p> 	<p>Tetramolecular Parallel d(TTAGGGT)</p>		[28]
<i>Oxytricha telomeric unimolecular parallel G-quadruplexes</i>				
6P45	<p><i>N</i>-methylnesoporphyrin IX</p> 	<p>Unimolecular Parallel d[(TGGGT)₄]</p>		[29]
6PNK		<p>Unimolecular Parallel d[(GGGTT)₃GGG]</p>		[29]
6K3X	<p>d(AG)</p> 	<p>Unimolecular Parallel d[TTGGT(GGGT)₃]</p>		[30]
6K3Y	<p>cGAMP</p> 	<p>Unimolecular Parallel d[TTGGT(GGGT)₃]</p>		[30]

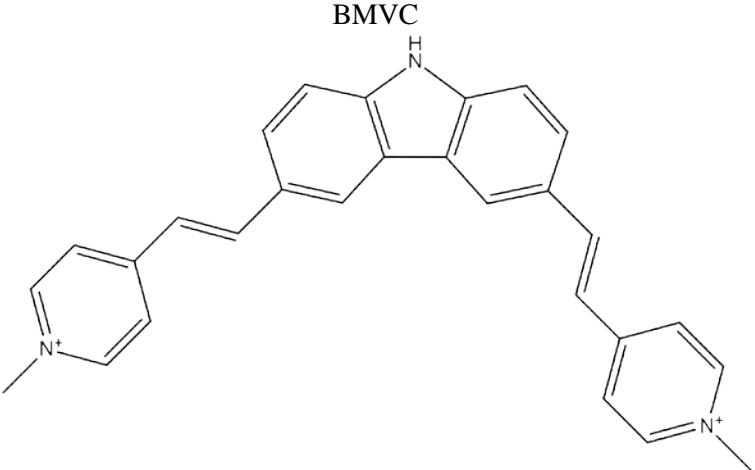
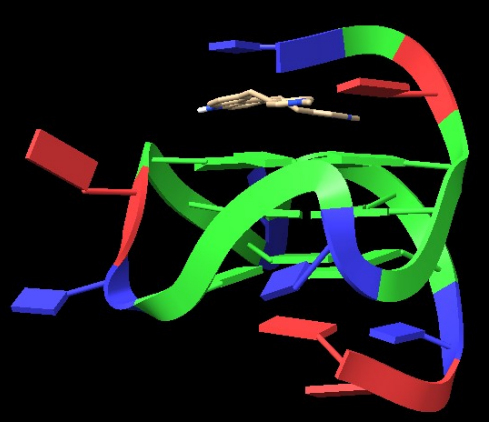

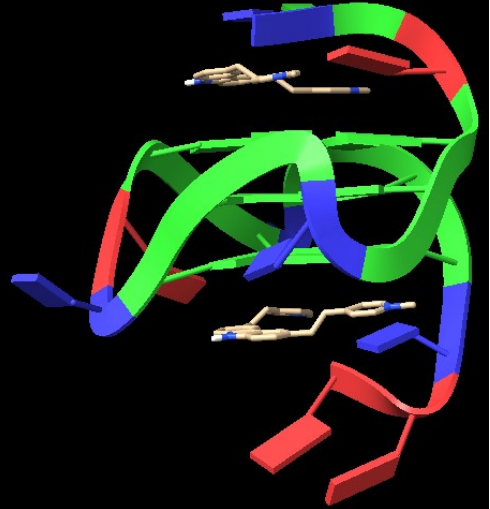
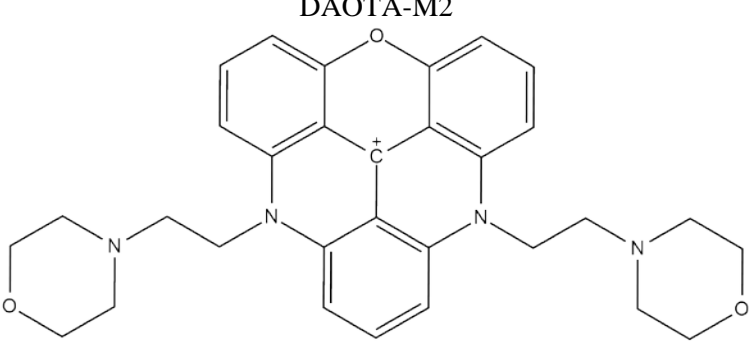
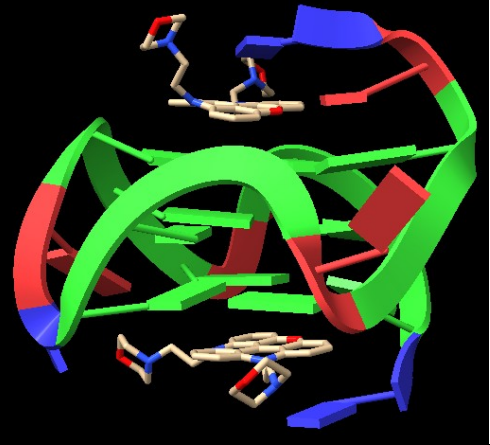
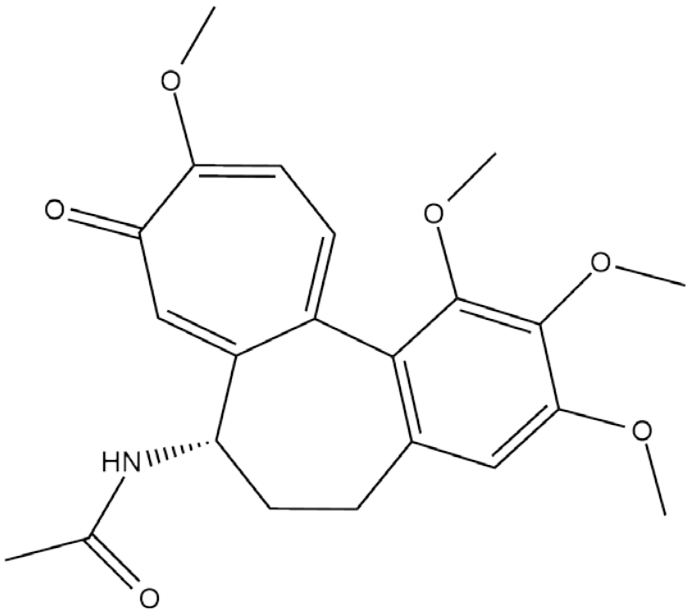
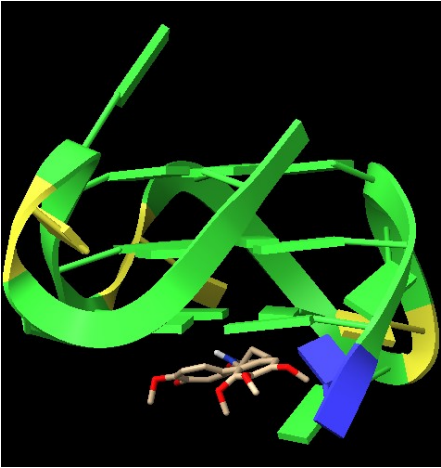
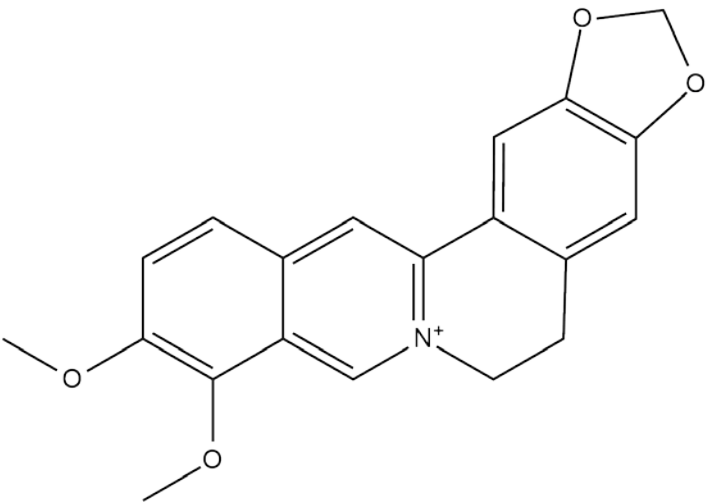
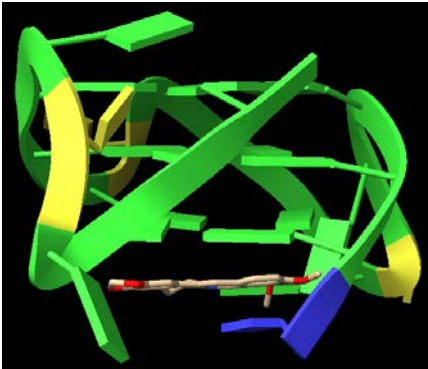
Oxytricha telomeric bimolecular antiparallel G-quadruplexes				
1L1H	BSU6039 	Bimolecular Antiparallel d(GGGGTTTTGGGG)		[31]
3EM2	3-morpholinopropionamido 3,6-disubstituted acridine derivative 	Bimolecular Antiparallel d(GGGGTTTTGGGG)		[32]
3EQW	3-(2-ethylpiperidino)propionamido 3,6-disubstituted acridine derivative 	Bimolecular Antiparallel d(GGGGTTTTGGGG)		[32]
3EUI		Bimolecular Antiparallel d(GGGGTTTTGGGG)		[32]
3ERU	3-(2-methylpiperidino)propionamido 3,6-disubstituted acridine derivative 	Bimolecular Antiparallel d(GGGGTTTTGGGG)		[32]

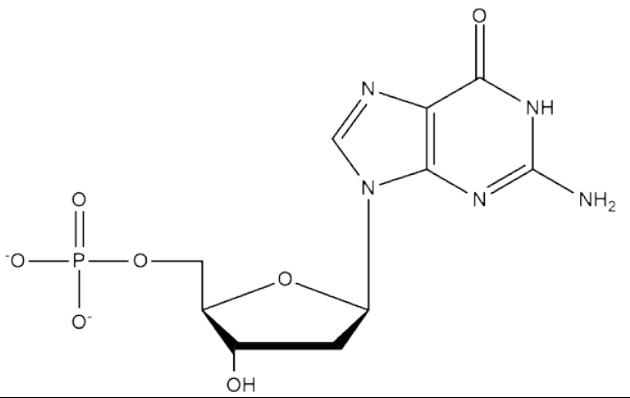
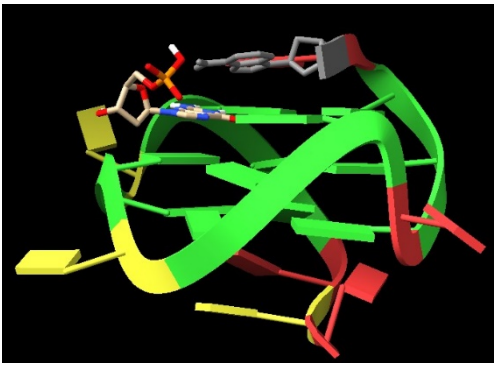
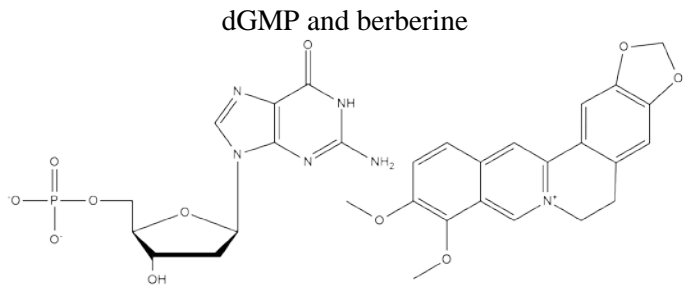
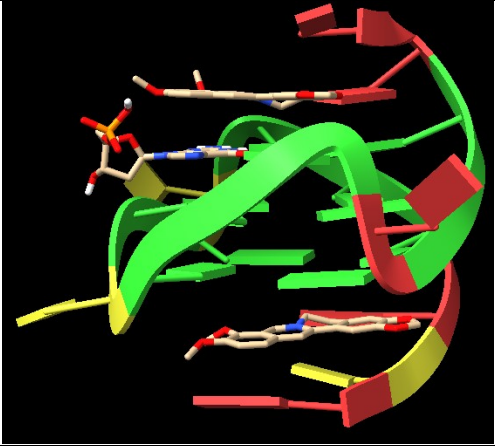
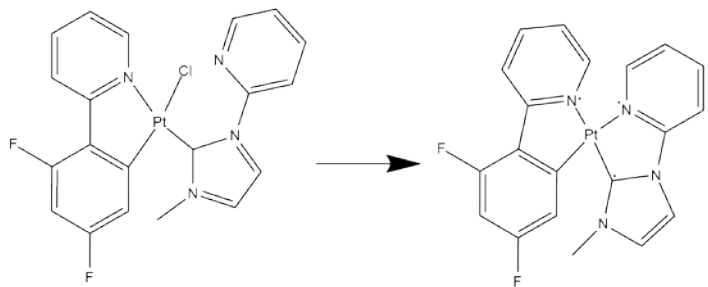
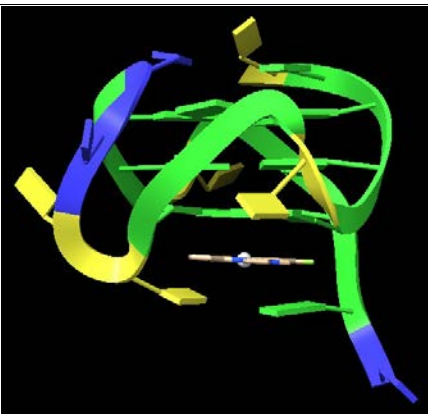
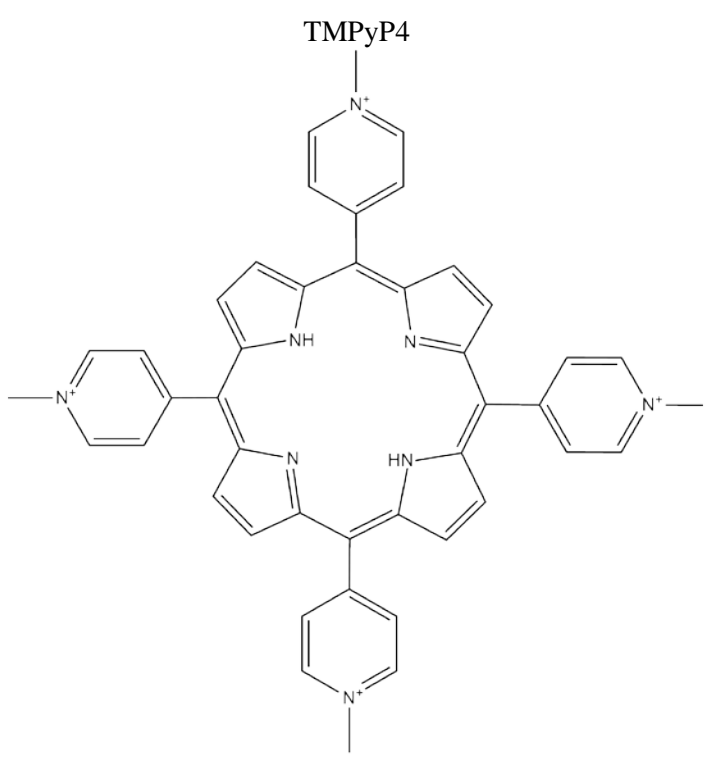
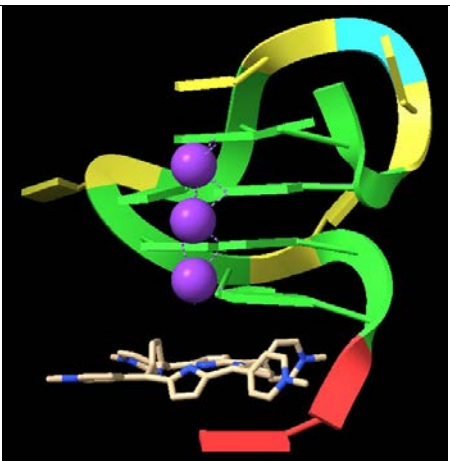
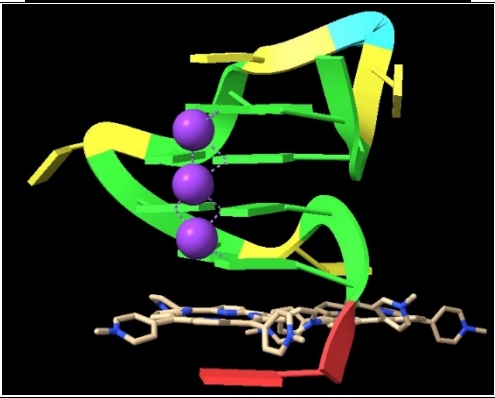
3ES0	<p>3-(4-methylpiperidino)propionamido 3,6-disubstituted acridine derivative</p> 	<p>Bimolecular Antiparallel d(GGGGTTTTGGGG)</p>		[32]
3ET8	<p>3-(3-methylpiperidino)propionamido groups 3,6-disubstituted acridine derivative</p> 	<p>Bimolecular Antiparallel d(GGGGTTTTGGGG)</p>		[32]
3EUM	<p>3-(azepan-1-yl)propionamido 3,6-disubstituted acridine derivative</p> 	<p>Bimolecular Antiparallel d(GGGGTTTTGGGG)</p>		[32]
3NYP	<p>bis-3-fluoropyrrolidine enantiomer (R,R)</p> 	<p>Bimolecular Antiparallel d(GGGGTTTTGGGG)</p>		[33]
3NZ7	<p>bis-3-fluoropyrrolidine enantiomer (S,S)</p> 	<p>Bimolecular Antiparallel d(GGGGTTTTGGGG)</p>		[33]

5HIX	<p>Oligoamide foldamer</p> 	<p>Bimolecular Antiparallel d(GGGGTTTGTGGGG)</p>		[34]
<i>Oxytricha</i> telomeric tetramolecular parallel G-quadruplexes				
100K	<p>Daunomycin</p> 	<p>Tetramolecular Parallel d(TGGGGT)</p>		[35]
3TVB		<p>Tetramolecular Parallel d(GGGG)</p>		[36]
2JT7	<p>Distamycin</p> 	<p>Tetramolecular Parallel d(TGGGGT)</p>		[37]
2KVY	<p>N-methyl amide distamycin derivative</p> 	<p>Tetramolecular Parallel d(TGGGGT)</p>		[38]

RNA telomeric G-quadruplexes				
3MIJ	Triazole-phenyl-diethylamine 3,6-disubstituted acridine 	Bimolecular Parallel r[(UAGGGU) ₂]		[39]
Oncogenic G-quadruplexes				
C-MYC oncogene promoter G-quadruplexes				
2MGN	Phen-DC3 	Unimolecular Parallel d(TGAGGGTGGTGTAGGGTGGGGAAGG)		[40]
2A5R	TMPyP4 	Unimolecular Parallel d(TGAGGGTGGIGAGGGTGGGGAAGG)		[41]
7N7D	Berberine 	Unimolecular Parallel d(TGAGGGTGGGTAGGGTGGGGAA)		[42]

7N7E	<p>Berberine</p> 	<p>Unimolecular Parallel d(TGAGGGTGGGTAGGGTGGGGAA)</p>		[42]
2L7V	<p>Quindoline</p> 	<p>Unimolecular Parallel d(TGAGGGTGGGTAGGGTGGGTAA)</p>		[43]
7KBW	<p>PEQ</p> 	<p>Unimolecular Parallel d(TGAGGGTGGGTAGGGTGGGGAA)</p>		[44]
7KBX		<p>Unimolecular Parallel d(TGAGGGTGGGTAGGGTGGGTAA)</p>		[44]
5W77	<p>DC-34</p> 	<p>Unimolecular Parallel d(TGAGGGTGGGTAGGGTGGGTAA)</p>		[45]

6JJ0	<div>BMVC</div> 	<div>Unimolecular</div> <div>Parallel</div> <div>d(TGAGGGTGGGTAGGGTGGGTAA)</div>		[46]
6O2L		<div>Unimolecular</div> <div>Parallel</div> <div>d(TGAGGGTGGGTAGGGTGGGTAA)</div>		[46]
5LIG	<div>DAOTA-M2</div> 	<div>Unimolecular</div> <div>Parallel</div> <div>d(TAGGGAGGGTAGGGAGGGT)</div>		[47]
RET oncogene promoter G-quadruplexes				
6JWE	<div>Colchicine</div> 	<div>Unimolecular</div> <div>Parallel</div> <div>d(GGGGCGGGGCGGGGCGGGGT)</div>		[48]
6JWD	<div>Berberine</div> 	<div>Unimolecular</div> <div>Parallel</div> <div>d(GGGGCGGGGCGGGGCGGGGT)</div>		[48]
PDGFR-β oncogene promoter G-quadruplexes				

6VOL	<p>dGMP</p> 	<p>Unimolecular Parallel d(AAGGGAGGGCGGCGGGACA)</p>		[49]
7MSV	<p>dGMP and berberine</p> 	<p>Unimolecular Parallel d(AAGGGAGGGCGGCGGGACA)</p>		[50]
VEGF oncogene promoter G-quadruplexes				
6LNZ	<p>Pt1 to Pt2</p> 	<p>Unimolecular Parallel d(CGCGGCGGGCCTTGGGCGGGGT)</p>		[51]
Viral G-quadruplexes				
6JJI		<p>Bimolecular Parallel r(GGCUCGGCGGCGGA)</p>		[52]
6JJH		<p>Bimolecular Parallel r(GGCUCGGCGGCGGA)</p>		[52]

References

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