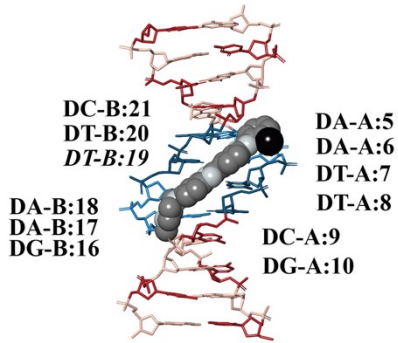


Figure S1: Molecular docking of the commercially available Hoechst 33258 and Hoechst 33342 ligands, as well as iodoHoechst 33258 to B-DNA (PDB ID: 129D, 5DAM, and 448D). The bases A, T, C, and G are coloured cyan, dark teal, dark red, and pink, respectively. Iodine atoms are coloured black, hydrogen atoms are coloured light yellow, nitrogen atoms are coloured silver, and oxygen atoms are coloured tan.

PDB ID: 129D

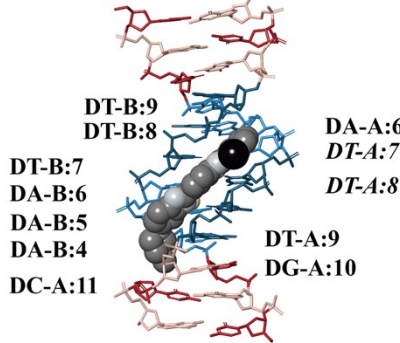
-11.7 kcal/mol



PDB ID: 5DAM

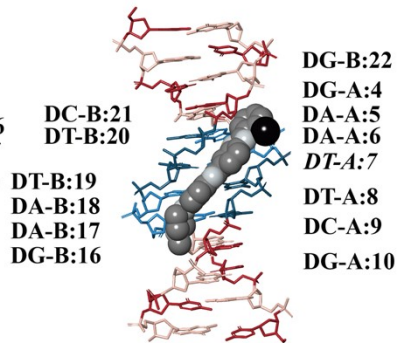
ortho-iodoHoechst

-13.3 kcal/mol

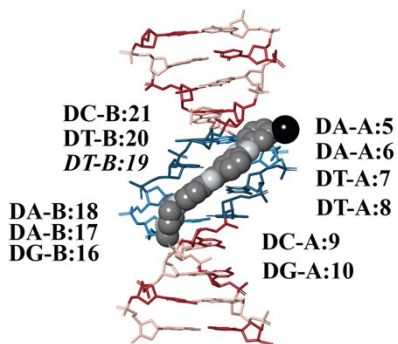


PDB ID: 448D

-12.8 kcal/mol

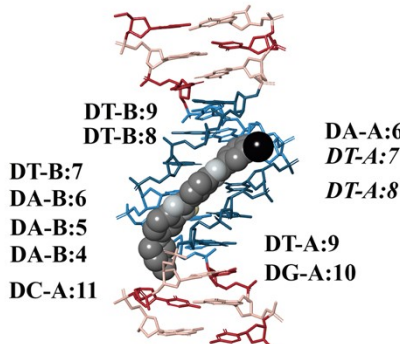


-11.6 kcal/mol

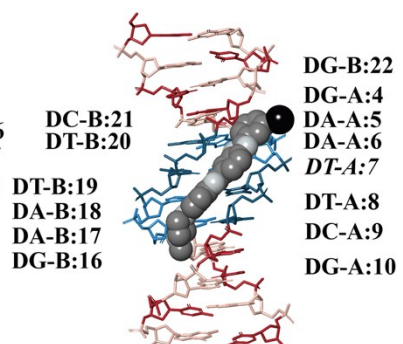


meta-iodoHoechst

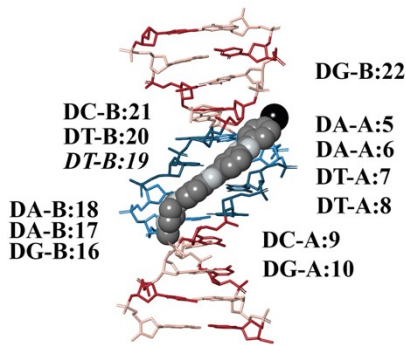
-13.3 kcal/mol



-12.9 kcal/mol

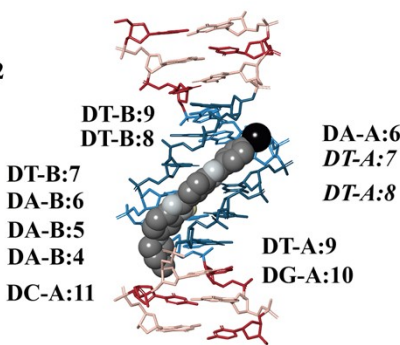


-11.9 kcal/mol

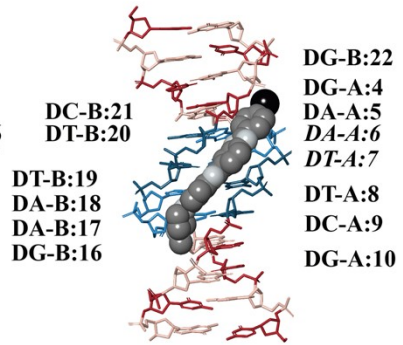


para-iodoHoechst

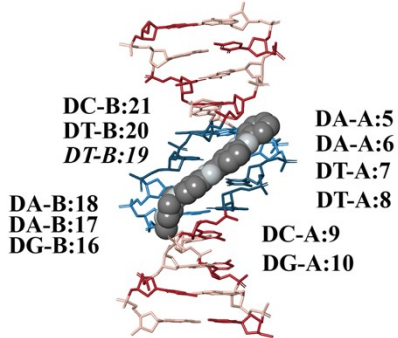
-13.2 kcal/mol



-13.0 kcal/mol

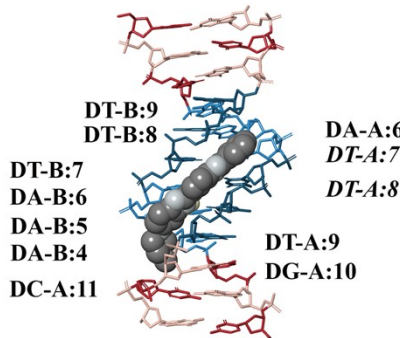


-11.5 kcal/mol



phenylHoechst

-13.1 kcal/mol



-12.7 kcal/mol

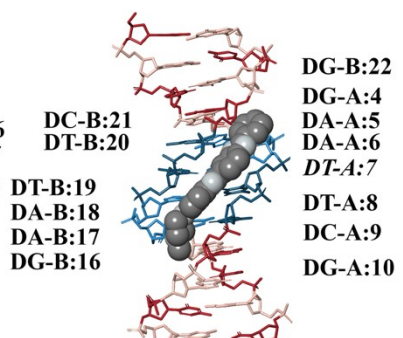


Figure S2: Molecular docking of the *ortho*-, *meta*-, and *para*-iodoHoechst ligands to B-DNA (PDB ID: 129D, 5DAM, and 448D). The bases A, T, C, and G are coloured cyan, dark teal, dark red, and pink, respectively. Iodine atoms are coloured black, hydrogen atoms are coloured light yellow, nitrogen atoms are coloured silver, and oxygen atoms are coloured tan.

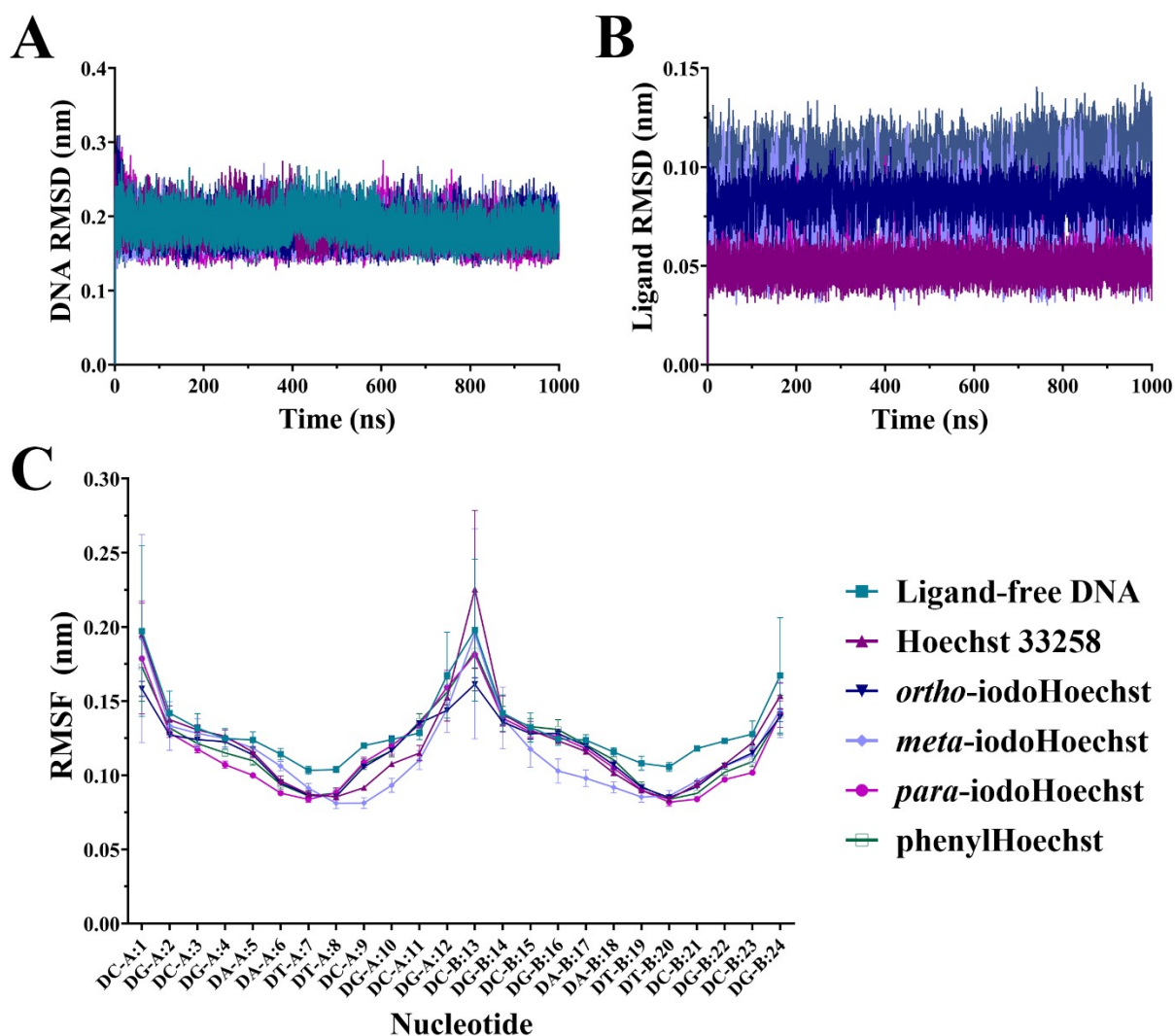


Figure S3: Stability of DNA dodecamer in complex with Hoechst ligands. Root mean square deviation (RMSD) for was calculated for DNA (A) and Hoechst ligands (B). Root mean square fluctuation (RMSF) was calculated for DNA (C), with values shown was mean \pm SD. Simulations were carried out for 1000 ns in triplicate for each system.

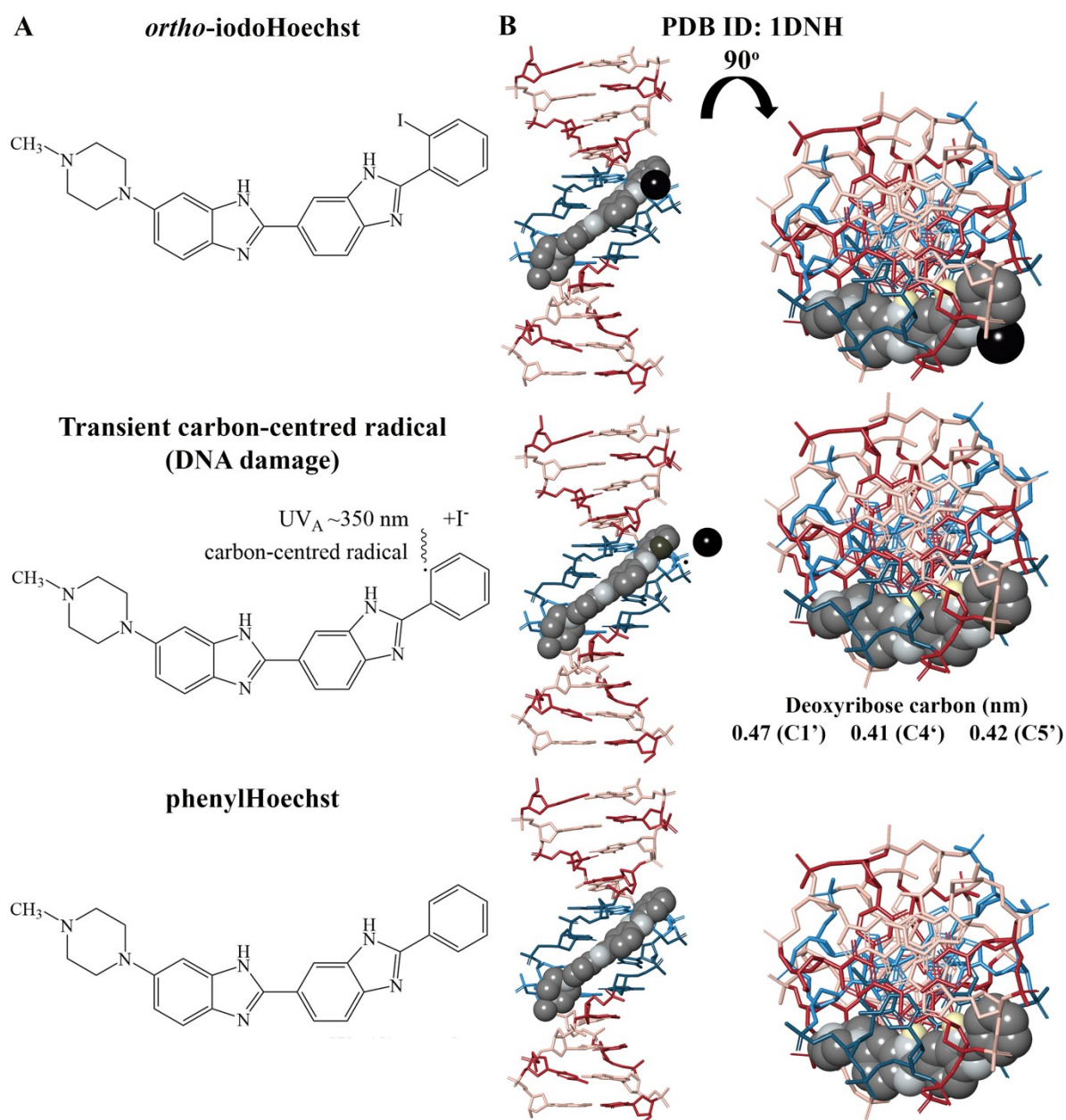


Figure S4: Photodehalogenation of *ortho*-iodoHoechst to phenylHoechst. The chemical structures of *ortho*-iodoHoechst, the carbon-centred radical, and phenylHoechst that are formed from the process of photodehalogenation can be seen. The docked ligands in the minor groove of B-DNA are shown (PDB ID: 1DNH) and the distances of the carbon-centred radical from the deoxyribose carbon (C1', C4', and C5') are provided.

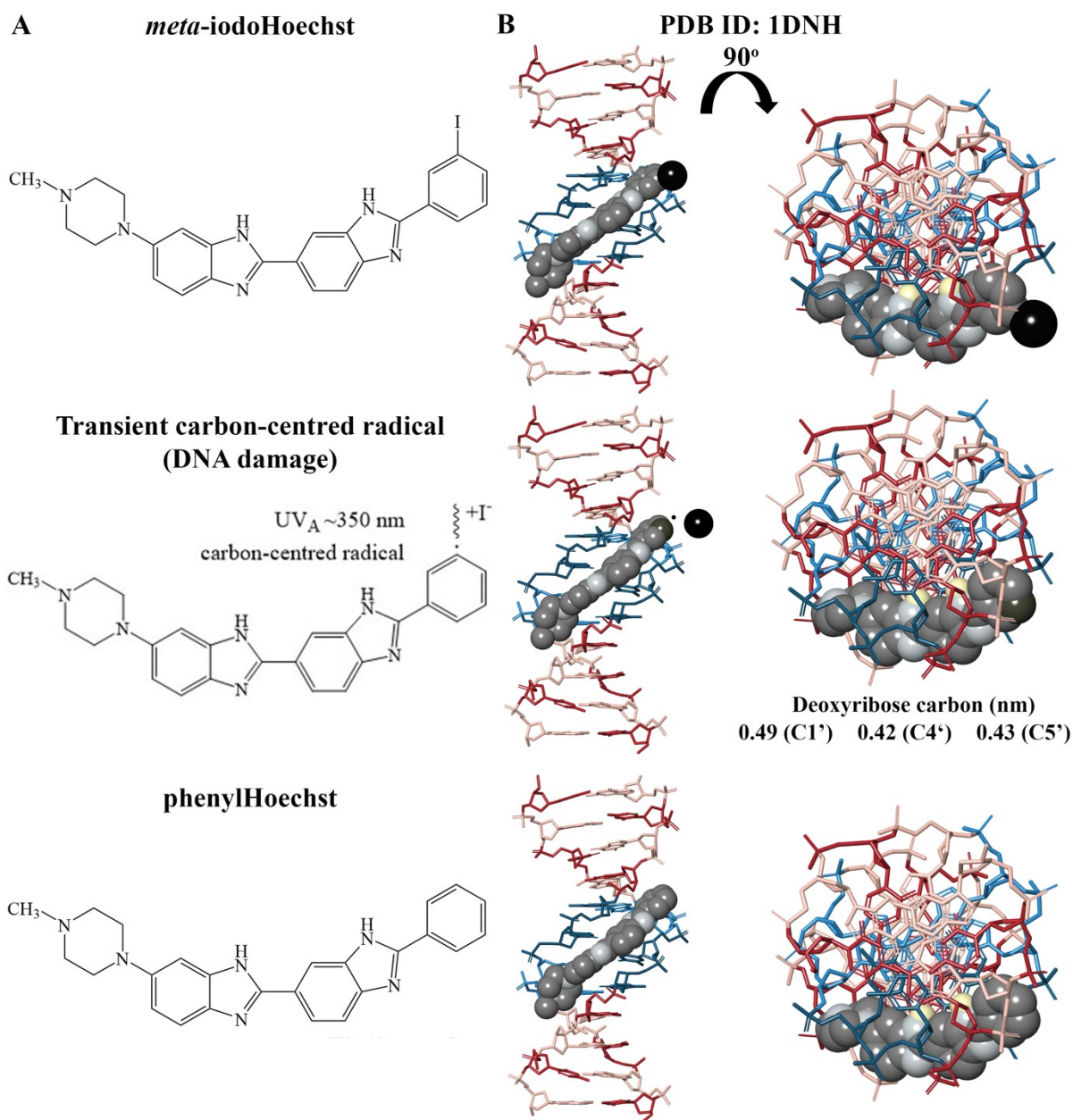
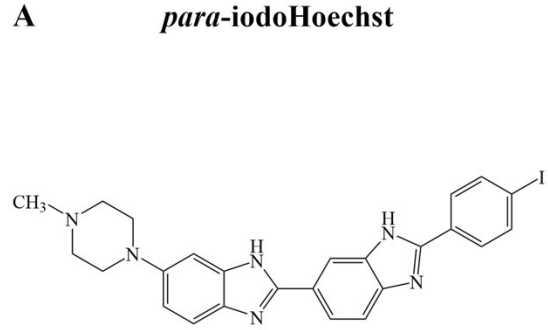
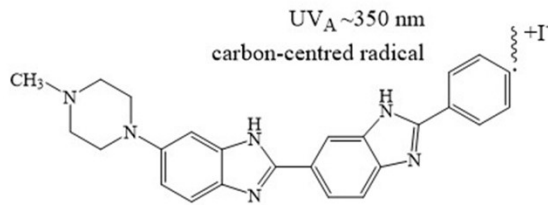


Figure S5: Photodehalogenation of *meta*-iodoHoechst to phenylHoechst. The chemical structures of *meta*-iodoHoechst, the carbon-centred radical, and phenylHoechst that are formed from the process of photodehalogenation can be seen. The docked ligands in the minor groove of B-DNA are shown (PDB ID: 1DNH) and the distances of the carbon-centred radical from the deoxyribose carbon (C1', C4', and C5') are provided.



**Transient carbon-centred radical
(DNA damage)**



phenylHoechst

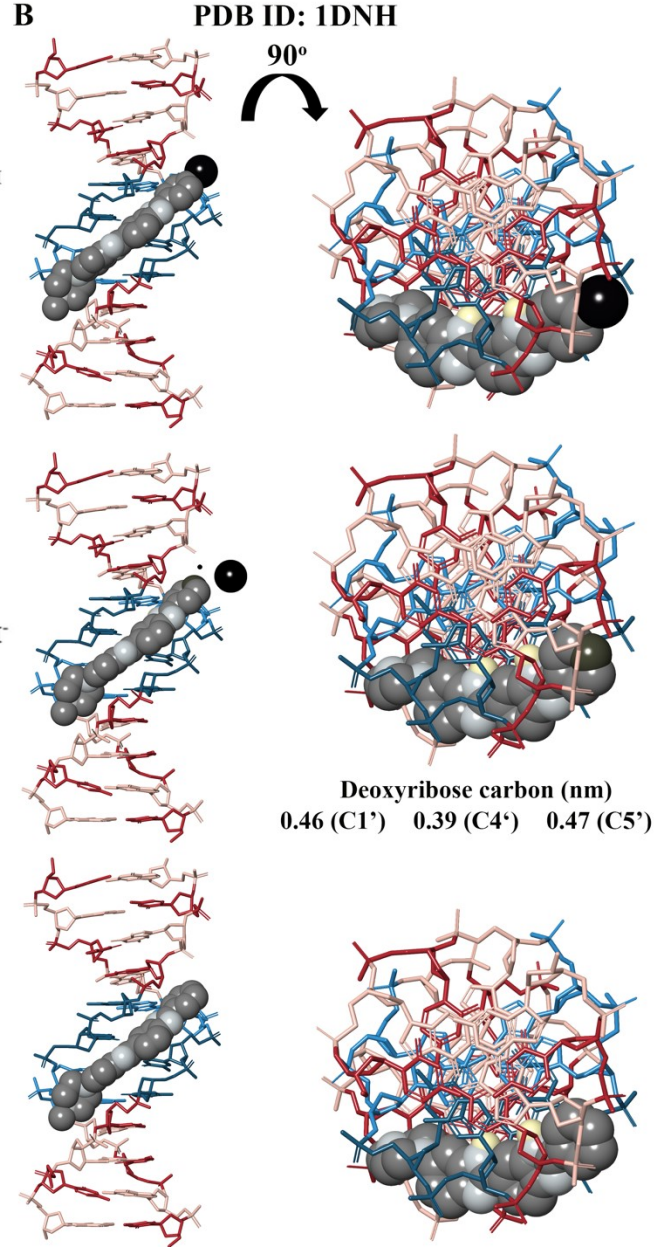
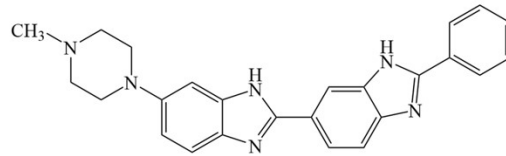


Figure S6: Photodehalogenation of *para*-iodoHoechst to phenylHoechst. Photodehalogenation of *para*-iodoHoechst. The chemical structures of *para*-iodoHoechst, the carbon-centred radical, and phenylHoechst that are formed from the process of photodehalogenation can be seen. The docked ligands in the minor groove of B-DNA are shown (PDB ID: 1DNH) and the distances of the carbon-centred radical from the deoxyribose carbon (C1', C4', and C5') are provided

Table S1. Iterative docking results of *ortho*-iodoHoechst to the human nucleosome structure (PDB ID: 2CV5).

Ligand #	ΔG (kcal/mol)	Binding site	Chain I	Chain J	Histone proteins
1	-11.6	DNA	DA-110, DA-109, DC-108, DC-107, DT-106, DT-105, DT-104	DG-185, DG-186, DA- 187, DA-188, DA-189, DC-190	None
2	-11.7	DNA	DA-54, DA-55, DA- 56, DA-57, DG-58, DG-59	DT-237, DT-238, DT- 239, DG-240, DA-241	ARG-A:63
3	-11.5	DNA	DC-44, DT-45, DG- 46, DC-47, DT-48, DC-49	DG-246, DC-247, DA- 248, DG-249, DT-250, DT-251	ARG-H:28, THR-B:80, ARG-A:83, GLN-A:85
4	-11.2	DNA	DT-74, DT-75, DC- 76, DA-77, DG-78, DC-79	DT-216, DG-217, DA- 218, DA-219, DT-220, DT-221	None
5	-11.0	DNA	DA-27, DC-26, DC- 25, DA-24, DT-23,	DG-268, DT-269, DA- 270, DG-271, DA-272,	ARG-D:30, ARG-D:28

			DC-22	DA-273	
6	-13.1	DNA	DT-142, DA-141, DT-140, DA-139, DG-138, DG-137	DA-153, DT-154, DC- 155, DC-156, DA-157, DC-158	ARG-A:52, ARG-A:49, THR-A:45, TYR-A:41
7	-10.8	DNA	DA-99, DG-98, DG- 97, DT-96, DA-95, DG-94, DA-99	DA-197, DT-198, DC- 199, DA-200	ARG-F:19, ASP-E:81, LEU-E:82, ARG-E:83
8	-11.0	DNA	DA-19, DG-18, DA- 17, DC-16, DG-15, DT-14	DG-277, DC-278, DA- 279, DG-280, DG-281	PRO-C:80, ILE-C:79, ARG-C:77, SER-D:52, SER-D:53, LYS-D:54
9	-11.3	DNA	DC-60, DA-61, DT- 62, DG-63, DT-64	DA-231, DT-232, DG- 233, DC-235, DT-236	None
10	-11.7	DNA	DA-115, DC-114, DA-113, DT-112, DA-111	DG-179, DT-180, DA- 181, DT-182, DT-183, DT-184	None
11	-10.9	DNA	DA-127, DA-126, DG-125, DA-124, DT-123, DG-122	DC-168, DT-169, DA- 170, DC-171, DC-172, DA-173	ARG-H:28
12	-10.8	DNA	DA-133, DC-132, DG-131, DT-130	DG-161, DC-162, DA- 163, DG-164, DA-165, DT-166	ARG-G:77, ILE-G:79, SER-H:52
13	-12.0	DNA	DA-41, DG-40, DG- 39, DT-38, DT-37	DC-253, DC-254, DA- 255, DA-256, DA-257, DT-258	THR-D:87, THR-D:85, ARG-D:83, ARG-C:42
14	-10.6	DNA	DT-90, DT-91, DT- 92, DT-93, DG-94,	DA-200, DA-201, DA- 202, DA-203, DG-204,	None

			DA-95	DG-205	
15	-10.8	DNA	DA-83, DC-84, DA-85, DT-86, DG-87, DC-88, DC-89	DA-207, DT-208, DG-209, DT-210, DT-211	None
16	-10.6	DNA	DT-32, DG-33, DT-34, DA-35, DT-36, DT-37	DA-259, DC-260, DA-261, DC-262, DT-263	ARG-C:42
17	-10.9	DNA	DC-12, DA-11, DC-10, DC-9, DT-8	DG-283, DG-284, DA-285, DT-286, DA-287, DT-288	None
18	-10.6	DNA	DT-70, DG-71, DA-72, DA-73, DT-74	DG-224, DA-223, DC-222, DT-221, DT-220	None
19	-10.5	DNA	DC-50, DA-51, DT-52, DC-53	DG-240, DA-241, DT-242, DG-243, DG-244, DA-245, DG-246	None
20	-9.8	DNA	DG-63, DT-64, DT-65, DC-66	DG-227, DA-228, DA-229, DC-230	LYS-B:31, ARG-B:35, GLU-A:50, VAL-A:46
21	-10.5	Histone	None	None	TYR-H:80, HIS-H:79, ARG-H:76, SER-H:75, GLY-H:72, GLY-D:72, SER-D:75, ARG-D:76, HIS-D:79, GLU-H:68, GLY-G:37, ASN-G:38, TYR-G:39, TYR-C:39, ASN-C:38, GLY-C:37, GLU-D:68, PHE-D:67, ASN-D:64, MET-F:84, TYR-F:88
22	-10.0	DNA	DG-94, DT-93, DT-92, DT-91, DT-90,	DT-198, DC-199, DA-200, DA-201, DA-202,	GLN-E:68, LEU-E:65

			DC-89	DA-203	
23	-9.8	DNA	DA-28, DA-29, DA-30, DG-31, DT-32, DG-33, DT-34	DT-258, DA-259, DC-260, DA-261, DC-262, DT-263	ARG-C:35, ARG-C:17
24	-9.8	DNA	DT-74, DA-73, DA-72, DG-71, DT-70, DC-69	DG-217, DA-218, DA-219, DT-220, DT-221, DC-222, DA-223	ALA-E:114, LYS-E:115, LYS-A:115
25	-10.1	DNA	DG-81, DA-82, DA-83, DC-84, DT-6, DA-7	DT-208, DG-209, DT-210	TYR-E:41, HIS-E:39, LYS-F:31, PRO-F:32, ARG-F:35, GLU-E:50, VAL-E:46
26	-11.3	DNA	DC-101, DA-102, DG-103, DT-104	DT-191, DG-192, DC-193, DT-194, DC-195	LYS-D:27, SER-D:29, GLN-E:85
27	-10.8	Histone	None	None	ARG-F:40, GLU-E:97, ALA-E:98, TYR-E:99, VAL-E:101, GLY-E:102, GLU-E:105, ASP-E:106, GLY-A:132, ARG-A:131, ILE-A:130, VAL-C:107, GLY-C:106, GLY-C:105, ILE-C:102, THR-C:101, VAL-C:100, ARG-C:99, ARG-E:131, GLU-E:133, ARG-G:99, ARG-F:95, GLN-C:84, ARG-C:88
28	-9.8	DNA	DT-136, DG-135, DG-134, DA-133, DC-132, DG-131, DT-130	DC-156, DA-157, DC-158, DC-159, DT-160	LYS-G:74, LYS-G:75

29	-9.9	DNA	DA-19, DT-20, DT-21, DC-22, DT-23, DA-24	DT-269, DG-268, DG-267	LYS-D:40, TYR-D:39, VAL-D:36, SER-D:35, ILE-D:51, SER-D:52, SER-D:53, MET-D:56
30	-9.8	DNA/Histone	DA-83, DC-84, DT-92, DT-91	DC-206, DA-207, DT-208	LYS-E:64, ARG-E:63, ILE-E:62, LEU-E:61, LEU-E:60, GLU-E:59, TYR-E:54, ARG-E:53, GLU-E:50, ARG-F:36, ARG-F:35
31	-9.6	DNA	DT-117, DC-116, DA-115, DC-114, DA-113, DT-112	DA-174, DA-175, DA-176, DG-177, DT-178, DG-179, DT-180	ARG-G:35, ARG-G:17
32	-10.1	Histone	None	None	ALA-E:135, LEU-A:109, ASP-A:106, GLU-A:105, GLY-A:102, VAL-A:101, ALA-A:98, GLU-A:97, GLU-A:94, GLN-A:93, ARG-B:40, THR-A:58, LEU-A:60, VAL-G:107, GLY-G:106, GLY-G:105, GLN-G:104, ALA-G:103, ILE-G:102, THR-G:101, VAL-G:100, GLY-G:98, GLN-G:84, ARG-G:88, ASN-G:94, ARG-E:129, ILE-E:130, ARG-A:131
33	-9.6	DNA	DT-123, DA-124, DG-125, DA-126, DA-127	DT-169, DC-168, DT-167, DT-166, DA-165	SER-H:35, VAL-H:36, TYR-H:39
34	-9.7	DNA	None	DC-155, DC-156, DA-157, DC-158, DC-159, DT-160	LYS-G:74, ASN-G:73, SER-A:57, LYS-A:56, ARG-A:53, ARG-A:52

35	-9.6	DNA	DT-143, DG-144, DA-145, DT-146	DT-152, DA-151. DA- 150, DC-149, DT-148	ARG-A:40, HIS-A:39, PRO-A:38
36	-9.5	DNA	DC-13, DC-12, DA- 11, DC-10	DG-277, DC-278, DA- 279, DG-280, DG-281, DT-282, DG-283	LYS-C:75, LYS-C:74
37	-9.5	DNA	DT-106, DT-105, DT-104, DG-103, DA-102, DC-101, DG-100	DG-185, DG-186, DA- 187, DA-188, DA-189, DC-190, DT-191	ARG-H:83, LYS-F:77
38	-9.8	DNA/Histone	DC-101, DA-102	DA-187	HIS-F:75, ALA-F:76, LYS-F:77, ARG-F:78, ARG-H:83, LYS-H:82, ASN-H:81, TYR-H:80, LYS-D:31, MET-F:84, ALA-F:83, THR-F:82, GLN-E:85, SER-E:87, GLY-F:102, PHE-F:100
39	-9.5	DNA	DA-11, DC-10, DC- 9, DT-8, DA-7	None	ARG-E:49, LYS-C:75, LYS-C:74, ASN-C:73
40	-9.5	DNA/Histone	DG-40, DA-41, DA- 42, DA-43, DC-44	DT-250, DG-249, DA- 248	ALA-B:76, ARG-B:78, TYR-B:88, ASP-B:85, MET-B:84, TYR-D:80, ASN-D:81
41	-10.1	DNA	DT-38, DG-39, DG- 40	DC-254, DC-253, DT- 252, DT-251, DT-250	ARG-D:83, ASN-D:81, HIS-B:75, ALA-B:76, LYS-B:77
42	-9.4	DNA	DA-133, DG-134, DG-135, DT-136, DG-137, DG-138	DG-161, DT-160, DC- 159, DC-158, DA-157	None
43	-9.3	DNA	DT-48, DC-49, DC-	DG-243, DT-242, DA-	LEU-A:65

			50, DA-51, DT-52, DC-53, DA-54, DA- 55	241, DG-240, DT-239, DT-238, DT-237	
44	-9.3	DNA	DT-48, DC-49, DC- 50, DA-51, DT-52, DC-53, DA-54, DA- 55	DG-243, DT-242, DA- 241, DG-240, DT-239, DT-238, DT-237	LEU-A:65
45	-9.3	DNA/Histone	DG-58, DG-59, DC- 60, DA-61	DA-231, DT-232, DT- 238	ARG-A:53, TYR-A:54, PRO-B:32, ARG-B:36, GLU-A:59, LEU-A:60, ILE-A:62, ARG-A:63, LYS-A:64
46	-9.2	DNA/Histone	DT-38, DG-39	DT-250, DG-249	SER-D:84, LYS-D:82, ASN-D:81, LYS-H:31, ARG-H:30
47	-10.8	DNA/Histone	DT-93	DC-195, DC-196, DA- 197, DT-198	ARG-E:72, ARG-E:79, GLN-E:68, LEU-E:65, LEU-F:22, LYS-F:20, HIS-F:18, SER-E:86
48	-9.1	DNA/Histone	None	DA-261, DC-260, DA- 259	ARG-C:35, LYS-C:36, ASN-C:38, SER-C:40, GLU-C:41, GLU-G:41, SER-G:40, ASN-G:38, ARG-G:35
49	-9.5	Histone	None	None	ASN-D:64, ARG-C:32, LEU-C:33, LYS-C:36, GLY-C:37, ASN-C:38, GLU-G:41, HIS-H:79, TYR-H:80, LYS-H:82, ARG-H:83, SER-H:84
50	-9.1	Histone	DC-132	None	ALA-G:69, ASP-G:72, ASN-G:73, LYS-G:75, LEU-G:85, HIS-G:82, ARG-G:81, PRO-G:80, ILE-G:79, LYS-A:56, THR-A:58, GLU-A:59,

					LYS-H:54, GLN-G:104
51	-9.4	DNA	DA-41, DA-42, DA-43, DC-44, DT-45	DT-252, DT-251, DT-250	None
52	-9.4	DNA	DA-19, DT-20, DT-21	DT-274, DA-273, DA-272, DG-271, DA-270, DT-269	SER-D:33, SER-D:35, VAL-D:36
53	-9.0	DNA	DC-3, DA-4, DA-5, DT-6, DA-7, DT-8, DC-9	DA-287, DT-286, DA-285, DG-284, DG-283, DT-282	None
54	-9.1	Histone	None	None	GLU-E:105, ASN-C:110, LEU-C:108, VAL-C:107, ARG-C:88, ASN-C:94, LYS-C:95, LEU-C:97, GLY-C:98, ARG-C:99, ARG-A:134, GLU-A:133, GLY-A:132, ARG-A:131, GLN-B:93
55	-9.0	Histone	None	DA-279	GLN:C-104, ILE-C:79, ARG-C:81, HIS-C:82, LEU-C:85, GLU-E:59, THR-E:58, LYS-E:56, LYS-C:75, ASN-C:73, ASP-C:72, ALA-C:69, ASN-C:89
56	-9.6	Histone	None	None	ARG-H:76, LYS-F:91, ASP-D:65, GLU-D:68, ARG-D:69, THR-F:96, ARG-C:99, LEU-C:96, LYS-C:95, ARG-B:92, GLN-B:93, ASN-B:64, ARG-B:67, ASP-B:68, ARG-D:96, LEU-D:97, LEU-D:98, LEU-D:99, PRO-D:100

57	-9.1	DNA	DT-112, DA-113, DC-114, DA-115, DC-116, DT-117	DG-177	ARG-G:35
58	-9.7	DNA/Histone	DC-9	None	ARG-E:53, LYS-E:56, ASN-C:73, ASP-C:72
59	-9.0	DNA	DC-84, DA-85, DT- 86	DA-207, DC-206, DG- 205	ARG-E:53, GLU-E:59
60	-8.9	Histone	None	None	GLU-E:133, GLY-E:132, LYS- G:95, LEU-H:98, ARG-H:69, GLU- H:68, ARG-H:76, ARG-F:92, GLN- F:93, GLY-F:94, ASN-F:64, PHE- F:61, TYR-E:99
61	-9.2	DNA/Histone	None	DT-167, DT-166	SER-H:35, SER-H:33, LYS-H:31, GLY-B:101, MET-B:84, TYR- B:88, MET-H:56, ASN-H:60, SER- H:53, SER-H:52, ILE-H:51
62	-9.9	Histone	None	None	ALA-E:135, ARG-E:134, GLU- E:133, GLY-E:132, ARG-E:131, GLY-F:94, GLN-F:93, ASN-G:94, LYS-G:95, GLY-G:98, ARG-G:99, GLY-B:94, ARG-B:92, LYS-B:91
63	-9.2	Histone	None	None	LYS-G:95, ASN-G:94, GLU-G:91, ARG-G:88, GLU-E:133, ARG- E:134, ALA-E:135, GLN-G:84, VAL-G:107, LEU-G:108, ASN- G:110, GLU-A:105

64	-8.9	DNA	DA-110, DA-111, DT-112, DA-113	DT-180, DA-181, DT- 182	VAL-G:43, GLY-G:44, ALA-G:45, ARG-G:17, HIS-G:31, TYR-H:118
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Movie S1: 1 μ s trajectory of ligand free DNA dodecamer

Movie S2: 1 μ s trajectory of DNA dodecamer bound with Hoechst 33258

Movie S3: 1 μ s trajectory of DNA dodecamer bound with *ortho*-iodoHoechst

Movie S4: 1 μ s trajectory of DNA dodecamer bound with *meta*-iodoHoechst

Movie S5: 1 μ s trajectory of DNA dodecamer bound with *para*-iodoHoechst

Movie S6: 1 μ s trajectory of DNA dodecamer bound with phenylHoechst