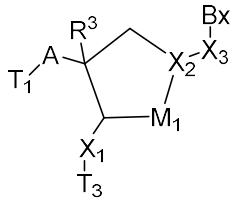
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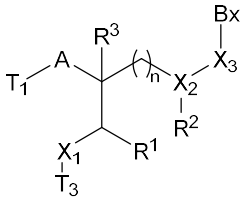
1. An oligonucleotide,

(1) comprising a 5'-terminal nucleotide represented by formula (V) or a stereoisomer thereof,



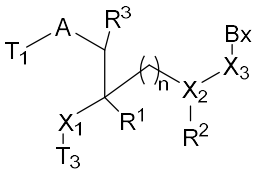
formula (V),

(2) comprising a 5'-terminal nucleotide represented by formula (VI) or a stereoisomer thereof,



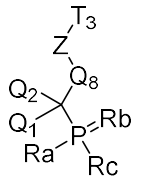
formula (VI),

(3) comprising a 5'-terminal nucleotide represented by formula (VII) or a stereoisomer thereof,



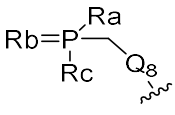
formula (VII),

(4) comprising a 5'-terminal nucleotide represented by formula (VIII) or a stereoisomer thereof,



formula (VIII),

(5) having a compound fragment of the following formula (Z) at a 5'-terminal nucleotide:



formula (Z)

wherein in formula (V), formula (VI), or formula (VII):

each T_1 is independently an optionally protected phosphine moiety;

each T_3 is independently an internucleoside linking group that links a 5'-terminal nucleotide to the oligonucleotide;

each X_1 is independently a chemical bond, O, S, NJ_1, or CJ_1J_2, wherein J_1 and J_2 are each independently hydrogen, halogen, sulfonyl, sulfinyl, optionally substituted C_1-C_6 alkyl, optionally substituted C_3-C_6 cycloalkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, optionally substituted C_5-C_{12} aryl, optionally substituted 5- to 12-membered heteroaryl, or optionally substituted 5- to 12-membered heterocycle;

each X_2 is independently CR^{15} or N;

each X_3 is independently a chemical bond, optionally substituted C_1-C_3 alkylene, SO, SO_2, C(=O), or

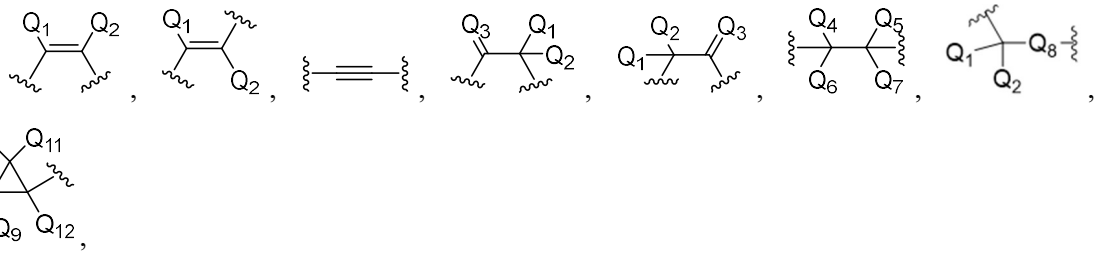
P(=O)R; R is OH, SH, C_1-C_6 alkyl, NH_2, or $NHSO_2CH_3$;

each Bx is independently a heterocyclic base moiety;

each R^1 and each R^2 are each independently H, halogen, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, or acetyl;

each R^3 and each R^{15} are each independently H, halogen, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, optionally substituted C_2-C_6 alkenyl, or optionally substituted C_2-C_6 alkynyl;

each A independently has one of the following formulas:



, and

,

Q_1 and Q_2 are each independently H, halogen, -CN, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, or NR^4R^5;

each Q_3 is independently O, S, NR^6, or CR^7R^8;

each Q_4, each Q_5, each Q_6, each Q_7, each Q_9, each Q_{10}, each Q_{11}, and each Q_{12} are each independently H, halogen, optionally protected hydroxyl, acetoxy, azido, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, or NR^9R^{10};

each Q_8 is independently O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11};

each R^{16} and each R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$;

each R^4, each R^5, each R^6, each R^7, each R^8, each R^9, each R^{10}, each R^{11}, each R^{18}, and each R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$;

M_1 is C(Rd)(Re) or C(Rd)(Re)C(Rf)(Rg), wherein each Rd, each Re, each Rg, and each Rf are each independently selected from the following substituent groups: hydrogen, halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, $O(CH_2)_2$-OCH_3, NJ_5, CN, $OC(=O)J_5$, $OC(=O)N(J_5)(J_6)$, and $C(=O)N((J_5)(J_6)$;

each J_3, each J_4, each J_5, and each J_6 are independently H or C_1-C_6 alkyl;

n is 0, 1, or 2;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

wherein in formula (VIII):

wherein Q_8 is S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$;

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected

sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, protected or optionally substituted amino, and a natural or modified nucleoside, and R_b is O or S or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

Q_1 and Q_2 are each independently H, halogen, -CN, or optionally substituted C_1-C_6 alkyl;

a substituent in the substituted amino is selected from optionally substituted C_1-C_6 alkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, and acetyl;

R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, or sulfo;

Z is a nucleoside comprising a sugar or sugar surrogate moiety;

T_3 is an internucleoside linking group that links the 5'-terminal nucleotide of formula (VIII) or the stereoisomer thereof to the oligonucleotide;

each substituted group comprises one or more substituent groups optionally and independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

wherein in formula (Z):

Q_8 is S, SO, SO_2, $PR^{16}R^{17}$, or NR_{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$; Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, protected or optionally substituted amino, and a natural or modified nucleoside, and R_b is O or S or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

a substituent in the substituted amino is selected from optionally substituted C_1-C_6 alkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, and acetyl;

R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, or sulfo;

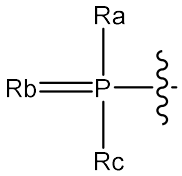
each substituted group comprises one or more substituent groups optionally and independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

"" refers to the linkage to the remainder of the 5'-terminal nucleotide.

2. The oligonucleotide according to claim 1, wherein the oligonucleotide satisfies any one of the following conditions:

(1) each formula (V), formula (VI), or formula (VII) satisfies any one of the following conditions:

(1-1) T_1 is an optionally protected phosphine moiety having the following formula:



wherein:

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or

protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

a substituent in the substituted amino is selected from optionally substituted C_1-C_6 alkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, and acetyl;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(1-2) T_3 is an internucleoside linking group selected from a phosphorus-containing linking group and a phosphorus-free linking group;

(1-3) the B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base;

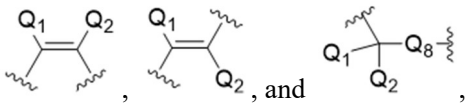
(1-4) R^{15} and R^3 are both H;

(1-5) X_1 is O;

(1-6) each R^1 and each R^2 are each independently H, methanesulfonyl, or acetyl;

(1-7) each X_2 is independently N, and each R^1 and each R^2 are each independently H, methanesulfonyl, or acetyl;

(1-8) A in formula (V), (VI), or (VII) has one of the following formulas:



, , and ,

wherein Q_1 and Q_2 are each independently H, halogen, -CN, or optionally substituted C_1-C_6 alkyl;

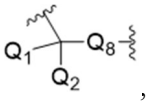
Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$;

R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$;

J_3 and J_4 are independently H or C_1-C_6 alkyl;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(1-9) Q_1 and Q_2 are each independently H, F, -CN, or methyl;

(1-10) when M_1 is C(Rd)(Re), X_2 is C, X_3 is a chemical bond, and A is 

, Q_8 is S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11};

(1-11) Q_8 is S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11};

(1-12) X_2 is N, and X_3 is a chemical bond, $-CH_2-$, $-CH_2CH_2-$, SO, or SO_2;

(1-13) X_2 is C, and X_3 is a chemical bond

(1-14) n is 0 or 1;

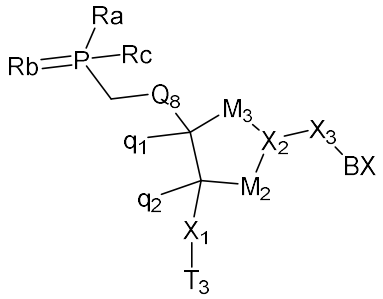
(2) formula (VIII) satisfies any one of the following conditions:

(2-1) Q_8 is S, SO, or SO_2;

(2-2) in the nucleoside comprising a sugar or sugar surrogate moiety, the sugar or sugar surrogate

moiety includes a 5-membered furanose ring, a non-furanose ring, or a 5- to 6-membered carbocyclic system, or an open system; preferably, the sugar or sugar surrogate moiety is selected from morpholinyl, cyclohexenyl, cyclohexyl, cyclopentyl, pyranyl, cyclohexanehexol group, furanose, unlocked nucleobase analog (UNA), glycerol nucleobase analog (GNA), locked nucleic acid (LNA), and bridged nucleic acid (BNA);

(2-3) formula (VIII) comprises a 5'-terminal nucleotide represented by formula (VIII-1) or a stereoisomer thereof:



formula (VIII-1);

(2-4) R_b is oxygen;

(2-5) Q_8 is SO or SO_2, and Ra and Rc are each independently selected from OH, SH, NH_2, and $NHSO_2CH_3$;

(2-6) Q_8 is S, SO, or SO_2, R_b is oxygen, and Ra and Rc are each independently selected from OH;

(2-7) X_1 is oxygen;

(2-8) the internucleoside linking group is independently an alkylphosphonate linking group, a phosphodiester internucleoside linking group, or a phosphorothioate nucleoside linking group;

(3) in formula (Z), the internucleoside linking group is independently an alkylphosphonate linking group, a phosphodiester internucleoside linking group, or a phosphorothioate nucleoside linking group.

3. The oligonucleotide according to claim 2, wherein the oligonucleotide satisfies any one of the following conditions:

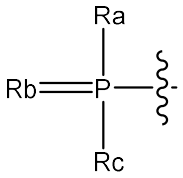
(1) each formula (V), formula (VI), or formula (VII) satisfies any one of the following conditions:

(1-1) the protecting group for hydroxyl or sulfhydryl is independently selected from methyl, ethyl, benzyl (Bn), phenyl, isopropyl, tert-butyl, acetyl, chloroacetyl, trichloroacetyl, trifluoroacetyl, pivaloyl, tert-butoxymethyl, methoxymethyl, 1-ethoxyethyl, 1-(2-chloroethoxy)ethyl, 2-trimethylsilylethyl, allyl, cyclohexyl (cHex), 9-fluorenylmethoxycarbonyl, methanesulfonyl, p-toluenesulfonyl, trifluoromethanesulfonyl, benzoyl, benzoylformate, p-phenylbenzoyl, 4-methoxybenzyl, monomethoxytrityl, dimethoxytrityl, trimethoxytrityl, 4-chlorobenzyl, 4-nitrobenzyl, 2,4-dinitrophenyl, 4-acyloxybenzyl, 2-methylphenyl, 2,6-dimethylphenyl, 2-chlorophenyl, 2,6-dichlorobenzyl, diphenylmethyl, triphenylmethyl, 4-methylthio-1-butyl, 2-(S-acetylthio)ethyl (SATE), 2-cyanoethyl, 2-cyano-1,1-dimethylethyl (CDM), 4-cyano-2-butenyl, 2-(trimethylsilyl)ethyl (TSE), 2-(phenylthio)ethyl, 2-(triphenylsilyl)ethyl, 2-(benzylsulfonyl)ethyl, 2,2,2-trichloroethyl, 2,2,2-tribromoethyl, 2,3-dibromopropyl, 2,2,2-trifluoroethyl, phenylthio, 2-chloro-4-tritylphenyl, 2-bromophenyl, 2-[N-isopropyl-N-(4-methoxybenzoyl)amino]ethyl, 4-(N-trifluoroacetylamino)butyl, 4-oxopentyl, 4-tritylaminophenyl, 4-

benzylaminophenyl, tetrahydropyranyl, morpholino, trimethylsilyl, triethylsilyl, tert-butyldimethylsilyl, tert-butyldiphenylsilyl, triphenylsilyl, triisopropylsilyl, pivaloyloxymethyl (POM), and 9-phenylxanthine-9-yl;

the amino-protecting group is independently selected from 2-(trimethylsilyl)ethoxycarbonyl (Teoc), 1-methyl-1-(4-biphenyl)ethoxycarbonyl (Bpoc), tert-butoxycarbonyl (BOC), allyloxycarbonyl (Alloc), 9-fluorenylmethoxycarbonyl (Fmoc), benzyloxycarbonyl (Cbz), benzyl, formyl, acetyl, pivaloyl, trihaloacetyl, benzoyl, nitrophenyl, acetyl, 2-nitrobenzenesulfonyl, phthalimido (Pht), p-toluenesulfonyl (Tos), trityl (Trt), 2,4-dimethoxybenzyl (PMB), and dithiosuccinyl;

(1-2) T_1 is an optionally protected phosphine moiety having the following formula:



wherein R_b is O or S, and Ra and Rc are each independently selected from protected hydroxyl, C_1-C_6 alkyl, and C_1-C_6 alkoxy;

(1-3) the phosphorus-containing internucleoside linking group is independently a phosphodiester linking group, a phosphotriester linking group, a phosphorothioate linking group, a phosphorodithioate linking group, an alkylphosphonate linking group, an aminophosphonate linking group, a phosphonate linking group, a phosphinate linking group, a phosphoramidothioate linking group, or a phosphoramidate linking group;

(1-4) the internucleoside linking group is independently an alkylphosphonate linking group, a phosphodiester internucleoside linking group, or a phosphorothioate internucleoside linking group;

(1-5) the B_X heterocyclic base moiety is selected from pyrimidine, substituted pyrimidine, pseudouracil, substituted pseudouracil, purine, hypoxanthine, and substituted purine;

or, the B_X heterocyclic base moiety is selected from 2-thiouracil, 5-fluorouracil, dihydrouridine (D), 7-methylguanosine (m7G), uracil, 5-thiazolouracil, thymine, cytosine, pseudouracil, N1-methyl-pseudouracil, hypoxanthine, 5-methylcytosine, 5-methyluracil, 3-benzoyluracil, 2,6-diaminopurine, adenine, and guanine;

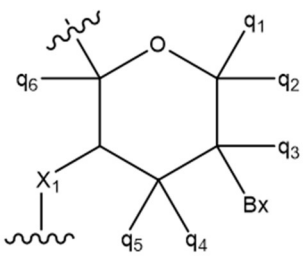
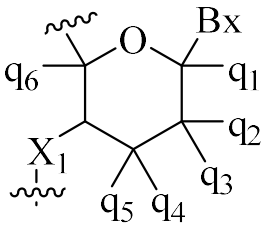
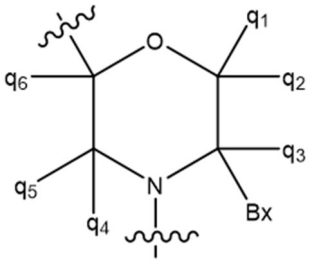
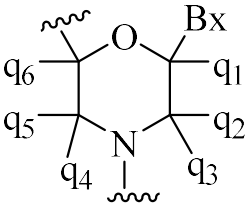
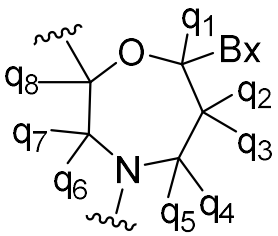
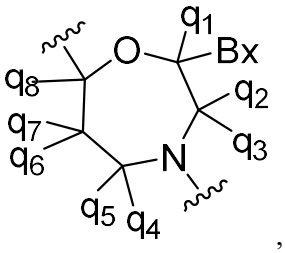
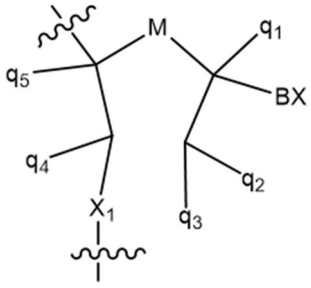
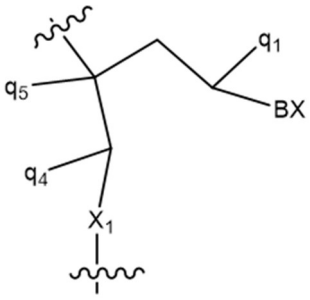
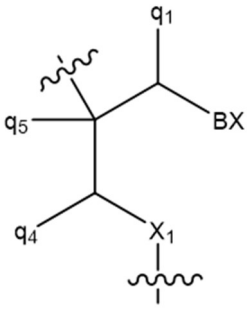
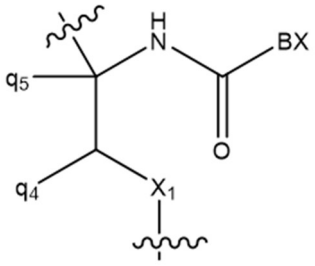
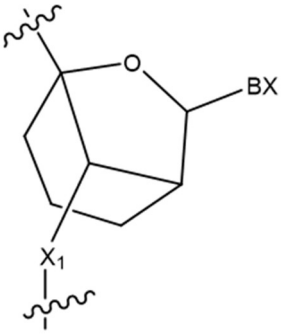
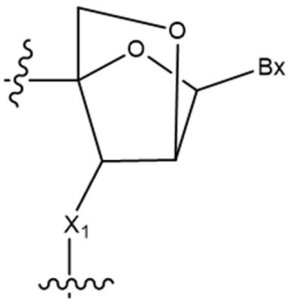
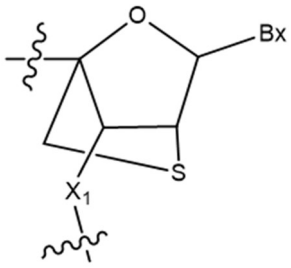
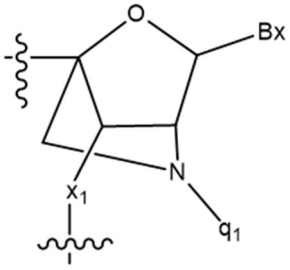
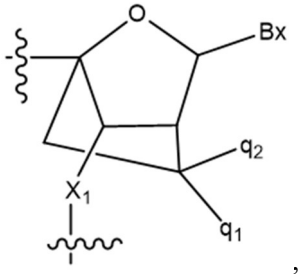
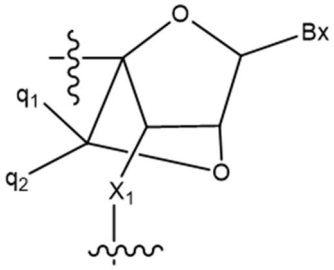
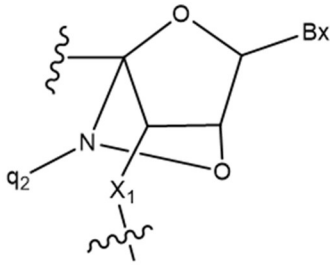
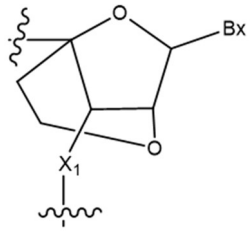
(1-6) Q_1 and Q_2 are each independently H;

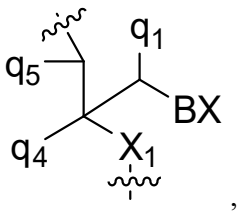
(2) formula (VIII) satisfies any one of the following conditions:

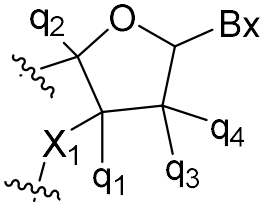
(2-1) Q_1 and Q_2 are each independently H;

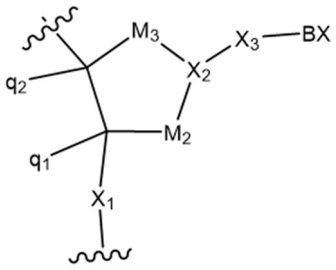
(2-2) Q_8 is bonded to the 4'-carbon or 5'-carbon of the sugar or sugar surrogate moiety;

(2-3) the nucleoside comprising a sugar or sugar surrogate moiety has the following structural schematics:


O
q1
q2
q3
Bx
q4
q5
q6
X1
,

O
Bx
q1
q2
q3
q4
q5
q6
X1
,

O
N
q1
q2
q3
q4
q5
q6
Bx
,

O
N
Bx
q1
q2
q3
q4
q5
q6
,

O
N
q1
Bx
q2
q3
q4
q5
q6
q7
q8
,

O
N
q1
Bx
q2
q3
q4
q5
q6
q7
q8
,

M
q1
BX
q2
q3
q4
q5
X1
,

q1
BX
q4
q5
X1
,

q1
BX
q4
q5
X1
,

H
N
BX
O
q4
q5
X1
,

O
BX
X1
,

O
O
Bx
X1
,

O
Bx
S
X1
,

O
Bx
N
X1
q1
,

O
Bx
q2
X1
q1
,

O
Bx
q1
q2
O
X1
,

O
Bx
N
q2
O
X1
,

O
Bx
O
X1
,





, and


,

wherein M_2 is $C(q_3)(q_4)$ or $C(q_3)(q_4)C(q_5)(q_6)$;

M_3 is O, S, NR^{13}, $C(q_7)(q_8)$, $C(q_7)(q_8)C(q_9)(q_{10})$, $C(q_7)=C(q_8)$, or $OC(q_7)(q_8)$;

each X_1 is independently a chemical bond, O, S, NJ_1, or CJ_1J_2, wherein J_1 and J_2 are each independently hydrogen, halogen, sulfonyl, sulfinyl, optionally substituted C_1-C_6 alkyl, optionally substituted C_3-C_6 cycloalkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, optionally substituted C_5-C_{12} aryl, optionally substituted 5- to 12-membered heteroaryl, or optionally substituted 5- to 12-membered heterocycle;

X_2 is CR^{15} or N;

X_3 is a chemical bond, optionally substituted C_1-C_3 alkylene, SO, SO_2, C(=O), or P(=O)R;

R is OH, SH, C_1-C_6 alkyl, NH_2, or $NHSO_2CH_3$;

Bx is a heterocyclic base moiety;

R^{15}, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, and q_{10} are each independently hydrogen, halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, $O(CH_2)_2$-OCH_3, CN, $OC(=O)J_5$, $OC(=O)N(J_5)(J_6)$, or $C(=O)N((J_5)(J_6)$, wherein J_5 and J_6 are independently H or C_1-C_6 alkyl;

R^{13} is hydrogen or C_1-C_6 alkyl;

(3) formula (VIII-1) satisfies any one of the following conditions:

(3-1) R^{15}, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, and q_{10} are each independently selected from hydrogen, fluorine, hydroxyl, methyl, methoxy, and $O(CH_2)_2$-OCH_3;

(3-2) M_3 is O, S, $C(q_7)(q_8)$, M_2 is $C(q_3)(q_4)$, X_2 is CR^{15} or N, and X_3 is a chemical bond, SO, or SO_2;

(3-3) M_3 is $C(q_7)(q_8)$, M_2 is $C(q_3)(q_4)C(q_5)(q_6)$, X_2 is CR^{15} or N, and X_3 is a chemical bond, SO, or SO_2;

(3-4) Q_8 is S, SO, or SO_2;

(3-5) R_b is oxygen;

(3-6) Q_8 is SO or SO_2, and Ra and Rc are each independently selected from OH, SH, NH_2, and $NHSO_2CH_3$;

(3-7) Q_8 is S, SO, or SO_2, R_b is oxygen, and Ra and Rc are each independently selected from OH;

(3-8) X_1 is oxygen;

(3-9) the B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base.

4. The oligonucleotide according to claim 3, wherein

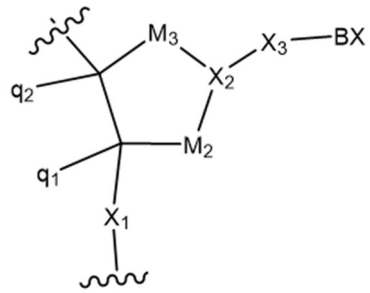
(1) the oligonucleotide satisfies any one of the following conditions:

(1-1) Ra and Rc are each OH, SH, OCH_3, OCH_2CH_3, $OCH(CH_3)_2$, $OCH_2OC(=O)C(CH_3)_3$, NH_2, OCH_2CH_2CN, or $NHSO_2CH_3$;

(1-2) Ra and Rc are each OH, and R_b is O;

(2) the sugar or sugar surrogate moiety satisfies any one of the following conditions:

(2-1) having the following structural schematic:



;

(2-2) R^{15}, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, and q_{10} are each independently selected from hydrogen, fluorine, hydroxyl, methyl, methoxy, and $O(CH_2)_2$-OCH_3;

(2-3) M_3 is O, S, $C(q_7)(q_8)$, M_2 is $C(q_3)(q_4)$, X_2 is CR^{15} or N, and X_3 is a chemical bond, SO, or SO_2;

(2-4) M_3 is $C(q_7)(q_8)$, M_2 is $C(q_3)(q_4)C(q_5)(q_6)$, X_2 is CR^{15} or N, and X_3 is a chemical bond, SO, or SO_2;

(2-5) Q_8 is S, SO, or SO_2;

(2-6) R_b is oxygen;

(2-7) Q_8 is SO or SO_2, and Ra and Rc are each independently selected from OH, SH, NH_2, and $NHSO_2CH_3$;

(2-8) Q_8 is S, SO, or SO_2, R_b is oxygen, and Ra and Rc are each independently selected from OH;

(2-9) X_1 is oxygen;

(2-10) in the nucleoside comprising a sugar or sugar surrogate moiety, B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base;

(3) the formula (VIII-1) satisfies any one of the following conditions:

(3-1) R^{15}, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, and q_{10} are each independently selected from hydrogen;

(3-2) M_3 is M_3 is O, S, CH_2, M_2 is CH_2, X_2 is CH, and X_3 is a chemical bond; or M_3 is CH_2, M_2 is CH_2, X_2 is N, and X_3 is a chemical bond, SO, or SO_2;

(3-3) M_3 is CH_2, M_2 is CH_2CH_2, X_2 is CH, and X_3 is a chemical bond; or M_3 is CH_2, M_2 is CH_2CH_2, X_2 is N, and X_3 is a chemical bond, SO, or SO_2;

(3-4) the B_X heterocyclic base moiety is pyrimidine, substituted pyrimidine, pseudouracil, substituted pseudouracil, purine, hypoxanthine, or substituted purine.

5. The oligonucleotide according to claim 4, wherein the oligonucleotide satisfies any one of the following conditions:

(1) the sugar or sugar surrogate moiety satisfies any one of the following conditions:

(1-1) M_3 is O, S, $C(q_7)(q_8)$, or $C(q_7)(q_8)C(q_9)(q_{10})$;

(1-2) R^{15}, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, and q_{10} are each independently selected from hydrogen;

(1-3) M_3 is M_3 is O, S, CH_2, M_2 is CH_2, X_2 is CH, and X_3 is a chemical bond;

(1-4) M_3 is CH_2, M_2 is CH_2, X_2 is N, and X_3 is a chemical bond, SO, or SO_2;

(1-5) M_3 is CH_2, M_2 is CH_2CH_2, X_2 is CH, and X_3 is a chemical bond;

(1-6) M_3 is CH_2, M_2 is CH_2CH_2, X_2 is N, and X_3 is a chemical bond, SO, or SO_2;

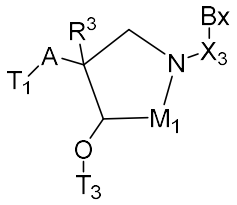
(1-7) in the nucleoside comprising a sugar or sugar surrogate moiety, the B_X heterocyclic base moiety is pyrimidine, substituted pyrimidine, pseudouracil, substituted pseudouracil, purine, hypoxanthine, or substituted purine;

or, the B_X heterocyclic base moiety is 2-thiouracil, 5-fluorouracil, dihydrouridine (D), 7-methylguanosine (m7G), uracil, 5-thiazolouracil, thymine, cytosine, pseudouracil, N1-methyl-pseudouracil, hypoxanthine, 5-methylcytosine, 5-methyluracil, 3-benzoyluracil, 2,6-diaminopurine, adenine, or guanine;

(2) in the formula (VIII-1), the B_X heterocyclic base moiety is 2-thiouracil, 5-fluorouracil, dihydrouridine (D), 7-methylguanosine (m7G), uracil, 5-thiazolouracil, thymine, cytosine, pseudouracil, N1-methyl-pseudouracil, hypoxanthine, 5-methylcytosine, 5-methyluracil, 3-benzoyluracil, 2,6-diaminopurine, adenine, or guanine.

6. The oligonucleotide according to claim 1, comprising

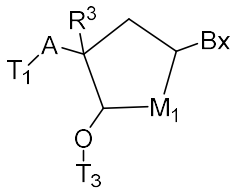
(1) a 5'-terminal nucleotide represented by formula (V-1) or a stereoisomer thereof:



formula (V-1)

X_3 is a chemical bond, C(=O), P(=O)R, SO, or SO_2; M_1 is C(Rd)(Re) or C(Rd)(Re)C(Rg)(Rf), wherein each Rd, each Re, each Rg, and each Rf are each independently selected from the following substituent groups: hydrogen, halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, $O(CH_2)_2$-OCH_3, NJ_5, CN, $OC(=O)J_5$, $OC(=O)N(J_5)(J_6)$, and $C(=O)N((J_5)(J_6)$, wherein J_5 and J_6 are independently H or C_1-C_6 alkyl; R is R is OH, SH, C_1-C_6 alkyl, NH_2, or $NHSO_2CH_3$;

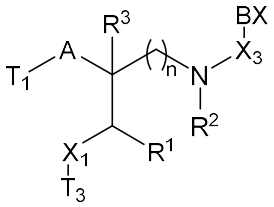
(2) a 5'-terminal nucleotide represented by formula (V-2) or a stereoisomer thereof:



formula (V-2)

M_1 is C(Rd)(Re) or C(Rd)(Re)C(Rg)(Rf), wherein each Rd, each Re, each Rg, and each Rf are each independently selected from the following substituent groups: hydrogen, halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, $O(CH_2)_2$-OCH_3, NJ_5, CN, $OC(=O)J_5$, $OC(=O)N(J_5)(J_6)$, and $C(=O)N((J_5)(J_6)$, wherein J_5 and J_6 are independently H or C_1-C_6 alkyl;

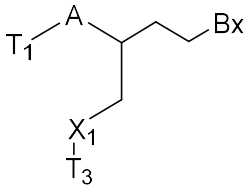
(3) a 5'-terminal nucleotide represented by formula (VI-1) or a stereoisomer thereof:



(VI-1)

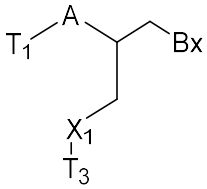
R^1 and R^2 are each independently H, methanesulfonyl, or acetyl;

(4) a 5'-terminal nucleotide represented by formula (VI-2) or a stereoisomer thereof:



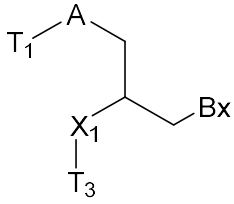
(VI-2);

(5) a 5'-terminal nucleotide represented by formula (VI-3) or a stereoisomer thereof:



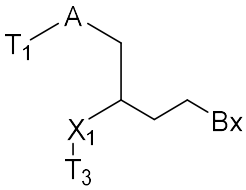
(VI-3);

(6) a 5'-terminal nucleotide represented by formula (VII-1) or a stereoisomer thereof:



formula (VII-1);

(7) a 5'-terminal nucleotide represented by formula (VII-2) or a stereoisomer thereof:



(VII-2).

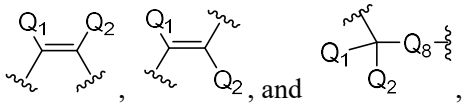
7. The oligonucleotide according to claim 5, wherein the oligonucleotide satisfies any one of the following conditions:

(1) formula (V-1) satisfies any one of the following conditions:

(1-1) X_3 is SO_2 or a chemical bond; R^3 is hydrogen;

(1-2) Rd, Re, Rg, and Rf are each independently selected from the following substituent groups: hydrogen, fluorine, hydroxyl, C_1-C_6 alkoxy, and $O(CH_2)_2$-OCH_3;

(1-3) A has one of the following formulas:



wherein Q_1 and Q_2 are each independently H, halogen, or optionally substituted C_1-C_6 alkyl;

Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$;

R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$; J_3 and J_4 are independently H or C_1-C_6 alkyl;

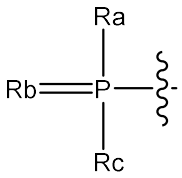
each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(1-4) each Q_1 and each Q_2 are each independently H, F, -CN, or methyl;

(1-5) Q_8 is independently NR^{11}, and R^{11} is independently methyl or methanesulfonyl;

(1-6) Q_8 is S or SO_2;

(1-7) T_1 is an optionally protected phosphine moiety having the following formula:



wherein:

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

(1-8) T_3 is an internucleoside linking group selected from an alkylphosphonate linking group, a phosphodiester internucleoside linking group, and a phosphorothioate internucleoside linking group;

(1-9) each B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base;

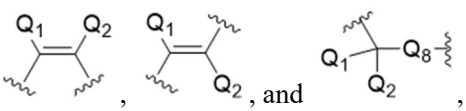
(2) formula (V-2) satisfies any one of the following conditions:

(2-1) each Rd, each Re, each Rg, and each Rf are each independently selected from the following substituent groups: hydrogen, fluorine, hydroxyl, C_1-C_6 alkoxy, and $O(CH_2)_2$-OCH_3;

(2-2) M_1 is CH_2 or CH_2CH_2;

(2-3) R^3 is hydrogen;

(2-4) A in formula (V-2) or the stereoisomer thereof has one of the following formulas:



Q_1 and Q_2 are each independently H, halogen, or optionally substituted C_1-C_6 alkyl; Q_8 is S, SO, SO_2 or NR^{11}, or $PR^{16}R^{17}$; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$;

R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$; J_3 and J_4 are independently H or C_1-C_6 alkyl;

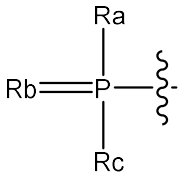
each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(2-5) each Q_1 and each Q_2 are each independently H, F, -CN, or methyl;

(2-6) Q_8 is independently NR^{11}, and R^{11} is independently methyl or methanesulfonyl;

(2-7) Q_8 is S or SO_2;

(2-8) T_1 is an optionally protected phosphine moiety having the following formula:



wherein:

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

(2-9) T_3 is an internucleoside linking group selected from an alkylphosphonate linking group, a phosphodiester internucleoside linking group, and a phosphorothioate internucleoside linking group;

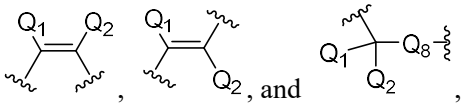
(2-10) each B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base;

(3) formula (VI-1) satisfies any one of the following conditions:

(3-1) n is 0 or 1;

(3-2) X_3 is CH_2 or CH_2CH_2; R^3 is H;

(3-3) A independently has one of the following formulas:



wherein Q_1 and Q_2 are each independently H, halogen, -CN, or optionally substituted C_1-C_6 alkyl; Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$; R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$; J_3 and J_4 are independently H or C_1-C_6 alkyl;

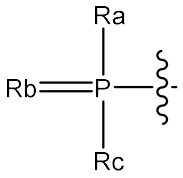
each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(3-4) each Q_1 and each Q_2 are each independently H, F, -CN, or methyl;

(3-5) Q_8 is independently NR^{11}, and R^{11} is independently methyl or methanesulfonyl;

(3-6) Q_8 is S or SO_2;

(3-7) T_1 is an optionally protected phosphine moiety having the following formula:



wherein:

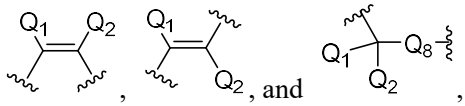
Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

(3-8) T_3 is an internucleoside linking group selected from an alkylphosphonate linking group, a phosphodiester internucleoside linking group, and a phosphorothioate internucleoside linking group;

(3-9) each B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base;

(4) each formula (VI-2), (VI-3), (VII-1), and (VII-2) satisfies any one of the following conditions:

(4-1) A independently has one of the following formulas:



, , and ,

wherein Q_1 and Q_2 are each independently H, halogen, -CN, or optionally substituted C_1-C_6 alkyl; Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$; R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$; J_3 and J_4 are independently H or C_1-C_6 alkyl;

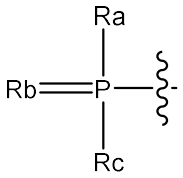
each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(4-2) each Q_1 and each Q_2 are each independently H, F, -CN, or methyl;

(4-3) Q_8 is independently NR^{11}, and R^{11} is independently methyl or methanesulfonyl;

(4-4) Q_8 is S or SO_2;

(4-5) T_1 is an optionally protected phosphine moiety having the following formula:



wherein:

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

(4-6) T_3 is an internucleoside linking group selected from an alkylphosphonate linking group, a phosphodiester internucleoside linking group, and a phosphorothioate internucleoside linking group;

(4-7) each B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base.

8. The oligonucleotide according to claim 7, wherein the oligonucleotide satisfies any one of the following conditions:

(1) formula (V-1) satisfies any one of the following conditions:

(1-1) Rd, Re, Rg, and Rf are hydrogen;

(1-2) Q_1 and each Q_2 are each independently H;

(1-3) in T_1, the substituted amino is selected from optionally substituted C_1-C_6 alkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, and acetyl;

(1-4) in T_1, R_b is O or S;

(1-5) in T_1, Ra and Rc are each OH, SH, NH_2, OCH_2CH_2CN, or $NHSO_2CH_3$;

(1-6) in T_1, Ra and Rc are each OH, and R_b is O;

(1-7) each B_X heterocyclic base moiety is independently pyrimidine, substituted pyrimidine, pseudouracil, substituted pseudouracil, purine, hypoxanthine, or substituted purine;

or, each BX heterocyclic base moiety is 2-thiouracil, 5-fluorouracil, dihydrouridine (D), 7-methylguanosine (m7G), uracil, 5-thiazolouracil, thymine, cytosine, pseudouracil, N1-methyl-pseudouracil, hypoxanthine, 5-methylcytosine, 5-methyluracil, 3-benzoyluracil, 2,6-diaminopurine, adenine, or guanine;

(2) each formula (V-2), formula (VI-1), formula (VI-2), formula (VI-3), formula (VII-1) and formula (VII-2) satisfies any one of the following conditions:

(2-1) Q_1 and each Q_2 are each independently H;

(2-2) in T_1, the substituted amino is selected from optionally substituted C_1-C_6 alkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, and acetyl;

(2-3) in T_1, R_b is O or S;

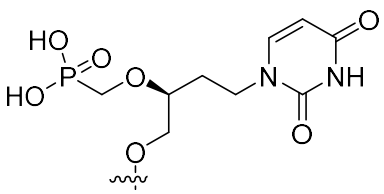
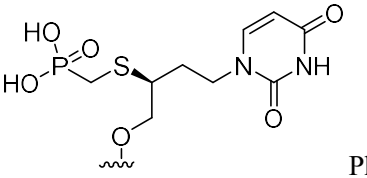
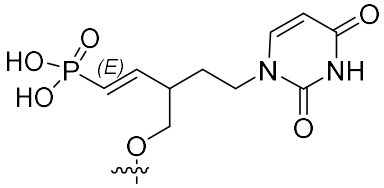
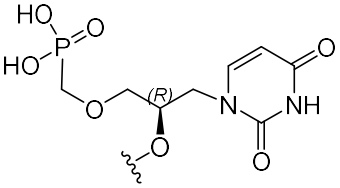
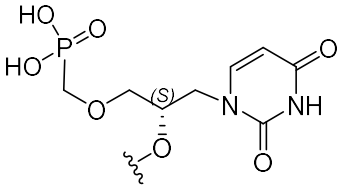
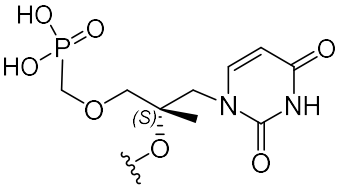
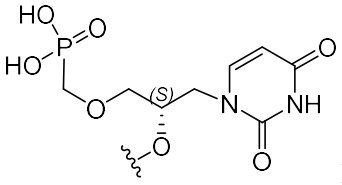
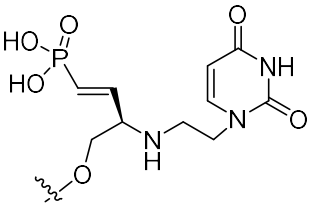
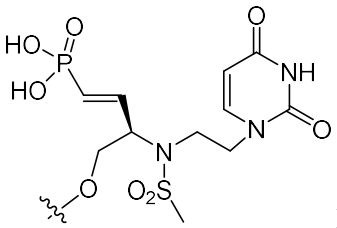
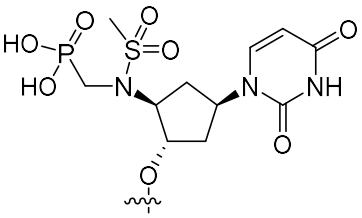
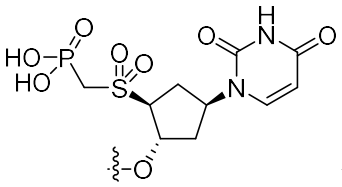
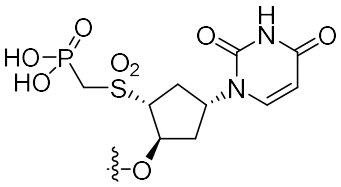
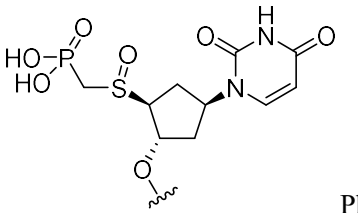
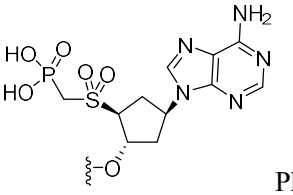
(2-4) in T_1, Ra and Rc are each OH, SH, NH_2, OCH_2CH_2CN, or $NHSO_2CH_3$;

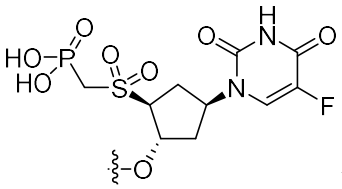
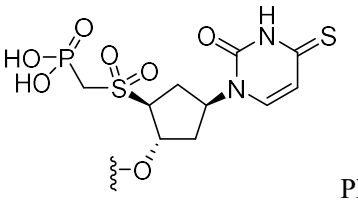
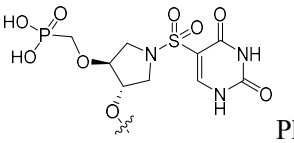
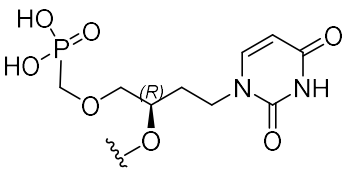
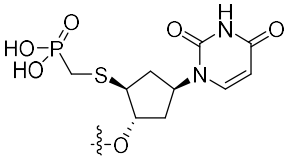
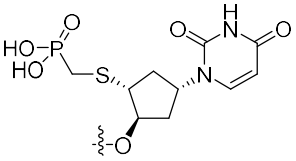
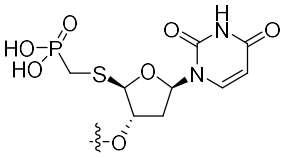
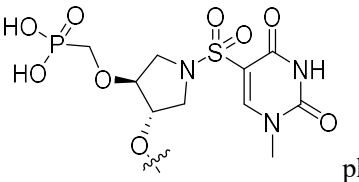
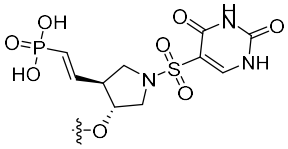
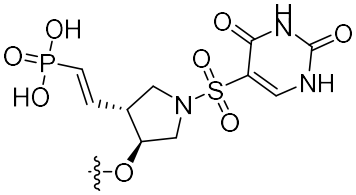
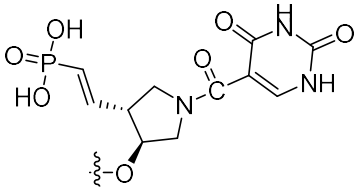
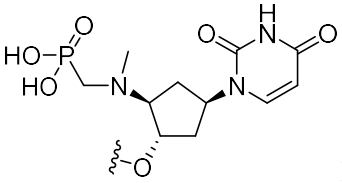
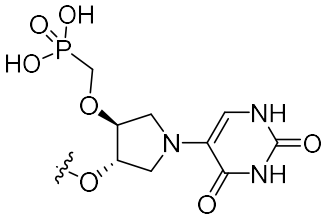
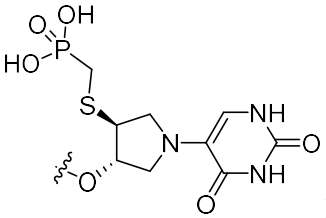
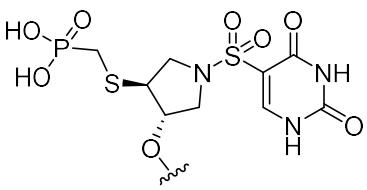
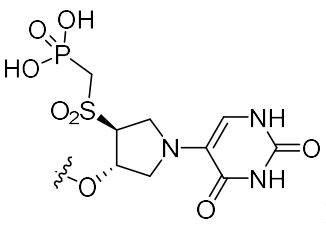
(2-5) in T_1, Ra and Rc are each OH, and R_b is O;

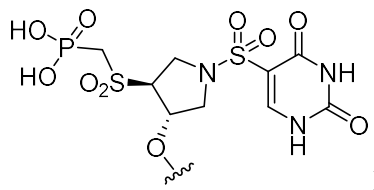
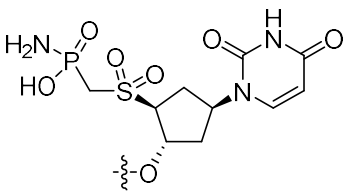
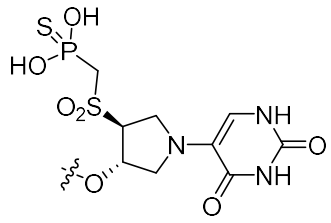
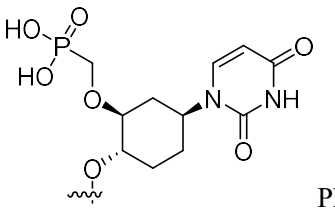
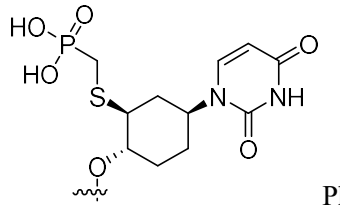
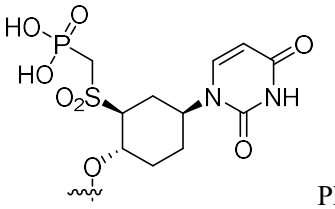
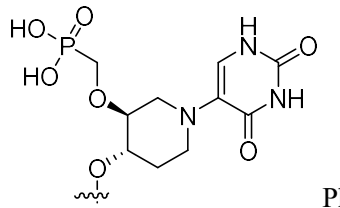
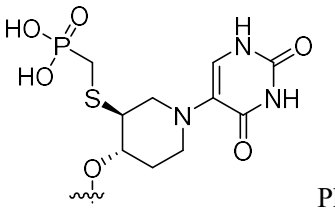
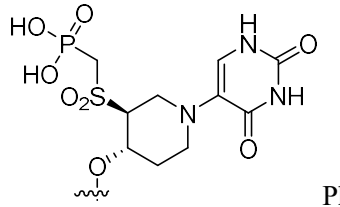
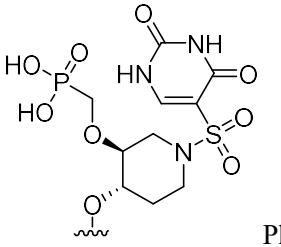
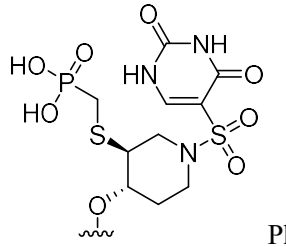
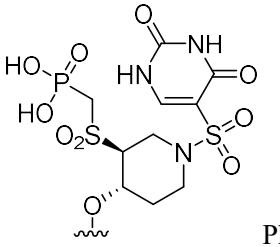
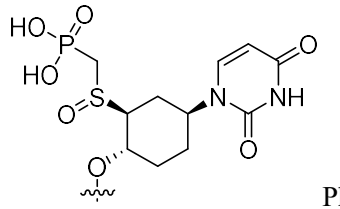
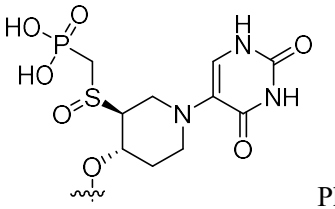
(2-6) each B_X heterocyclic base moiety is independently pyrimidine, substituted pyrimidine, pseudouracil, substituted pseudouracil, purine, hypoxanthine, or substituted purine;

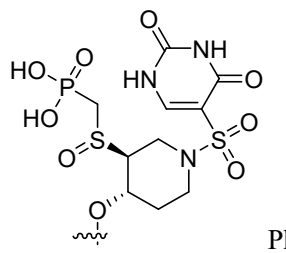
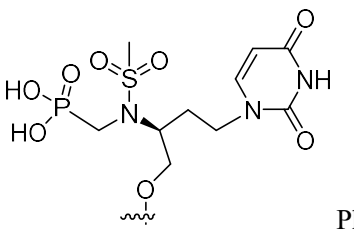
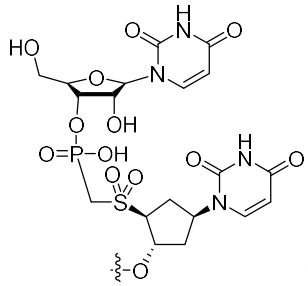
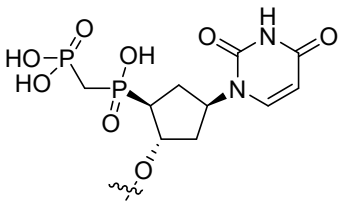
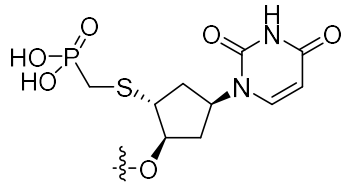
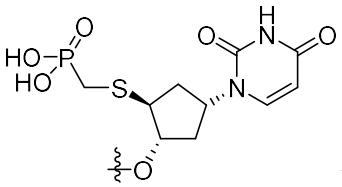
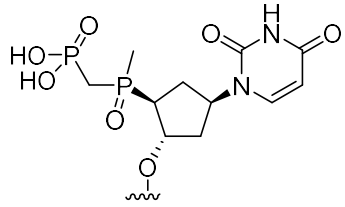
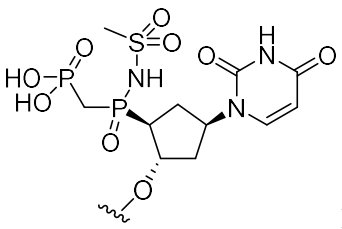
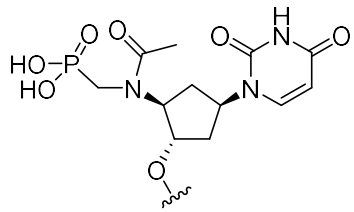
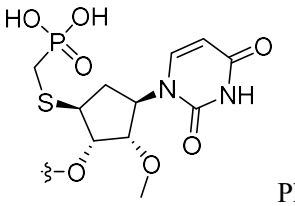
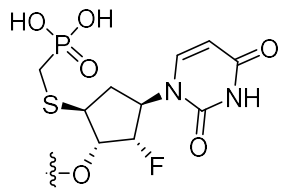
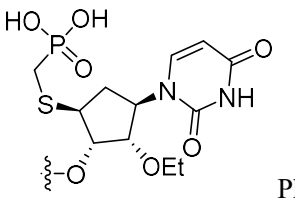
or, each BX heterocyclic base moiety is 2-thiouracil, 5-fluorouracil, dihydrouridine (D), 7-methylguanosine (m7G), uracil, 5-thiazolouracil, thymine, cytosine, pseudouracil, N1-methyl-pseudouracil, hypoxanthine, 5-methylcytosine, 5-methyluracil, 3-benzoyluracil, 2,6-diaminopurine, adenine, or guanine.

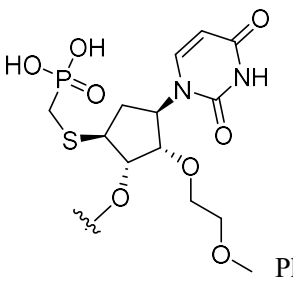
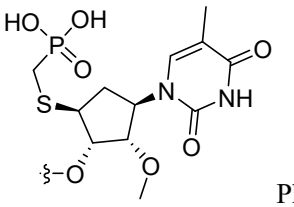
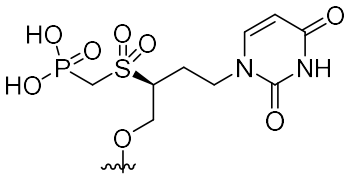
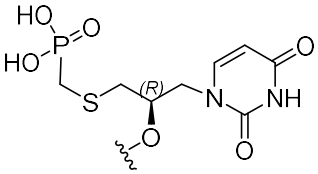
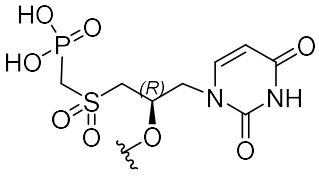
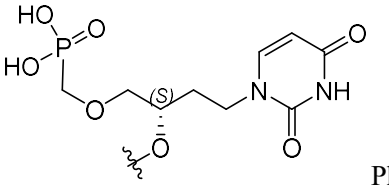
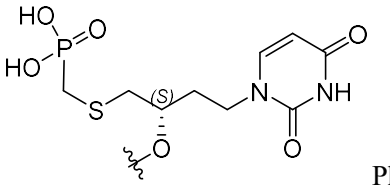
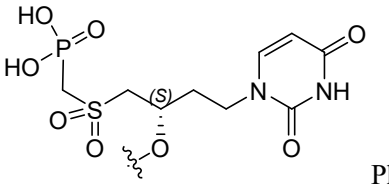
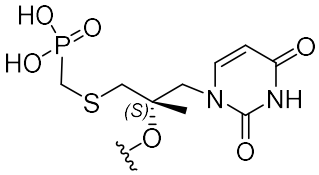
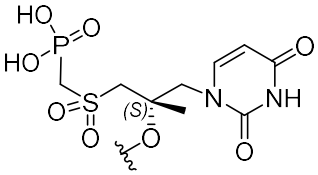
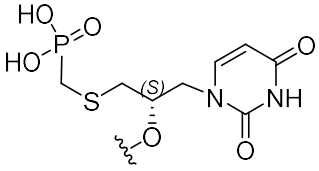
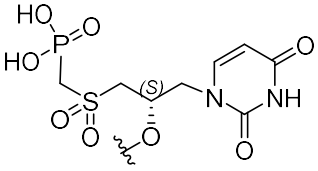
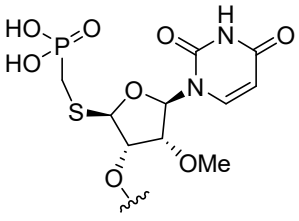
9. The oligonucleotide according to any one of claims 1-8, comprising a 5'-terminal nucleoside represented by one of the following specific structures or a stereoisomer thereof:

 Phos-01	 Phos-02
 Phos-03	 Phos-04
 Phos-05	 Phos-06
 Phos-07	 Phos-08
 Phos-09	 Phos-10
 Phos-11-1	 Phos-11-2
 Phos-11-4	 Phos-11-7

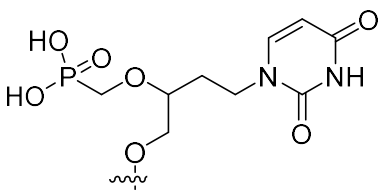
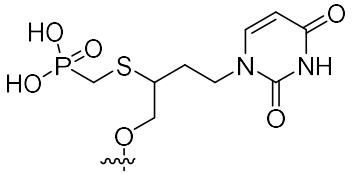
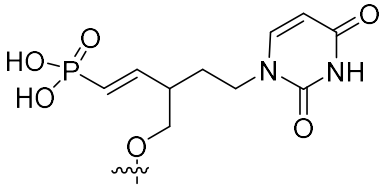
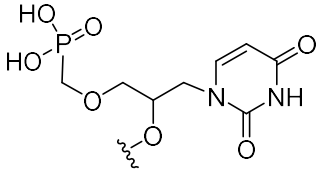
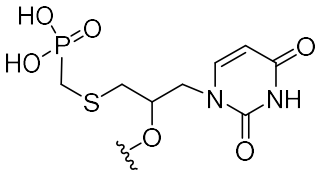
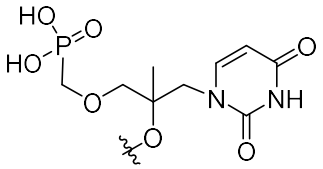
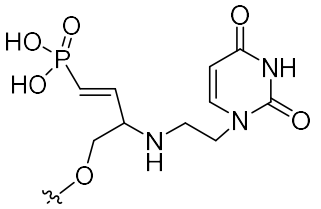
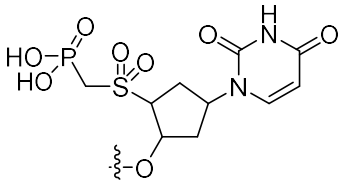
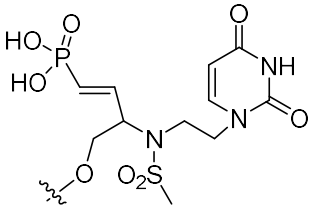
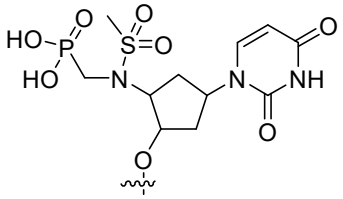
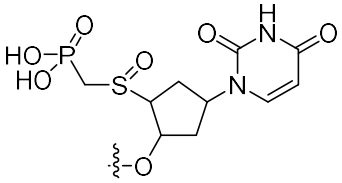
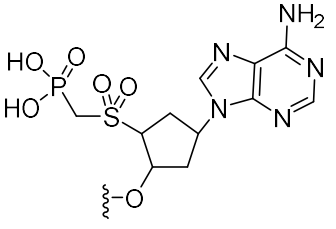
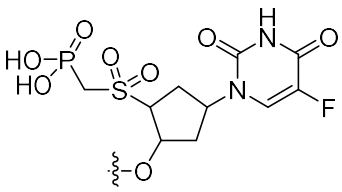
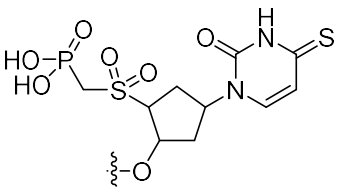
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 Phos-15-1	 Phos-15-2
 Phos-15-3	 phos-18
 Phos-19-1	 Phos-19-2
 Phos-19-5	 Phos-21
 Phos-22	 Phos-23
 Phos-26	 Phos-25

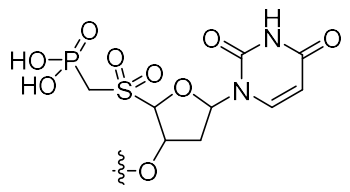
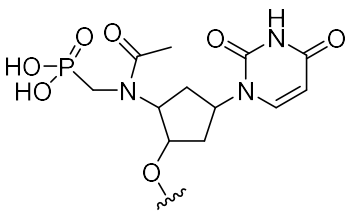
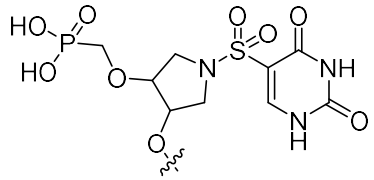
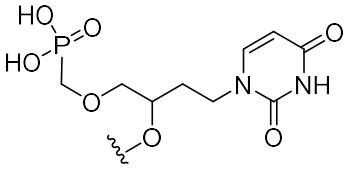
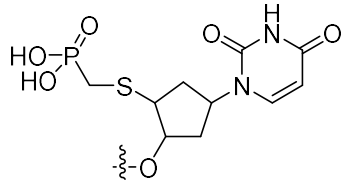
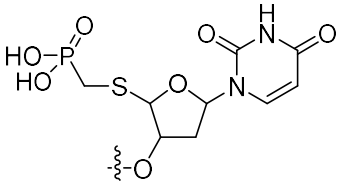
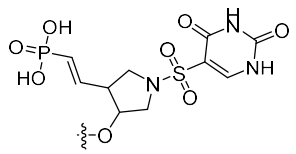
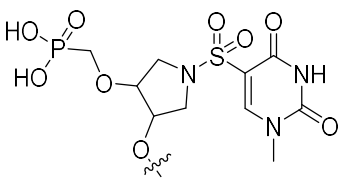
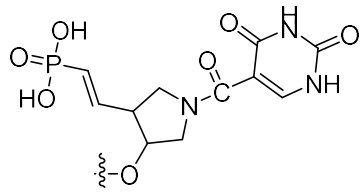
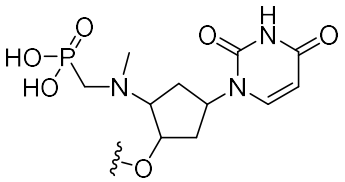
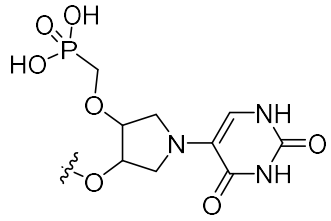
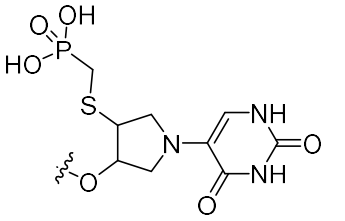
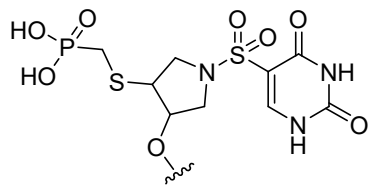
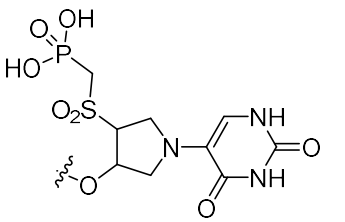
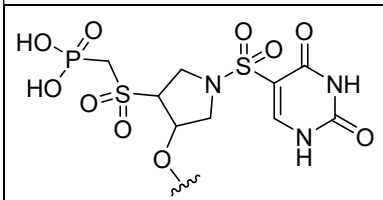
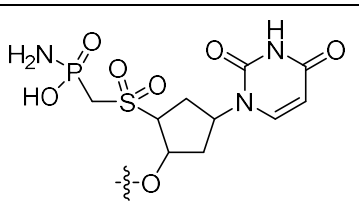
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 Phos-28	 Phos-29
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 Phos-34	 Phos-35
 Phos-36-1	 Phos-37
 Phos-38	 Phos-39

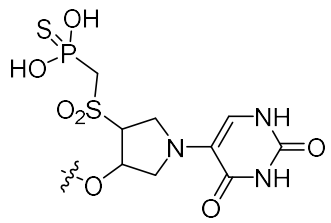
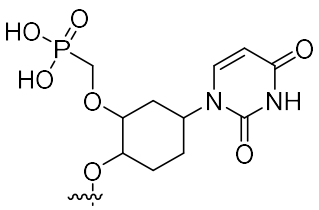
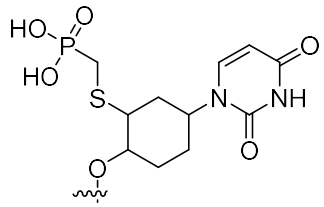
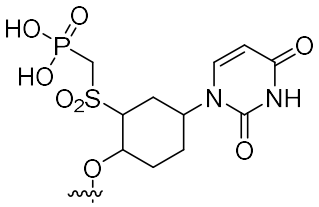
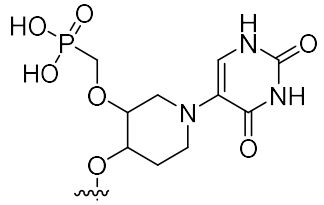
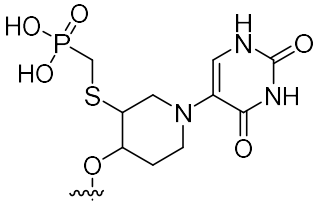
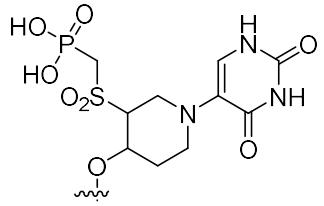
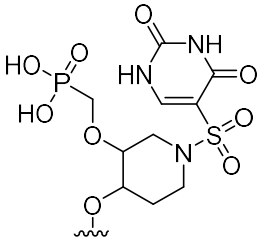
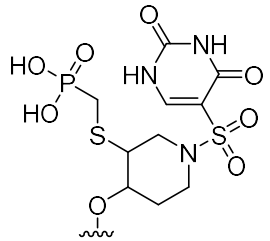
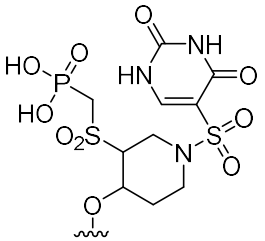
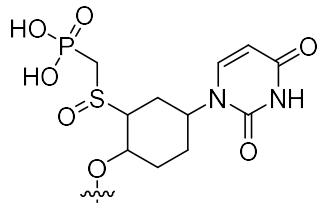
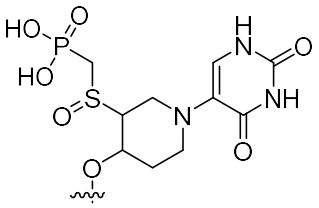
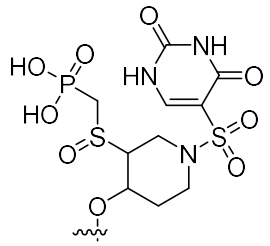
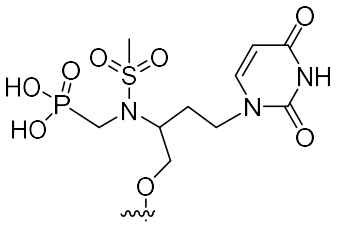
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 Phos-44	 Phos-45

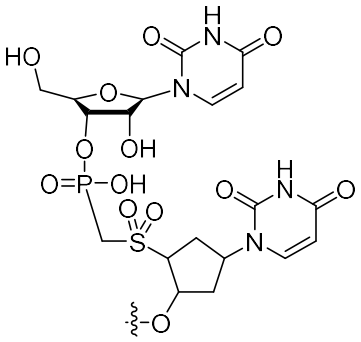
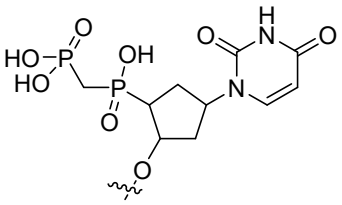
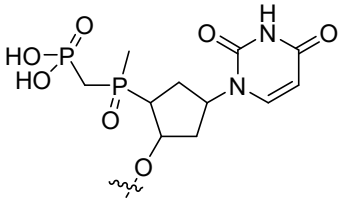
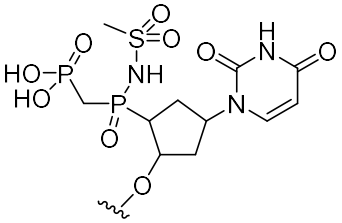
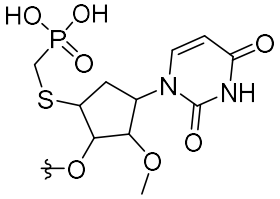
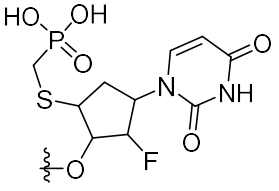
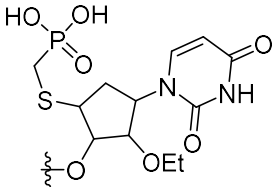
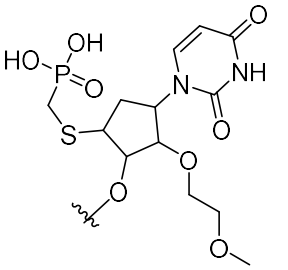
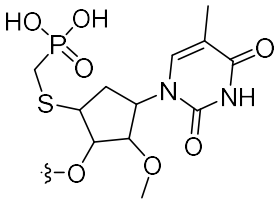
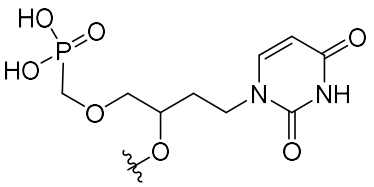
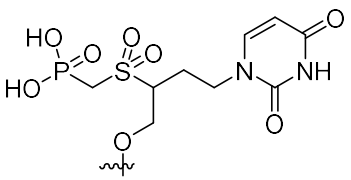
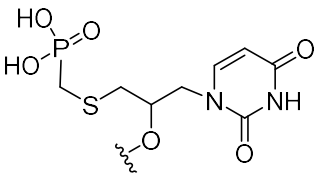
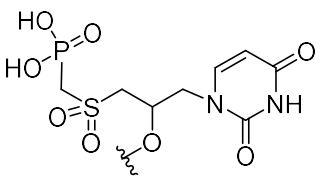
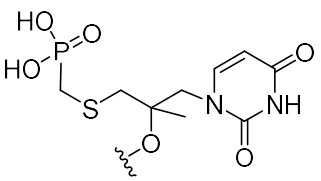
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 Phos-6-1	 Phos-6-2
 Phos-7-1	 Phos-7-2
 Phos-53	.

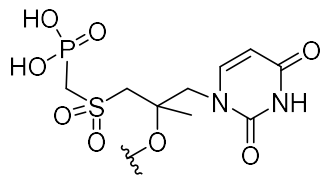
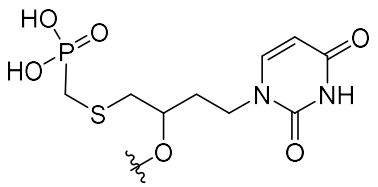
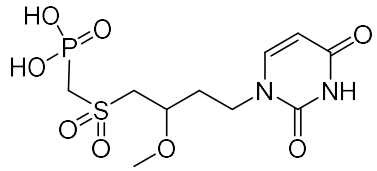
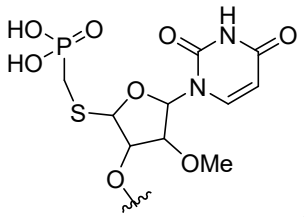
or

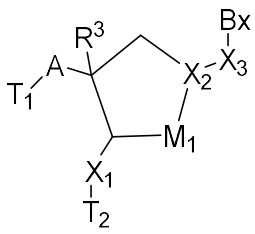
10. The oligonucleotide according to any one of claims 1-9, wherein the oligonucleotide is a double-stranded ribonucleic acid (dsRNA) agent comprising: a sense strand and an antisense strand, wherein the sense strand and the antisense strand are completely or partially complementary, and the antisense strand is partially or completely complementary to a nucleic acid target gene; at least one of the sense strand and the antisense strand is the oligonucleotide of the represented 5'-terminal nucleotide according to any one of claims 1-9; and the double-stranded ribonucleic acid (dsRNA) agent optionally further comprises an independent targeting group.

11. The oligonucleotide according to claim 10 wherein in the double-stranded ribonucleic acid (dsRNA) agent, the antisense strand comprises the oligonucleotide of the represented 5'-terminal nucleotide according to any one of claims 1-9.

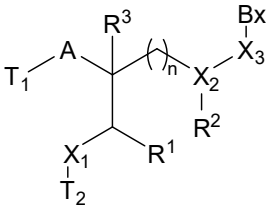
or, in the oligonucleotide or double-stranded ribonucleic acid (dsRNA), each strand comprises 8-40 nucleotides.

12. A medicament for inhibiting gene expression, comprising the oligonucleotide according to any one of claims 1-11.

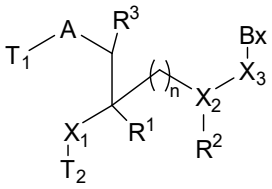
13. A compound represented by formula (I), formula (II), formula (III), or formula (IV), or stereoisomers thereof:



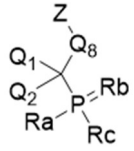
formula (I),



formula (II),



formula (III), or



formula (IV)

wherein in formula (I), formula (II), and formula (III):

each T_1 is independently an optionally protected phosphine moiety;

each T_2 is independently an active phosphorus group;

each X_1 is independently a chemical bond, O, S, NJ_1, or CJ_1J_2, wherein J_1 and J_2 are each independently hydrogen, halogen, sulfonyl, sulfinyl, optionally substituted C_1-C_6 alkyl, optionally substituted C_3-C_6 cycloalkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, optionally substituted C_5-C_{12} aryl, optionally substituted 5- to 12-membered heteroaryl, or optionally substituted 5- to 12-membered heterocycle;

each X_2 is independently CR^{15} or N;

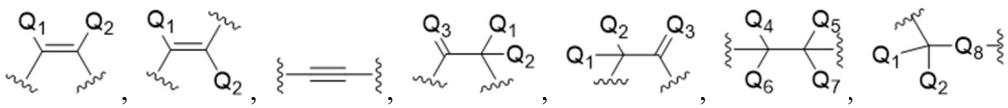
each X_3 is independently a chemical bond, optionally substituted C_1-C_3 alkylene, SO, SO_2, C(=O), or P(=O)R; R is OH, SH, C_1-C_6 alkyl, NH_2, or $NHSO_2CH_3$;

each Bx is independently a heterocyclic base moiety;

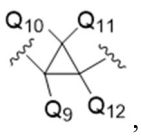
each R^1 and each R^2 are each independently H, halogen, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, or acetyl;

each R^3 and each R^{15} are each independently H, halogen, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, optionally substituted C_2-C_6 alkenyl, or optionally substituted C_2-C_6 alkynyl;

each A independently has one of the following formulas:



, and



,

wherein each Q_1 and each Q_2 are each independently H, halogen, -CN, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-

C_6 alkynyl, or NR^4R^5;

each Q_3 is independently O, S, NR^6, or CR^7R^8;

Q_4, Q_5, Q_6, Q_7, Q_9, Q_{10}, Q_{11}, and Q_{12} are each independently H, halogen, optionally protected hydroxyl, acetoxy, azido, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, or NR^9R^{10};

Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11};

R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$;

each R^4, each R^5, each R^6, each R^7, each R^8, each R^9, each R^{10}, each R^{11}, each R^{18}, and each R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$;

M_1 is C(Rd)(Re) or C(Rd)(Re)C(Rf)(Rg), wherein each Rd, each Re, each Rg, and each Rf are each independently selected from the following substituent groups: hydrogen, halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, $O(CH_2)_2$-OCH_3, NJ_5, CN, $OC(=O)J_5$, $OC(=O)N(J_5)(J_6)$, and $C(=O)N((J_5)(J_6)$;

each J_3, each J_4, each J_5, and each J_6 are independently H or C_1-C_6 alkyl;

each n is independently 0, 1, or 2;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

wherein in formula (IV):

Q_8 is S, SO, SO_2, $PR^{16}R^{17}$, or NR_{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$; Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, protected or optionally substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

a substituent in the substituted amino is selected from optionally substituted C_1-C_6 alkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, and acetyl;

Q_1 and Q_2 are each independently H, halogen, -CN, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, or NR^4R^5;

each R^4, each R^5, each R^{11}, each R^{18}, and each R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, or sulfo;

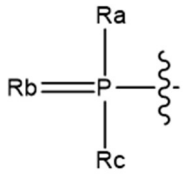
Z is a nucleoside comprising a phosphoramidite or a sugar or sugar surrogate moiety;

each substituted group comprises one or more substituent groups optionally and independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN.

14. The compound according to claim 13, wherein the compound satisfies any one of the following conditions:

(1) each formula (I), formula (II), and formula (III) satisfies any one of the following conditions:

(1-1) each T_1 is independently an optionally protected phosphine moiety having the following formula:

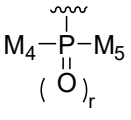


wherein:

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

a substituent in the substituted amino is selected from optionally substituted C_1-C_6 alkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, and acetyl;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(1-2) each T_2 is independently an active phosphorus group having the following structure: 

, wherein M_4 is H, optionally substituted C_1-C_6 alkyl, OH, OJ_7, SH, SJ_7, or NJ_7J_8, and M_5 is optionally substituted C_1-C_6 alkyl, OH, OJ_7, SH, SJ_7, or NJ_7J_8, wherein each J_7 or J_8 is independently and optionally substituted C_1-C_6 alkyl or sulfonyl; r is 0 or 1;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(1-3) each X_1 is independently O;

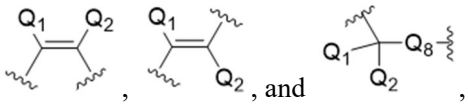
(1-4) each B_X heterocyclic base moiety is independently selected from a natural nucleobase, a modified nucleobase, and a universal base;

(1-5) each R^{15} and each R^3 are each independently H;

(1-6) each R^1 and each R^2 are each independently H, methanesulfonyl, or acetyl;

(1-7) each X_2 is independently N, and each R^1 and each R^2 are each independently H, methanesulfonyl, or acetyl;

(1-8) A has one of the following formulas:

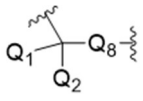


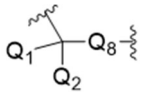
, , and ,

wherein Q_1 and Q_2 are each independently H, halogen, -CN, or optionally substituted C_1-C_6 alkyl; Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$; R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$; J_3 and J_4 are independently H or C_1-C_6 alkyl;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(1-9) each Q_1 and each Q_2 are each independently H, F, -CN, or methyl;

(1-10) a proviso is that when M_1 is C(Rd)(Re), X_2 is C, X_3 is a chemical bond, and A is , Q_8 is S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11};

(1-11) a proviso is that when M_1 is C(Rd)(Re), X_2 is C, X_3 is a chemical bond, and A is , Q_8 is S, SO, SO_2, or NR^{11};

(1-12) X_2 is N, and X_3 is a chemical bond, -CH_2-, -CH_2CH_2-, SO, or SO_2;

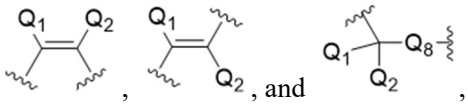
(1-13) X_2 is CH, and X_3 is a chemical bond;

(1-14) n is 0 or 1;

(1-15) R^3 is hydrogen;

(1-16) X_3 is SO_2 or a chemical bond;

(1-17) A has one of the following formulas:



wherein Q_1 and Q_2 are each independently H, halogen, or optionally substituted C_1-C_6 alkyl;

Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$; R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$; J_3 and J_4 are independently H or C_1-C_6 alkyl;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

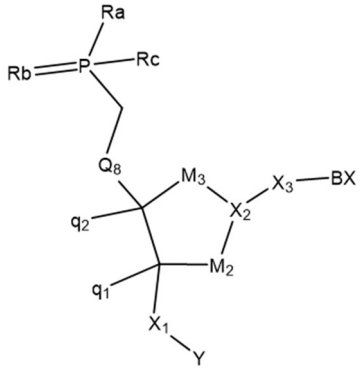
(2) formula (IV) satisfies any one of the following conditions:

(2-1) Q_8 is S, SO, or SO_2;

(2-2) Q_1 and Q_2 are each independently H;

(2-3) in the nucleoside comprising a sugar or sugar surrogate moiety, the sugar or sugar surrogate moiety comprises a 5-membered furanose ring, a non-furanose ring, or a 5- to 6-membered carbocyclic system, or an open system;

(2-4) formula (IV) is formula (IV-1)



formula (IV-1);

(2-5) R_b is O or S, and Ra and Rc are each independently selected from protected hydroxyl, C_1-C_6 alkyl, and C_1-C_6 alkoxy;

(2-6) Ra and Rc are each independently selected from hydroxyl, OCH_3, OCH_2CH_3, $OCH(CH_3)_2OCH_3$, OCH_2CH_2CN, and $NHSO_2CH_3$;

(2-7) the phosphoramidite is selected from diisopropylcyanoethoxy phosphoramidite, diisopropylethyl phosphoramidite, and H-phosphonate.

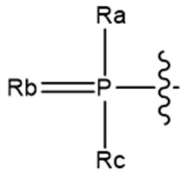
15. The compound according to claim 14, wherein the compound satisfies any one of the following conditions:

(1) each formula (I), formula (II), and formula (III) satisfies any one of the following conditions:

(1-1) a protecting group for the hydroxyl or sulfhydryl is independently selected from methyl, ethyl, benzyl (Bn), phenyl, isopropyl, tert-butyl, acetyl, chloroacetyl, trichloroacetyl, trifluoroacetyl, pivaloyl, tert-butoxymethyl, methoxymethyl, 1-ethoxyethyl, 1-(2-chloroethoxy)ethyl, 2-trimethylsilylethyl, allyl, cyclohexyl (cHex), 9-fluorenylmethoxycarbonyl, methanesulfonyl, p-toluenesulfonyl, trifluoromethanesulfonyl, benzoyl, benzoylformate, p-phenylbenzoyl, 4-methoxybenzyl, monomethoxytrityl, dimethoxytrityl, trimethoxytrityl, 4-chlorobenzyl, 4-nitrobenzyl, 2,4-dinitrophenyl, 4-acyloxybenzyl, 2-methylphenyl, 2,6-dimethylphenyl, 2-chlorophenyl, 2,6-dichlorobenzyl, diphenylmethyl, triphenylmethyl, 4-methylthio-1-butyl, 2-(S-acetylthio)ethyl (SATE), 2-cyanoethyl, 2-cyano-1,1-dimethylethyl (CDM), 4-cyano-2-butenyl, 2-(trimethylsilyl)ethyl (TSE), 2-(phenylthio)ethyl, 2-(triphenylsilyl)ethyl, 2-(benzylsulfonyl)ethyl, 2,2,2-trichloroethyl, 2,2,2-tribromoethyl, 2,3-dibromopropyl, 2,2,2-trifluoroethyl, phenylthio, 2-chloro-4-tritylphenyl, 2-bromophenyl, 2-[N-isopropyl-N-(4-methoxybenzoyl)amino]ethyl, 4-(N-trifluoroacetylamino)butyl, 4-oxopentyl, 4-tritylaminophenyl, 4-benzylaminophenyl, tetrahydropyranyl, morpholino, trimethylsilyl, triethylsilyl, tert-butyldimethylsilyl, tert-butyldiphenylsilyl, triphenylsilyl, triisopropylsilyl, pivaloyloxymethyl (POM), and 9-phenylxanthine-9-yl;

the amino-protecting group is independently selected from 2-(trimethylsilyl)ethoxycarbonyl (Teoc), 1-methyl-1-(4-biphenyl)ethoxycarbonyl (Bpoc), tert-butoxycarbonyl (BOC), allyloxycarbonyl (Alloc), 9-fluorenylmethoxycarbonyl (Fmoc), benzyloxycarbonyl (Cbz), benzyl, formyl, acetyl, pivaloyl, trihaloacetyl, benzoyl, nitrophenyl, acetyl, 2-nitrobenzenesulfonyl, phthalimido (Pht), p-toluenesulfonyl (Tos), trityl (Trt), 2,4-dimethoxybenzyl (PMB), and dithiosuccinyl;

(1-2) each T_1 is independently an optionally protected phosphine moiety having the following formula:



wherein:

Ra and Rc are each independently selected from protected hydroxyl and protected sulfhydryl, and R_b is O or S;

protecting groups for the hydroxyl are each independently selected from acetyl, tert-butyl, tert-butoxymethyl, methoxymethyl, tetrahydropyranyl, 1-ethoxyethyl, 1-(2-chloroethoxy)ethyl, 2-trimethylsilylethyl, p-chlorophenyl, 2,4-dinitrophenyl, benzyl, benzoyl, p-phenylbenzoyl, 2,6-dichlorobenzyl, diphenylmethyl, p-nitrobenzyl, trimethylsilyl, triethylsilyl, tert-butyldimethylsilyl, tert-butyldiphenylsilyl, triphenylsilyl, triisopropylsilyl, benzoylformate, chloroacetyl, trichloroacetyl, trifluoroacetyl, pivaloyl, 9-fluorenylmethoxycarbonyl, methanesulfonyl, p-toluenesulfonyl, trifluoromethanesulfonyl, trityl, monomethoxytrityl, dimethoxytrityl, trimethoxytrityl, pivaloyloxymethyl (POM), and substituted 9-phenylxanthine-9-yl;

protecting groups for the sulfhydryl are each independently selected from methyl, ethyl, acetyl, tert-butyl, tert-butoxymethyl, methoxymethyl, tetrahydropyranyl, 1-ethoxyethyl, 1-(2-chloroethoxy)ethyl, 2-trimethylsilylethyl, p-chlorophenyl, 2,4-dinitrophenyl, benzyl, benzoyl, p-phenylbenzoyl, 2,6-dichlorobenzyl, diphenylmethyl, p-nitrobenzyl, trimethylsilyl, triethylsilyl, tert-butyldimethylsilyl, tert-butyldiphenylsilyl, triphenylsilyl, triisopropylsilyl, benzoylformate, chloroacetyl, trichloroacetyl, trifluoroacetyl, pivaloyl, 9-fluorenylmethoxycarbonyl, methanesulfonyl, p-toluenesulfonyl, trifluoromethanesulfonyl, trityl, monomethoxytrityl, dimethoxytrityl, trimethoxytrityl, and substituted 9-phenylxanthine-9-yl;

(1-3) in T_1, R_b is O or S, and Ra and Rc are each independently selected from protected hydroxyl, C_1-C_6 alkyl, and C_1-C_6 alkoxy;

(1-4) in T_1, R_b is O, and Ra and Rc are each independently selected from OH, SH, OCH_3, OCH_2CH_3, $OCH(CH_3)_2$, $OCH_2OC(=O)C(CH_3)_3$, OCH_2CH_2CN, and $NHSO_2CH_3$;

(1-5) in T_2, each J_7 or J_8 is independently substituted C_1-C_6 alkyl, and a substituent is selected from cyano and halogen;

(1-6) in T_2, M_4 is selected from methyl, ethyl, propyl, and isopropyl;

(1-7) in T_2, M_4 is selected from methanesulfonamido;

(1-8) in T_2, M_4 is OJ_7, wherein J_7 is substituted C_1-C_6 alkyl, and a substituent is selected from cyano and halogen;

(1-9) in T_2, M_4 is $O(CH_2)_2CN$; M_5 is $N(CH(CH_3)_2)_2$; r is 0;

(1-10) each T_2 active phosphorus group is independently a phosphoramidite;

(1-11) each T_2 active phosphorus group is independently selected from diisopropylcyanoethoxy

phosphoramidite, diisopropylethyl phosphoramidite, and H-phosphonate;

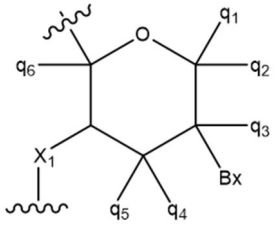
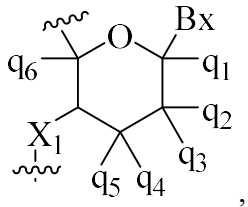
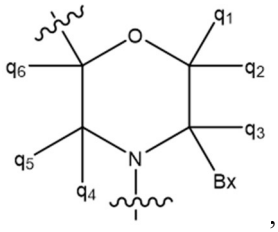
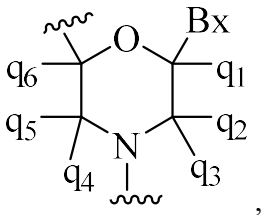
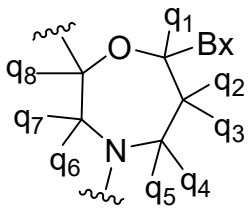
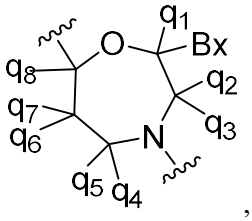
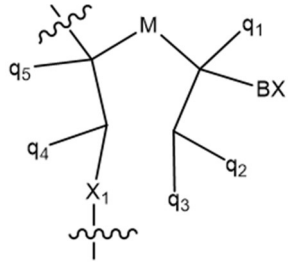
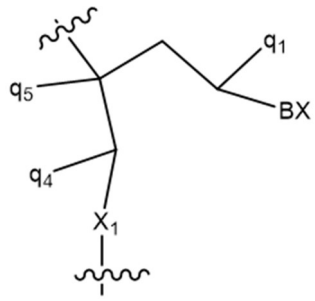
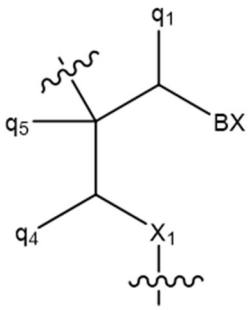
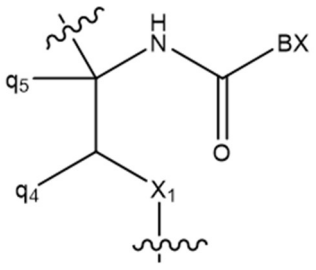
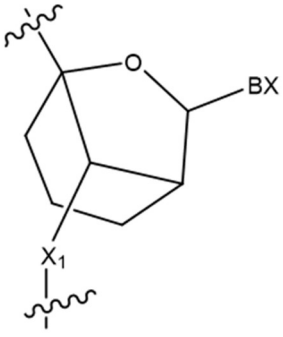
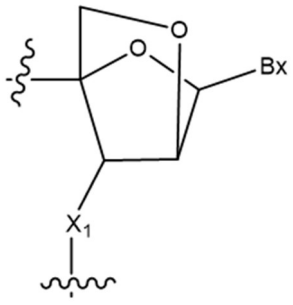
(1-12) each B_X heterocyclic base moiety is independently pyrimidine, substituted pyrimidine, pseudouracil, substituted pseudouracil, purine, hypoxanthine, or substituted purine;

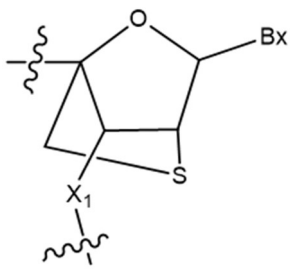
(1-13) each Q_1 and each Q_2 are each independently H;

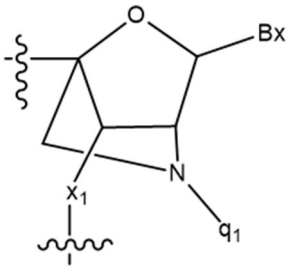
(2) formula (IV) satisfies any one of the following conditions:

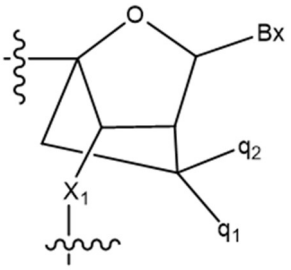
(2-1) the sugar or sugar surrogate moiety is selected from morpholinyl, cyclohexenyl, cyclohexyl, cyclopentyl, pyranyl, cyclohexanehexol group, furanose, unlocked nucleobase analog (UNA), glycerol nucleobase analog (GNA), locked nucleic acid (LNA), and bridged nucleic acid (BNA);

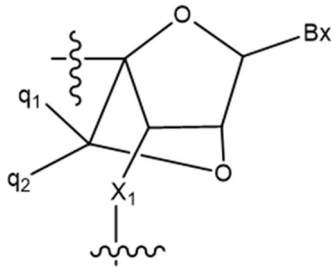
(2-2) the nucleoside comprising a sugar or sugar surrogate moiety has the following structural schematics:

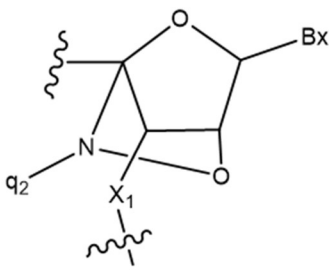

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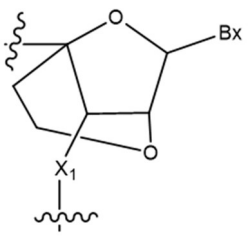


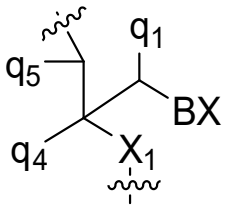
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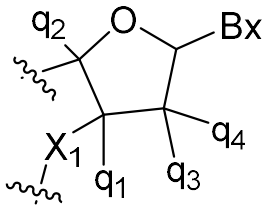
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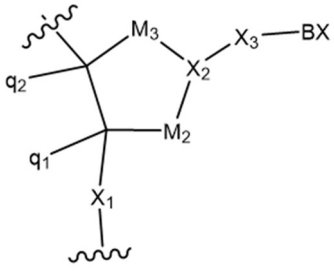
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wherein M_2 is $C(q_3)(q_4)$ or $C(q_3)(q_4)C(q_5)(q_6)$;

M_3 is O, S, NR^{13}, $C(q_7)(q_8)$, $C(q_7)(q_8)C(q_9)(q_{10})$, $C(q_7)=C(q_8)$, or $OC(q_7)(q_8)$;

X_1 is a chemical bond or is selected from O, S, NJ_1, and CJ_1J_2, wherein J_1 and J_2 are each independently hydrogen, halogen, sulfonyl, sulfinyl, optionally substituted C_1-C_6 alkyl, optionally substituted C_3-C_6 cycloalkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, optionally substituted C_5-C_{12} aryl, optionally substituted 5- to 12-membered heteroaryl, or optionally substituted 5- to 12-membered heterocycle;

X_2 is CR^{15} or N;

X_3 is a chemical bond, optionally substituted C_1-C_3 alkylene, SO, SO_2, C(=O), or P(=O)R;

R is OH, SH, C_1-C_6 alkyl, NH_2, or $NHSO_2CH_3$;

Bx is a heterocyclic base moiety;

R^{15}, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, and q_{10} are each independently hydrogen, halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, $O(CH_2)_2$-OCH_3, CN, $OC(=O)J_5$, $OC(=O)N(J_5)(J_6)$, or $C(=O)N((J_5)(J_6)$, wherein J_5 and J_6 are independently H or C_1-C_6 alkyl;

R^{13} is hydrogen or C_1-C_6 alkyl;

(3) formula (IV-1) satisfies any one of the following conditions:

(3-1) R^{15}, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, and q_{10} are each independently selected from hydrogen, fluorine, hydroxyl, methyl, methoxy, and $O(CH_2)_2$-OCH_3;

(3-2) M_3 is O, S, $C(q_7)(q_8)$, M_2 is $C(q_3)(q_4)$, X_2 is CR^{15} or N, and X_3 is a chemical bond, SO, or SO_2;

(3-3) M_3 is $C(q_7)(q_8)$, M_2 is $C(q_3)(q_4)C(q_5)(q_6)$, X_2 is CR^{15} or N, and X_3 is a chemical bond, SO, or SO_2;

(3-4) Q_8 is S, SO, or SO_2;

(3-5) R_b is O or S, and Ra and Rc are each independently selected from protected hydroxyl, C_1-C_6 alkyl, and C_1-C_6 alkoxy;

(3-6) Ra and Rc are each independently selected from hydroxyl, OCH_3, OCH_2CH_3, $OCH(CH_3)_2OCH_3$, OCH_2CH_2CN, and $NHSO_2CH_3$;

(3-7) the B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base.

16. The compound according to claim 15, wherein the compound satisfies any one of the following conditions:

(1) each formula (I), formula (II), and formula (III) satisfies any one of the following conditions:

(1-1) in T_1, the protecting groups for the hydroxyl are each independently selected from acetyl, benzyl, tert-butyldimethylsilyl, pivaloyloxymethyl (POM), tert-butyldiphenylsilyl, and 4,4'-dimethoxytrityl; the protecting groups for the sulfhydryl are each independently selected from benzyl, 4,4'-dimethoxytrityl, and trityl;

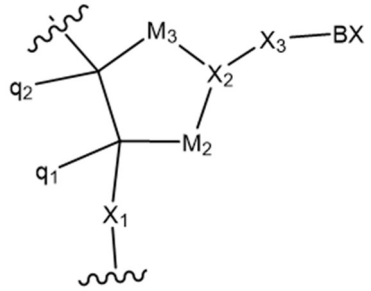
(1-2) each B_X heterocyclic base moiety is independently 2-thiouracil, 5-fluorouracil, dihydrouridine (D), 7-methylguanosine (m7G), uracil, 5-thiazolouracil, thymine, cytosine, pseudouracil, N1-methyl-pseudouracil, hypoxanthine, 5-methylcytosine, 5-methyluracil, 3-benzoyluracil, 2,6-diaminopurine, adenine, or guanine;

(2) formula (IV) satisfies any one of the following conditions:

(2-1) in the nucleoside comprising a sugar or sugar surrogate moiety, Q_8 is bonded to the 4'-carbon or 5'-carbon of the sugar or sugar surrogate moiety;

(2-2) in the nucleoside comprising a sugar or sugar surrogate moiety, each R^{15}, each q_1, each q_2, each q_3, each q_4, each q_5, each q_6, each q_7, each q_8, each q_9, and each q_{10} are each independently selected from the following groups: hydrogen, fluorine, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, and $O(CH_2)_2$-OCH_3; or, each R^{15}, each q_1, each q_2, each q_3, each q_4, each q_5, each q_6, each q_7, each q_8, each q_9, and each q_{10} are hydrogen;

(2-3) the nucleoside comprising a sugar or sugar surrogate moiety has the following structural schematics:



;

(3) formula (IV-1) satisfies any one of the following conditions:

(3-1) R^{15}, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, and q_{10} are hydrogen;

(3-2) M_3 is O, S, or CH_2, M_2 is CH_2, X_2 is CH, and X_3 is a chemical bond;

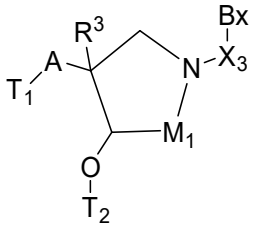
(3-3) M_3 is CH_2, M_2 is CH_2, X_2 is N, and X_3 is a chemical bond, SO, or SO_2;

(3-4) M_3 is CH_2, M_2 is CH_2CH_2, X_2 is CH, and X_3 is a chemical bond;

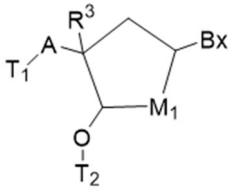
(3-5) M_3 is CH_2, M_2 is CH_2CH_2, X_2 is N, and X_3 is a chemical bond, SO, or SO_2;

(3-6) the B_X heterocyclic base moiety is pyrimidine, substituted pyrimidine, pseudouracil, substituted pseudouracil, purine, hypoxanthine, or substituted purine; or, the B_X heterocyclic base moiety is 2-thiouracil, 5-fluorouracil, dihydrouridine (D), 7-methylguanosine (m7G), uracil, 5-thiazolouracil, thymine, cytosine, pseudouracil, N1-methyl-pseudouracil, hypoxanthine, 5-methylcytosine, 5-methyluracil, 3-benzoyluracil, 2,6-diaminopurine, adenine, or guanine.

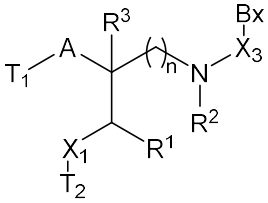
17. The compound according to claim 13, having a compound represented by formula (I-1), formula (I-2), formula (II-1), formula (II-2), formula (II-3), formula (III-1) or formula (III-2) or a stereoisomer thereof:



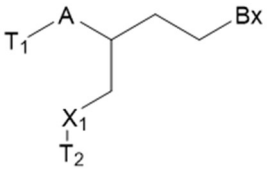
formula (I-1)



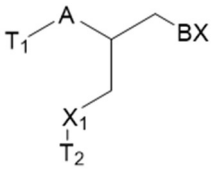
formula (I-2)



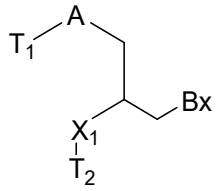
formula (II-1)



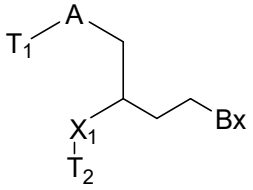
formula (II-2),



formula (II-3)



formula (III-1),



formula (III-2)

wherein in formula (I-1):

T_1, T_2, A, R^3, and Bx are each as defined in claim 89; X_3 is a chemical bond, C(=O), P(=O)R, SO, or SO_2; M_1 is C(Rd)(Re) or C(Rd)(Re)C(Rg)(Rf), wherein each Rd, each Re, each Rg, and each Rf are each independently selected from the following substituent groups: hydrogen, halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, $O(CH_2)_2$-OCH_3, NJ_5, CN, $OC(=O)J_5$, $OC(=O)N(J_5)(J_6)$, and $C(=O)N((J_5)(J_6)$, wherein J_5 and J_6 are independently H or C_1-C_6 alkyl; R is OH, SH, C_1-C_6 alkyl, NH_2, or $NHSO_2CH_3$;

in formula (I-2):

T_1, T_2, A, R^3, and Bx are each as defined in claim 89; M_1 is C(Rd)(Re) or C(Rd)(Re)C(Rg)(Rf), wherein each Rd, each Re, each Rg, and each Rf are each independently selected from the following substituent groups: hydrogen, halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, $O(CH_2)_2$-OCH_3, NJ_5, CN, $OC(=O)J_5$, $OC(=O)N(J_5)(J_6)$, and $C(=O)N((J_5)(J_6)$, wherein J_5 and J_6 are independently H or C_1-C_6 alkyl;

in formula (II-1):

R^1 and R^2 are each independently H, methanesulfonyl, or acetyl.

18. The compound according to claim 17, wherein the compound satisfies any one of the following conditions:

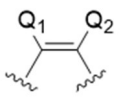
(1) formula (I-1) satisfies any one of the following conditions:

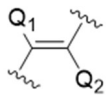
(1-1) each Rd, each Re, each Rg, and each Rf are each independently selected from the following substituent groups: hydrogen, fluorine, hydroxyl, C_1-C_6 alkoxy, and $O(CH_2)_2$-OCH_3;

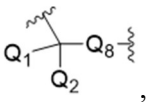
(1-2) R^3 is hydrogen;

(1-3) X_3 is SO_2 or a chemical bond;

(1-4) A has one of the following formulas:



, 

, and 

,

wherein Q_1 and Q_2 are each independently H, halogen, or optionally substituted C_1-C_6 alkyl;

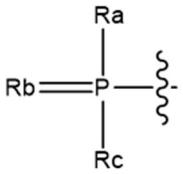
Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$; R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally

substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, C(=O)J_3, C(=O)OJ_3, or C(=O)N(J_3)(J_4); J_3 and J_4 are independently H or C_1-C_6 alkyl;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(1-5) each Q_1 and each Q_2 are each independently H, F, -CN, or methyl;

(1-6) T_1 is an optionally protected phosphine moiety having the following formula:



wherein:

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

(1-7) T_2 is an active phosphorus group, and the active phosphorus group is a phosphoramidite;

(1-8) the B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base;

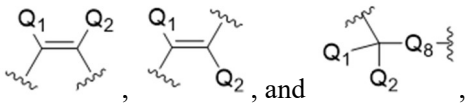
(2) formula (I-2) satisfies any one of the following conditions:

(2-1) each Rd, each Re, each Rg, and each Rf are each independently selected from the following substituent groups: hydrogen, fluorine, hydroxyl, C_1-C_6 alkoxy, and O$(CH_2)_2$-OCH_3;

(2-2) M_1 is CH_2 or CH_2CH_2;

(2-3) R^3 is hydrogen;

(2-4) A has one of the following formulas:



, , and ,

wherein Q_1 and Q_2 are each independently H, halogen, or optionally substituted C_1-C_6 alkyl;

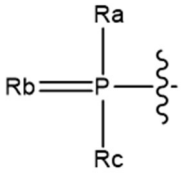
Q_8 is S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$;

R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, C(=O)J_3, C(=O)OJ_3, or C(=O)N(J_3)(J_4); J_3 and J_4 are independently H or C_1-C_6 alkyl;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(2-5) each Q_1 and each Q_2 are each independently H, F, -CN, or methyl;

(2-6) T_1 is an optionally protected phosphine moiety having the following formula:



wherein:

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

(2-7) T_2 is an active phosphorus group, and the active phosphorus group is a phosphoramidite;

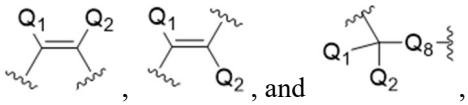
(2-8) the B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base;

(3) formula (II-1) satisfies any one of the following conditions:

(3-1) n is 0 or 1;

(3-2) X_3 is CH_2 or CH_2CH_2;

(3-3) A has one of the following formulas:



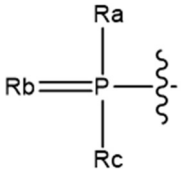
, , and ,

wherein Q_1 and Q_2 are each independently H, halogen, -CN, or optionally substituted C_1-C_6 alkyl; Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$; R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$; J_3 and J_4 are independently H or C_1-C_6 alkyl;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(3-4) each Q_1 and each Q_2 are each independently H, F, -CN, or methyl;

(3-5) T_1 is an optionally protected phosphine moiety having the following formula:



wherein:

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

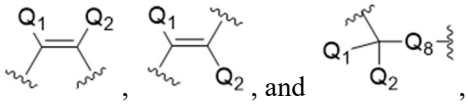
(3-6) T_2 is an active phosphorus group, and the active phosphorus group is a phosphoramidite; preferably, the T_2 active phosphorus group is selected from diisopropylcyanoethoxy phosphoramidite,

diisopropylethyl phosphoramidite, and H-phosphonate;

(3-7) the B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base;

(4) each formula (II-2), formula (II-3), formula (III-1), and formula (III-2) satisfies any one of the following conditions:

(4-1) A has one of the following formulas:



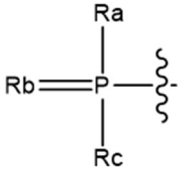
, , and ,

wherein Q_1 and Q_2 are each independently H, halogen, -CN, or optionally substituted C_1-C_6 alkyl; Q_8 is O, S, SO, SO_2, $PR^{16}R^{17}$, or NR^{11}; R^{16} and R^{17} are independently (=O), (=S), OH, SH, C_1-C_6 alkyl, or $NR^{18}R^{19}$; R^{11}, R^{18}, and R^{19} are independently H, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, methanesulfonyl, sulfo, $C(=O)J_3$, $C(=O)OJ_3$, or $C(=O)N(J_3)(J_4)$; J_3 and J_4 are independently H or C_1-C_6 alkyl;

each optionally substituted group comprises one or more substituent groups independently selected from halogen, hydroxyl, C_1-C_6 alkyl, C_1-C_6 alkoxy, C_1-C_6 alkylsulfhydryl, and CN;

(4-2) each Q_1 and each Q_2 are each independently H, F, -CN, or methyl;

(4-3) T_1 is an optionally protected phosphine moiety having the following formula:



wherein:

Ra and Rc are each independently selected from hydroxyl or protected hydroxyl, sulfhydryl or protected sulfhydryl, optionally substituted C_1-C_6 alkyl, optionally substituted C_1-C_6 alkoxy, amino or protected/substituted amino, and a natural or modified nucleoside, and R_b is O, S, or NR^{12}, wherein R^{12} is hydrogen, C_1-C_6 alkyl, or an amino-protecting group;

(4-4) T_2 is an active phosphorus group, and the active phosphorus group is a phosphoramidite;;

(4-5) the B_X heterocyclic base moiety is selected from a natural nucleobase, a modified nucleobase, and a universal base.

19. The compound according to claim 18, wherein the compound satisfies any one of the following conditions:

(1) formula (I-1) satisfies any one of the following conditions:

(1-1) each Rd, each Re, each Rg, and each Rf are each independently hydrogen;

(1-2) each Q_1 and each Q_2 are each independently H;

(1-3) in T_1, a substituent in the substituted amino is selected from optionally substituted C_1-C_6 alkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, and acetyl;

(1-4) in T_1, R_b is O or S, and Ra and Rc are each independently selected from protected hydroxyl, C_1-C_6 alkyl, and C_1-C_6 alkoxy;

(1-5) in T_1, R_b is O, and Ra and Rc are each independently selected from OH, OCH_3, OCH_2CH_3, $OCH(CH_3)_2$, $OCH_2OC(=O)C(CH_3)_3$, OCH_2CH_2CN, and $NHSO_2CH_3$;

(1-6) in T_1, the T_2 active phosphorus group is selected from diisopropylcyanoethoxy phosphoramidite, diisopropylethyl phosphoramidite, and H-phosphonate;

(1-7) the B_X heterocyclic base moiety is pyrimidine, substituted pyrimidine, pseudouracil, substituted pseudouracil, purine, hypoxanthine, or substituted purine; or, the B_X heterocyclic base moiety is 2-thiouracil, 5-fluorouracil, dihydrouridine (D), 7-methylguanosine (m7G), uracil, 5-thiazolouracil, thymine, cytosine, pseudouracil, N1-methyl-pseudouracil, hypoxanthine, 5-methylcytosine, 5-methyluracil, 3-benzoyluracil, 2,6-diaminopurine, adenine, or guanine;

(2) each formula (I-2), (II-1), (II-2), (III-1) and (III-2) satisfies any one of the following conditions:

(2-1) each Q_1 and each Q_2 are each independently H;

(2-2) in T_1, a substituent in the substituted amino is selected from optionally substituted C_1-C_6 alkyl, optionally substituted C_2-C_6 alkenyl, optionally substituted C_2-C_6 alkynyl, sulfinyl, sulfonyl, and acetyl;

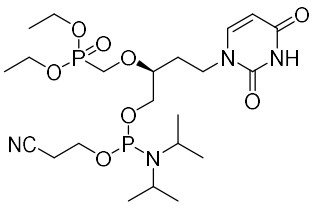
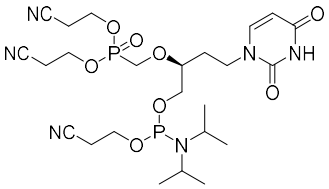
(2-3) in T_1, R_b is O or S, and Ra and Rc are each independently selected from protected hydroxyl, C_1-C_6 alkyl, and C_1-C_6 alkoxy;

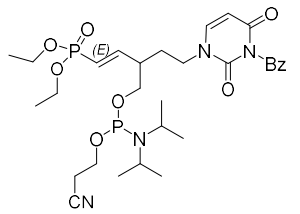
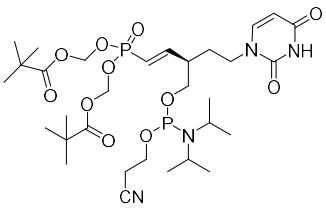
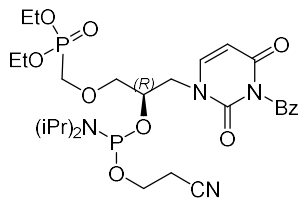
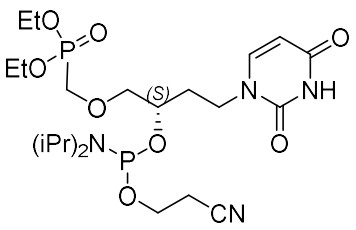
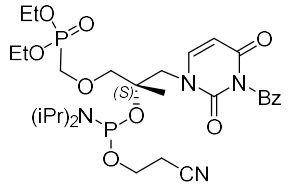
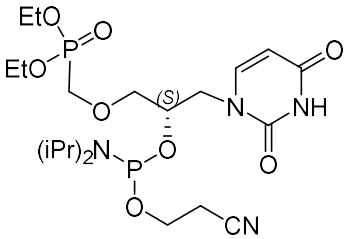
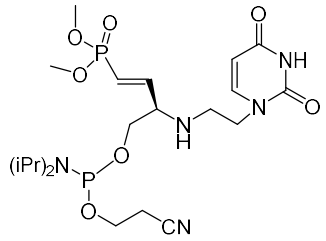
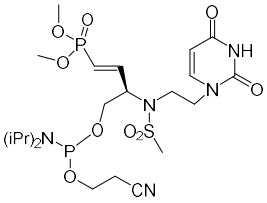
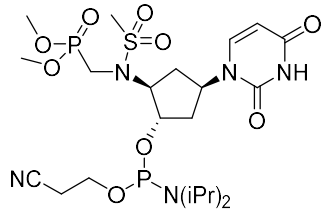
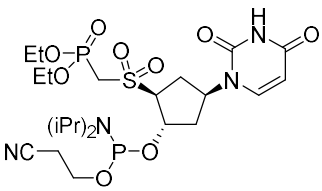
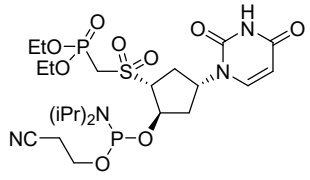
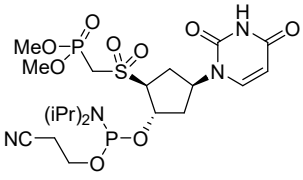
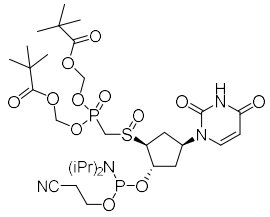
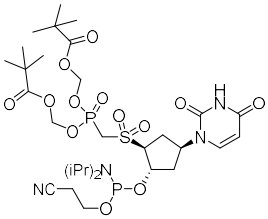
(2-4) R_b is O, and Ra and Rc are each independently selected from OH, OCH_3, OCH_2CH_3, $OCH(CH_3)_2$, $OCH_2OC(=O)C(CH_3)_3$, OCH_2CH_2CN, and $NHSO_2CH_3$;

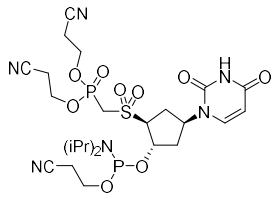
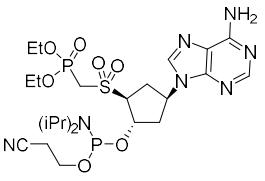
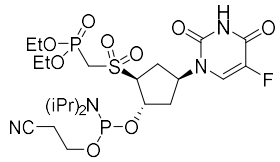
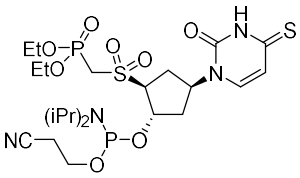
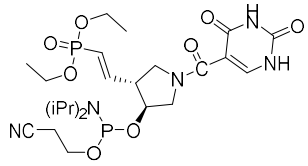
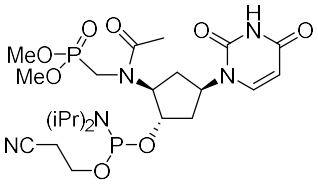
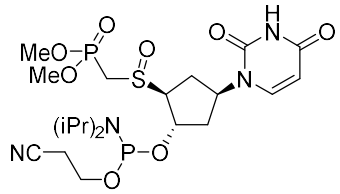
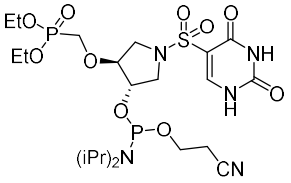
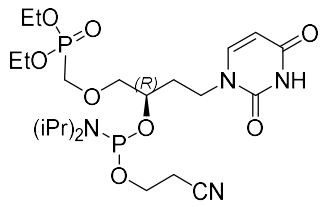
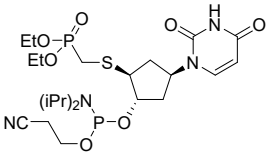
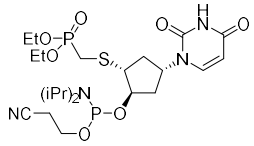
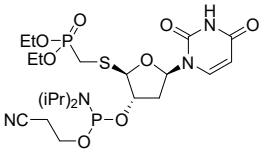
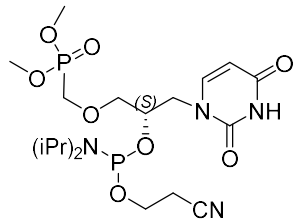
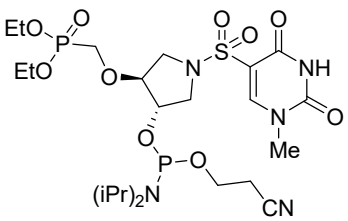
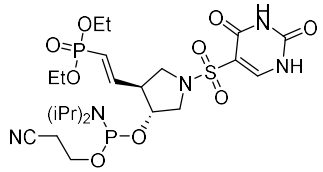
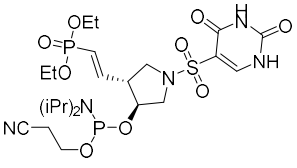
(2-5) the T_2 active phosphorus group is selected from diisopropylcyanoethoxy phosphoramidite, diisopropylethyl phosphoramidite, and H-phosphonate;

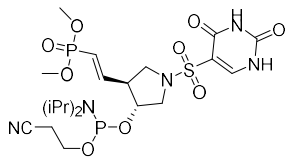
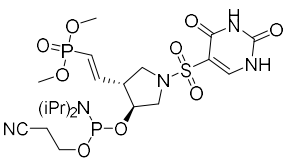
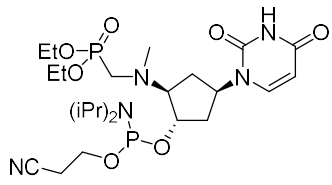
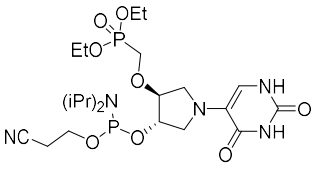
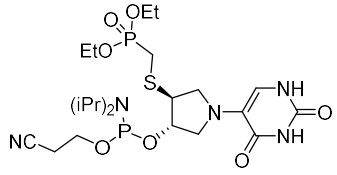
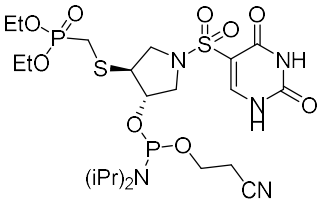
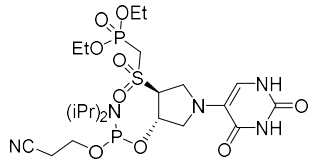
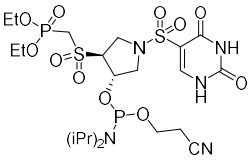
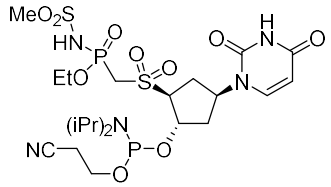
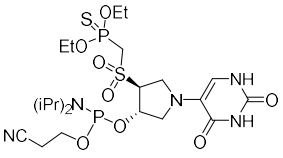
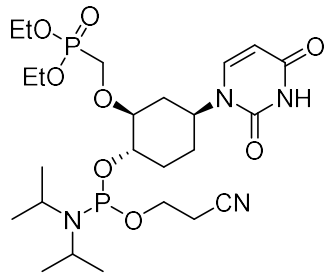
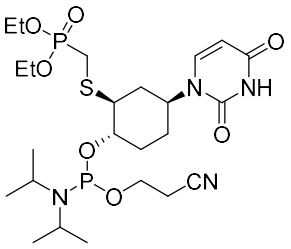
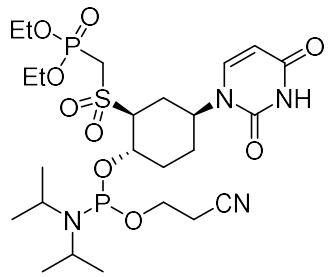
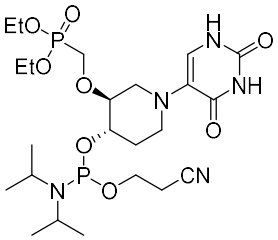
(2-6) the B_X heterocyclic base moiety is pyrimidine, substituted pyrimidine, pseudouracil, substituted pseudouracil, purine, hypoxanthine, or substituted purine; or, the B_X heterocyclic base moiety is 2-thiouracil, 5-fluorouracil, dihydrouridine (D), 7-methylguanosine (m7G), uracil, 5-thiazolouracil, thymine, cytosine, pseudouracil, N1-methyl-pseudouracil, hypoxanthine, 5-methylcytosine, 5-methyluracil, 3-benzoyluracil, 2,6-diaminopurine, adenine, or guanine.

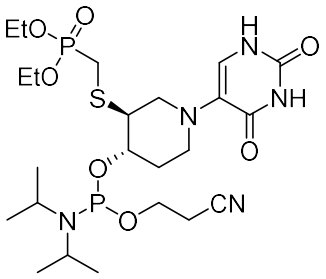
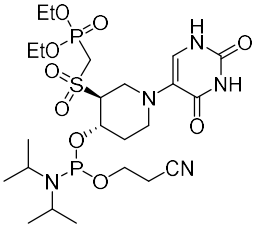
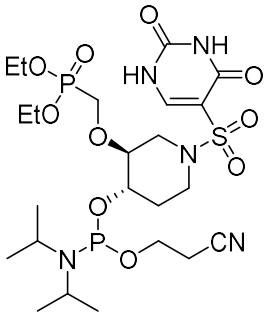
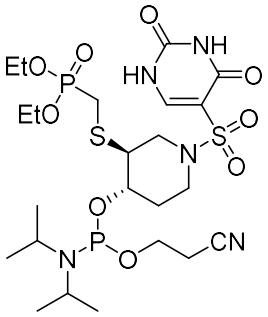
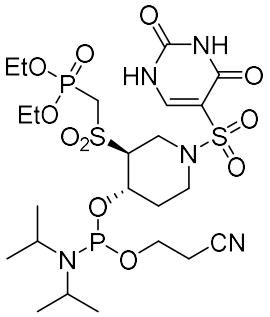
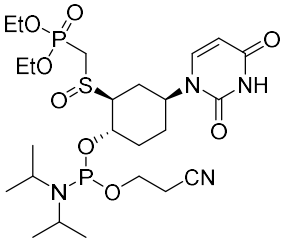
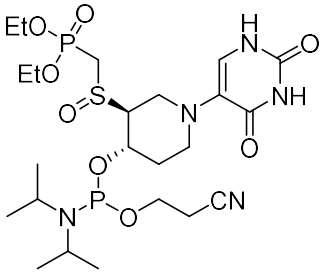
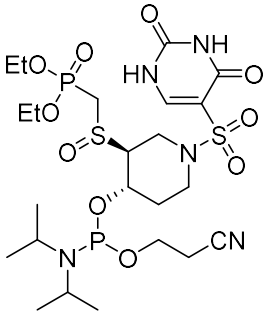
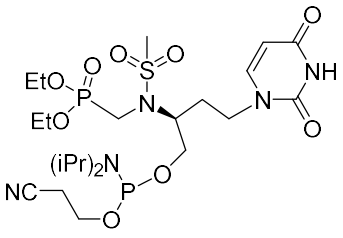
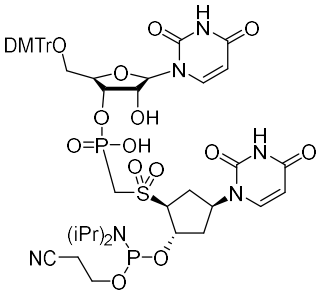
20. The compound according to any one of claims 13-19, having the following specific structures:

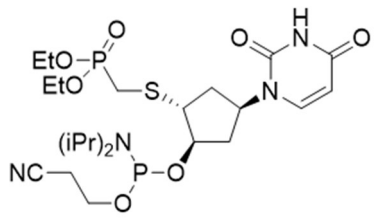
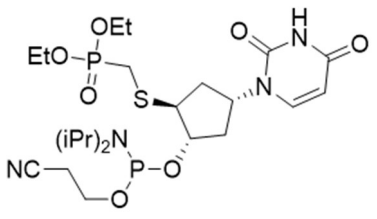
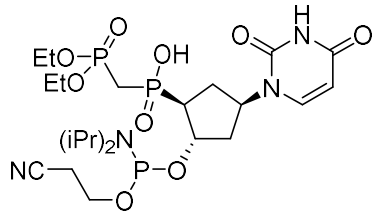
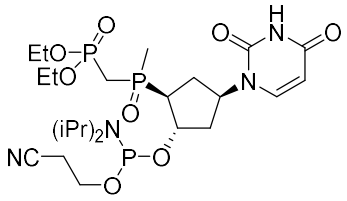
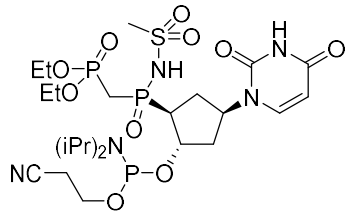
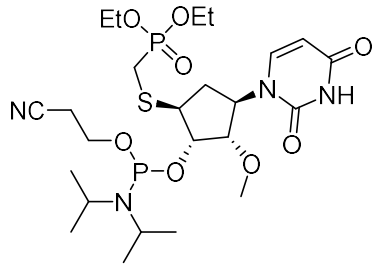
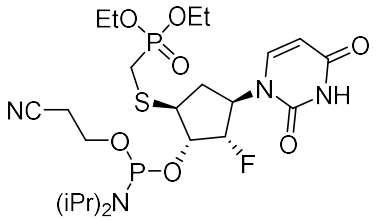
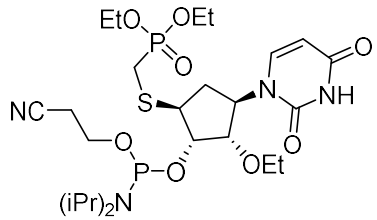
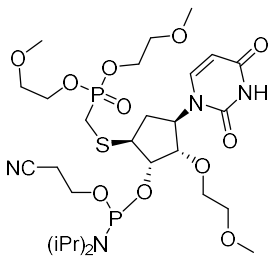
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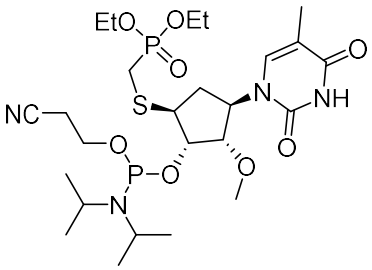
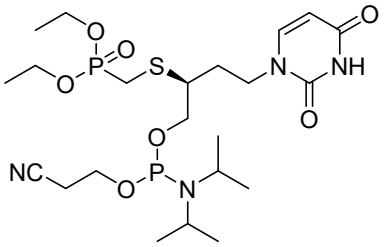
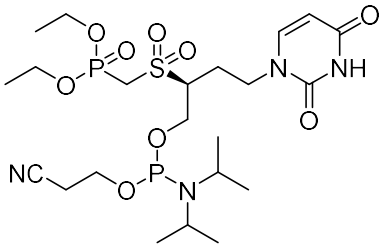
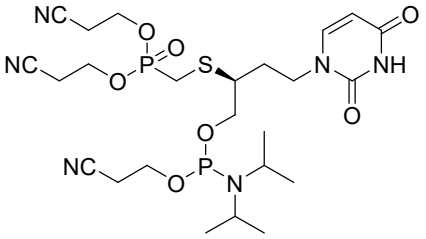
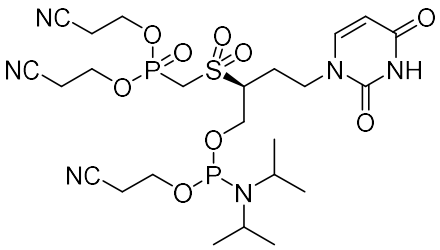
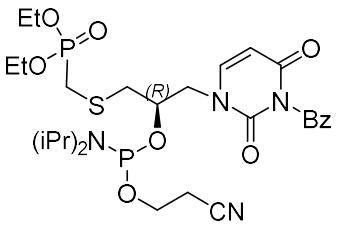
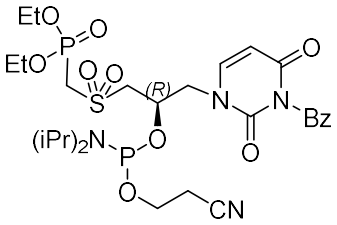
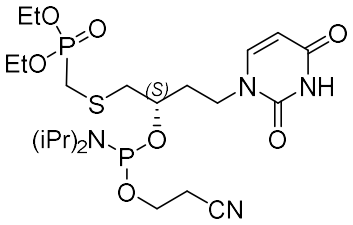
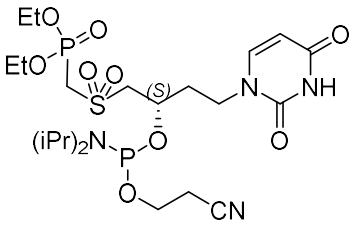
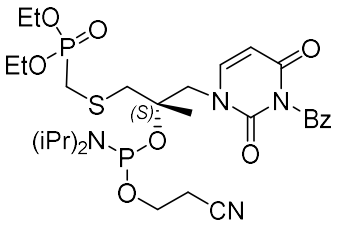
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 phosphoramidite-04	 phosphoramidite-05
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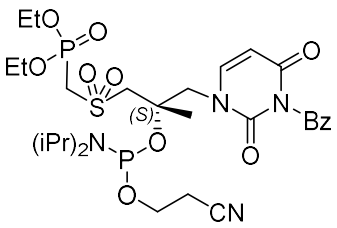
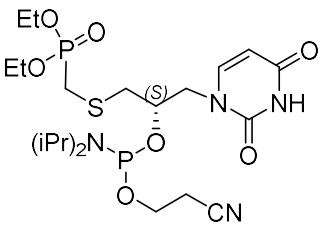
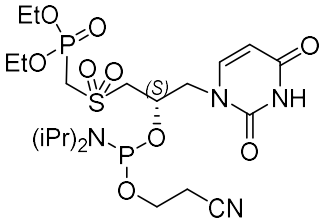
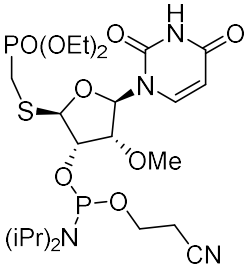
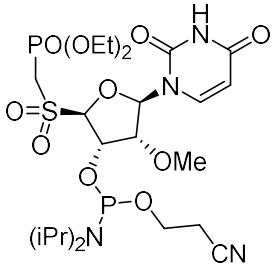
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 phosphoramidite-14	 phosphoramidite-15-1
 phosphoramidite-15-2	 phosphoramidite-15-3
 phosphoramidite-07-1	 phosphoramidite-18
 phosphoramidite-19-	 phosphoramidite-19-2

1	
 phosphoramidite-19-3	 phosphoramidite-19-4
 phosphoramidite-21	 phosphoramidite-22
 phosphoramidite-23	 phosphoramidite-26
 phosphoramidite-25	 phosphoramidite-24
 phosphoramidite-27	 phosphoramidite-28
 phosphoramidite-29	 phosphoramidite-30
 phosphoramidite-31	 phosphoramidite-32

 phosphoramidite-33	 phosphoramidite-34
 phosphoramidite-35	 phosphoramidite-36-1
 phosphoramidite-37	 phosphoramidite-38
 phosphoramidite-39	 phosphoramidite-40
 phosphoramidite-41	 phosphoramidite-42-3

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 phosphoramidite-43-1	 phosphoramidite-44-1
 phosphoramidite-45-1	phosphoramidite-15-4
 phosphoramidite-43	 phosphoramidite-44
 phosphoramidite-45	 phosphoramidite-46

 phosphoramidite-47	 phosphoramidite-1-1
 phosphoramidite-1-2	 phosphoramidite-2-1
 phosphoramidite-2-2	 phosphoramidite-4-1
 phosphoramidite-4-2	 phosphoramidite-5-1
 phosphoramidite-5-2	 phosphoramidite-6-1

 phosphoramidite-6-2	 phosphoramidite-7-1
 phosphoramidite-7-2	 phosphoramidite-53
 phosphoramidite-53-1.	

or

