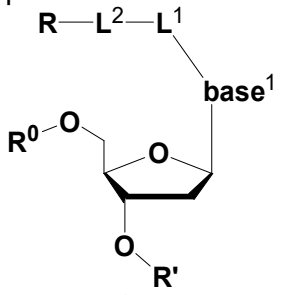
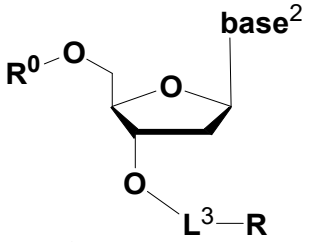
Claims

1. A compound of formula I or formula II or a salt thereof,

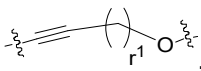
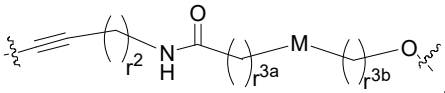
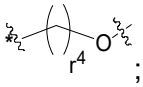


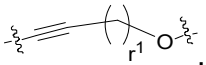
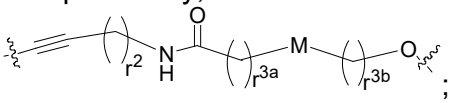
formula I

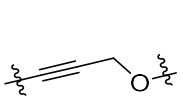
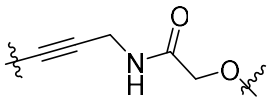
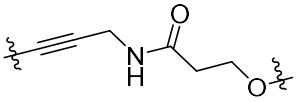
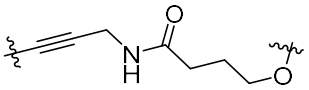
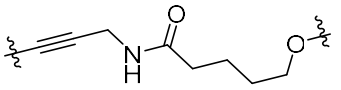
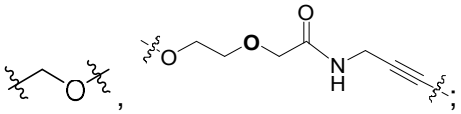


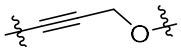
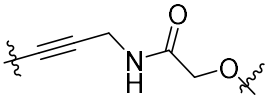
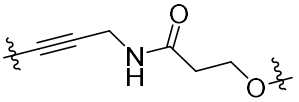
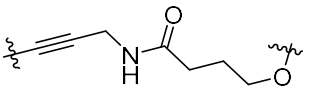
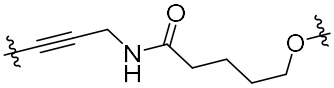
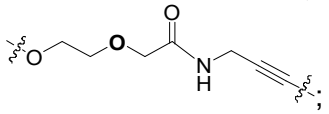
formula II

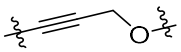
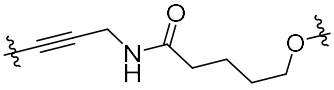
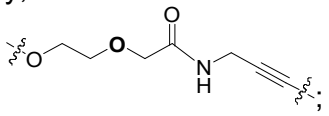
wherein:

L^1 is selected from , , ;

preferably, L^1 is selected from , ;

or preferably, L^1 is selected from , , , , , ;

or more preferably, L^1 is selected from , , , , , ;

or most preferably, L^1 is selected from , , ;

r^1, r^2, r^{3a}, r^{3b}, r^4, independently of each other, are selected from any integer between 1 and 6;

preferably, r^1 is selected from 1, 2, 3;

more preferably, r^1 is 1;

preferably, r^2 is selected from 1, 2, 3;

more preferably, r^2 is 1;

preferably, r^{3a}, r^{3b}, independently of each other, are selected from 1, 2, 3, 4, 5;

more preferably, r^{3a}, r^{3b}, independently of each other, are selected from 1, 2, 3;

most preferably, r^{3a} is 1;

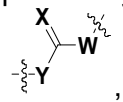
most preferably, r^{3b} is 2;

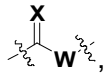
preferably, r^4 is selected from 1, 2, 3;

more preferably, r^4 is 1;

M is selected from a direct bond, CH_2, NH, O, S;

preferably, M is selected from CH_2, O;

L^2 is , preferably, W being linked to R;

L^3 is , preferably, W being linked to R;

each X, independently, is selected from O, S, NH;

preferably, each X, independently, is selected from O, S;

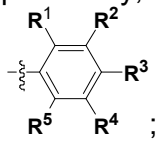
more preferably, X is O;

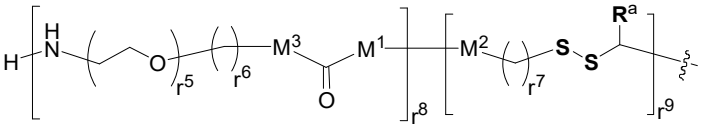
Y is selected from a direct bond, O, S, NH;

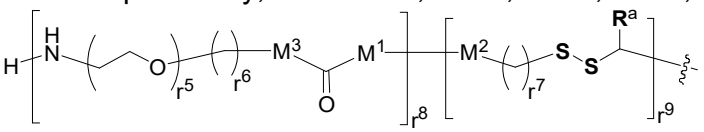
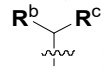
preferably, Y is a direct bond;

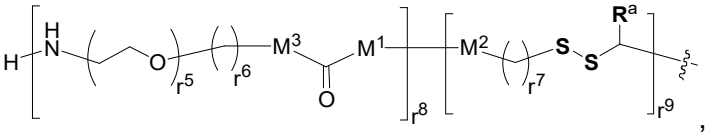
each W, independently, is selected from a direct bond, O, S, NH;

preferably, W is a direct bond;

R is ;

in R^1, R^2, R^3, R^4, R^5, any one is , and the others, , independently of each other, are selected from H, , azido, nitro, amino, sulfo, carboxyl, aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), F, I, Br, Cl, alkoxyl (e.g., C_1-C_6 alkoxyl);

preferably, in R^1, R^2, R^3, R^4, R^5, any one is , and the others, , independently of each other, are selected from H, ;

more preferably, in R^1, R^2, R^3, R^4, R^5, any one is , another (e.g., R^1 or R^5) is


selected from H, , and the remaining three are H;

r^5, r^6, r^7, independently of each other, are selected from any integer between 1 and 6;

preferably, r^5 is selected from 1, 2, 3;

more preferably, r^5 is 2;

preferably, r^6 is selected from 1, 2, 3;

more preferably, r^6 is 1 or 2;

preferably, r^7 is selected from 1, 2, 3;

more preferably, r^7 is 2;

r^8, r^9, independently of each other, are selected from 0, 1, r^8 and r^9 being not 0 at the same time;

M^1, M^2, M^3, independently of each other, are selected from a direct bond, NH, O, S;

preferably, M^1 is selected from a direct bond, NH, O;

preferably, M^2 is NH;

preferably, M^3 is selected from a direct bond, NH;

R^a is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl);

preferably, R^a is selected from H, C_1-C_6 alkyl;

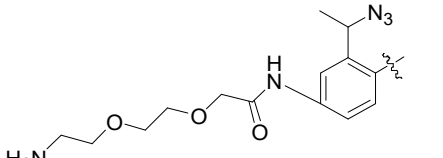
more preferably, R^a is methyl;

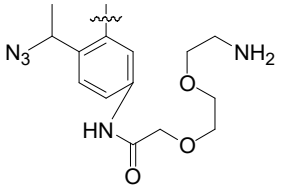
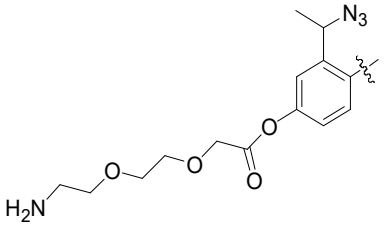
in R^b, R^c, any one is selected from -N_3, -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), -ONH_2, -$OCOR_x$, -$OCONHR_x$, and the other is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), wherein each R_x, independently, is selected from aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl) or aromatic alkyl (e.g., phenyl C_1-C_6 alkyl);

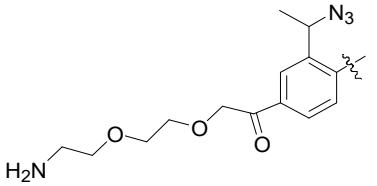
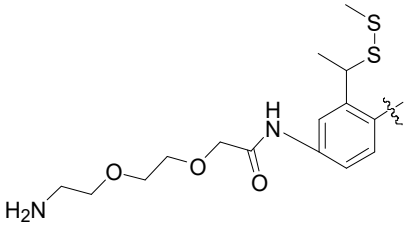
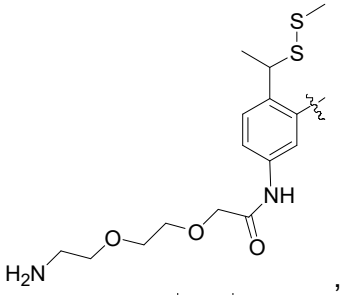
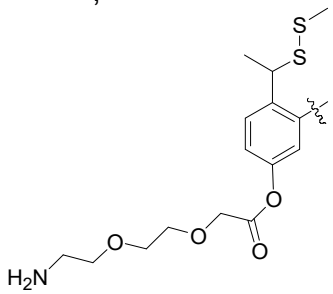
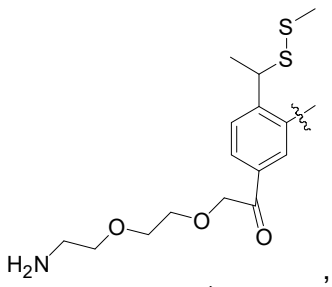
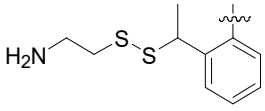
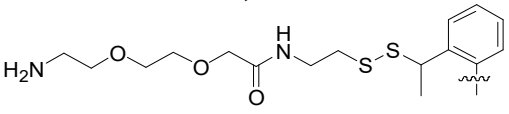
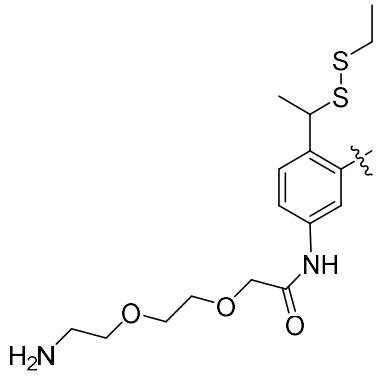
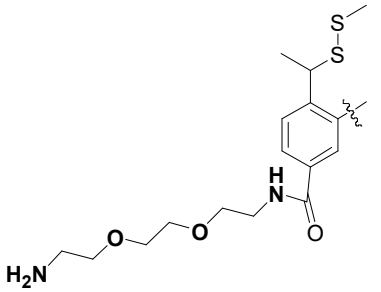
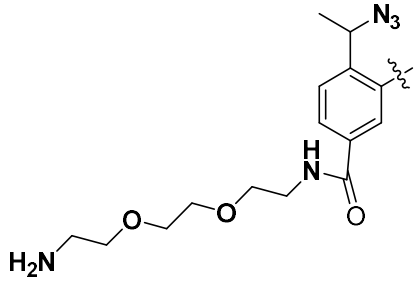
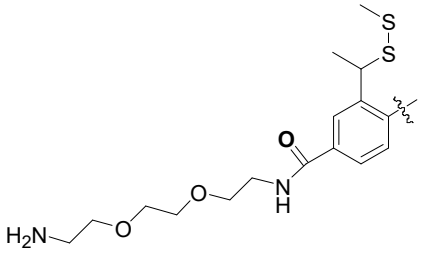
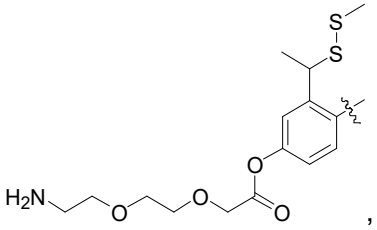
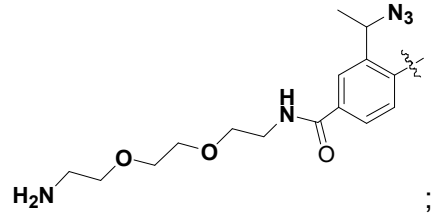
preferably, in R^b, R^c, any one is selected from -N_3, -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl;

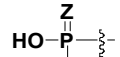
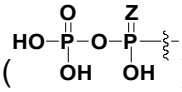
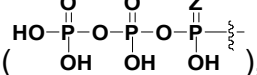
more preferably, in R^b, R^c, any one is selected from -N_3, -SS-Me, -SS-Et, and the other is methyl;

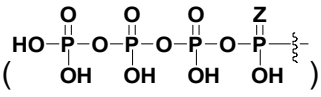
most preferably, in R^b, R^c, any one is selected from -N_3, -SS-Me, and the other is methyl;

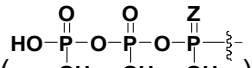
preferably, R is selected from ,

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R^0 is selected from H, monophosphate group (), diphosphate group (), triphosphate group (), tetraphosphate group

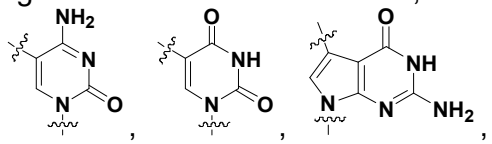
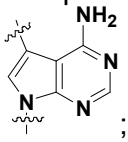

;

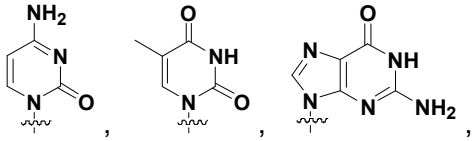
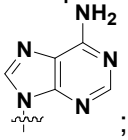
preferably, R^0 is a triphosphate group ();

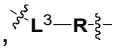
each Z, independently, is selected from O, S, BH;

preferably, Z is O;

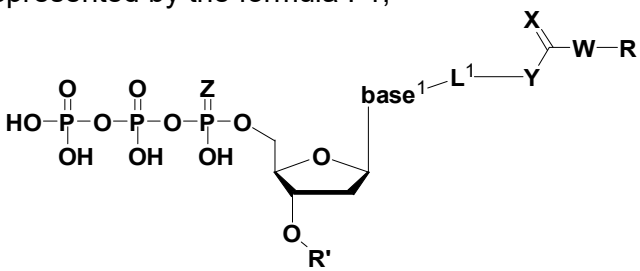
$base^1$, $base^2$, independently of each other, are selected from a base, a deaza base or a tautomer thereof, for example, adenine, 7-deazaadenine, thymine, uracil, cytosine, guanine, 7-deazaguanine or a tautomer thereof;

preferably, $base^1$ is selected from , ;

preferably, $base^2$ is selected from , ;

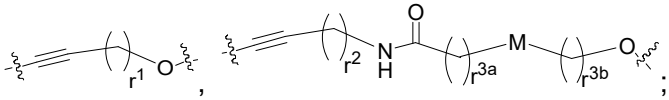
in the formula I, R' represents a reversible blocking group, and in the formula II,  represents a reversible blocking group.

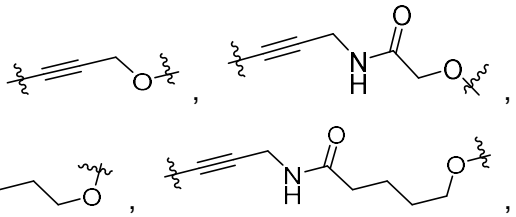
2. The compound or a salt thereof according to claim 1, wherein the compound is represented by the formula I-1,

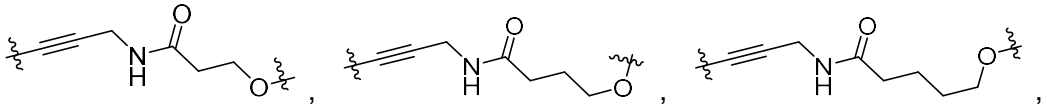


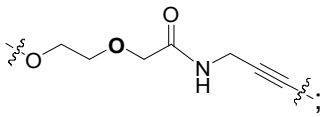
formula I-1

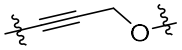
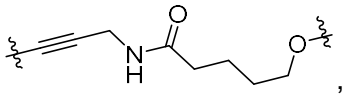
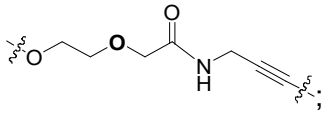
wherein:

L^1 is selected from ;

preferably, L^1 is selected from ,

,



more preferably, L^1 is selected from , , ;

r^1, r^2, r^{3a}, r^{3b}, independently of each other, are selected from any integer between 1 and 6;

preferably, r^1 is selected from 1, 2, 3;

more preferably, r^1 is 1;

preferably, r^2 is selected from 1, 2, 3;

more preferably, r^2 is 1;

preferably, r^{3a}, r^{3b}, independently of each other, are selected from 1, 2, 3, 4, 5;

more preferably, r^{3a}, r^{3b}, independently of each other, are selected from 1, 2, 3;

most preferably, r^{3a} is 1;

most preferably, r^{3b} is 2;

M is selected from a direct bond, CH_2, NH, O, S;

preferably, M is selected from CH_2, O;

X is selected from O, S, NH;

preferably, X is selected from O, S;

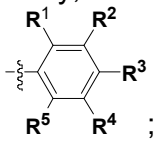
more preferably, X is O;

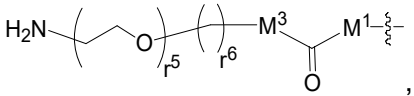
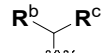
Y is selected from a direct bond, O, S, NH;

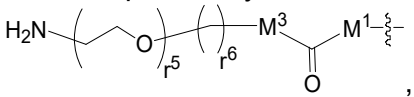
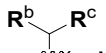
preferably, Y is a direct bond;

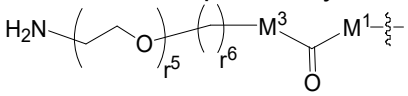
W is selected from a direct bond, O, S, NH;

preferably, W is a direct bond;

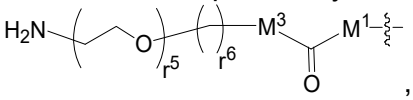
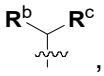
R is ;

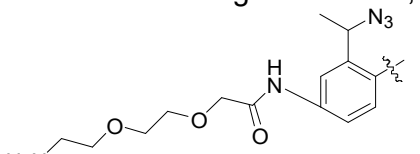
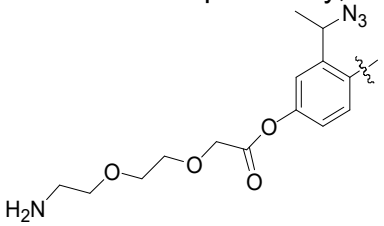
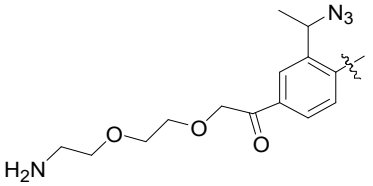
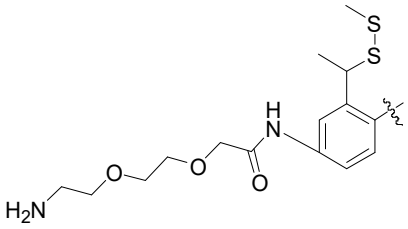
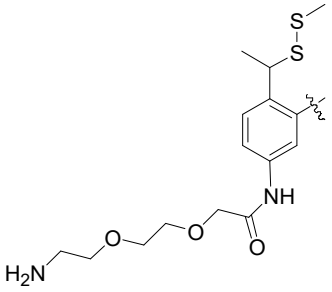
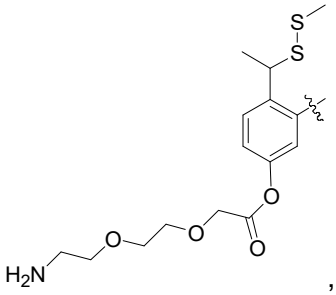
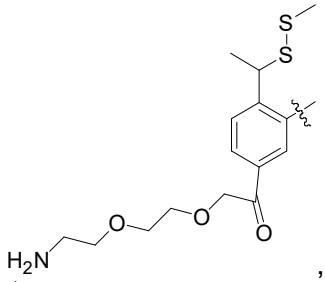
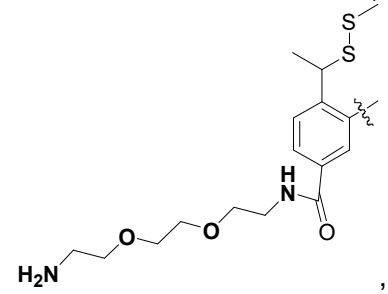
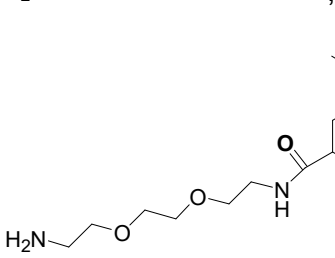
in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^2, R^3 or R^4) is , and the others, independently of each other, are selected from H, , azido, nitro, amino, sulfo, carboxyl, aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), F, I, Br, Cl, alkoxyl (e.g., C_1-C_6 alkoxyl);

preferably, in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^2, R^3 or R^4) is , and the others, independently of each other, are selected from H, ;

more preferably, in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^2, R^3 or R^4) is , another (e.g., R^1 or R^5) is , and the

remaining three are H;

further preferably, in R^1, R^2, R^3, R^4, R^5, R^3 or R^4 is , R^1 is , and the remaining three are H;

most preferably, R is selected from , , , , , , , , ;

r^5, r^6, independently of each other, are selected from any integer between 1 and 6;

preferably, r^5 is selected from 1, 2, 3;

more preferably, r^5 is 2;

preferably, r^6 is selected from 1, 2, 3;

more preferably, r^6 is 1 or 2;

M^1, M^3, independently of each other, are selected from a direct bond, NH, O, S;

preferably, M^1 is selected from a direct bond, NH, O;

preferably, M^3 is selected from a direct bond, NH;

more preferably, when M^1 is NH, O or S, M^3 is a direct bond, and when M^3 is NH, O or S, M^1 is a direct bond;

in R^b, R^c, any one is selected from $-N_3$, $-SS-C_1-C_6$ alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), $-ONH_2$, $-OCOR_x$, $-OCONHR_x$, and the other is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl $-C_1-C_6$ alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), wherein each R_x, independently, is selected from aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl) or aromatic alkyl (e.g., phenyl C_1-C_6 alkyl);

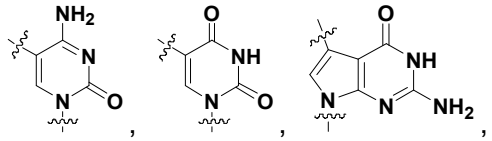
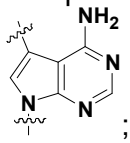
preferably, in R^b, R^c, any one is selected from $-N_3$, $-SS-C_1-C_6$ alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl;

more preferably, in R^b, R^c, any one is selected from $-N_3$, -SS-Me, and the other is methyl;

Z is selected from O, S, BH;

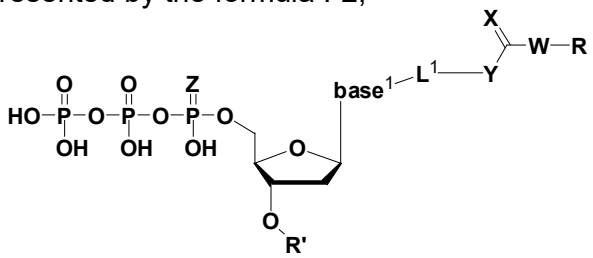
preferably, Z is O;

$base^1$ is selected from a base, a deaza base or a tautomer thereof, for example, adenine, 7-deazaadenine, thymine, uracil, cytosine, guanine, 7-deazaguanine or a tautomer thereof;

preferably, $base^1$ is selected from , ;

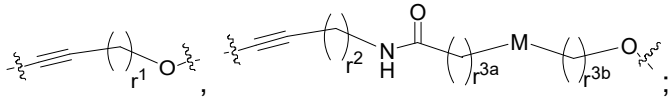
R' represents a reversible blocking group.

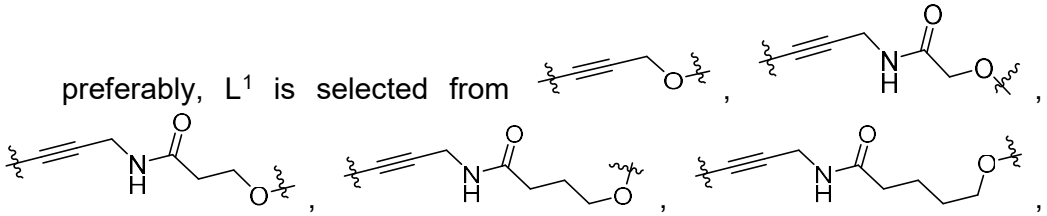
3. The compound or a salt thereof according to claim 1, wherein the compound is represented by the formula I-2,

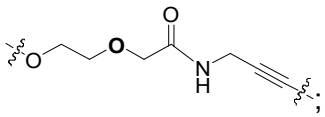


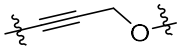
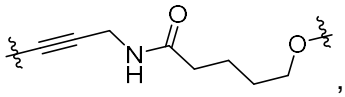
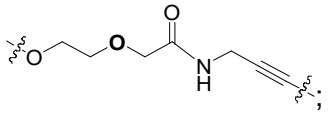
formula I-2

wherein:

L^1 is selected from ;

preferably, L^1 is selected from ,



more preferably, L^1 is selected from , , ;

r^1, r^2, r^{3a}, r^{3b}, independently of each other, are selected from any integer between 1 and 6;

preferably, r^1 is selected from 1, 2, 3;

more preferably, r^1 is 1;

preferably, r^2 is selected from 1, 2, 3;

more preferably, r^2 is 1;

preferably, r^{3a}, r^{3b}, independently of each other, are selected from 1, 2, 3, 4, 5;

more preferably, r^{3a}, r^{3b}, independently of each other, are selected from 1, 2, 3;

most preferably, r^{3a} is 1;

most preferably, r^{3b} is 2;

M is selected from a direct bond, CH_2, NH, O, S;

preferably, M is selected from CH_2, O;

X is selected from O, S, NH;

preferably, X is selected from O, S;

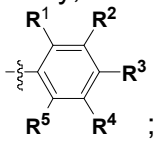
more preferably, X is O;

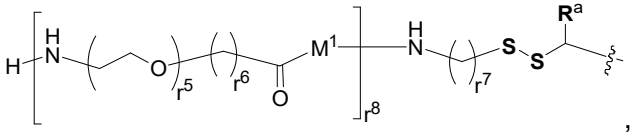
Y is selected from a direct bond, O, S, NH;

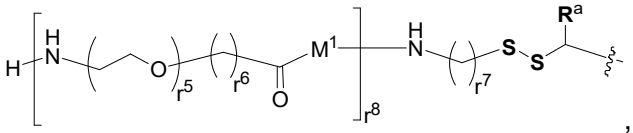
preferably, Y is a direct bond;

W is selected from a direct bond, O, S, NH;

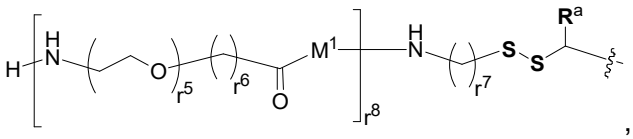
preferably, W is a direct bond;

R is ;

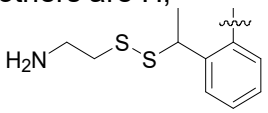
in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^1 or R^5) is , and the others, independently of each other, are selected from H, azido, nitro, amino, sulfo, carboxyl, aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), F, I, Br, Cl, alkoxyl (e.g., C_1-C_6 alkoxyl);

preferably, in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^1 or R^5) is , and the others are H;

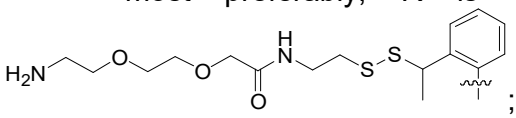
more preferably, in R^1, R^2, R^3, R^4, R^5, R^1 is



, and the others are H;

most preferably, R is selected from 

,



;

r^5, r^6, r^7, independently of each other, are selected from any integer between 1 and 6;

preferably, r^5 is selected from 1, 2, 3;

more preferably, r^5 is 2;

preferably, r^6 is selected from 1, 2, 3;

more preferably, r^6 is 1;

preferably, r^7 is selected from 1, 2, 3;

more preferably, r^7 is 2;

r^8 is selected from 0, 1;

M^1 is selected from a direct bond, NH, O, S;

preferably, M^1 is a direct bond;

R^a is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl);

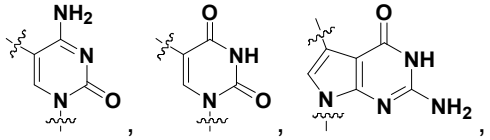
preferably, R^a is selected from C_1-C_6 alkyl;

more preferably, R^a is methyl;

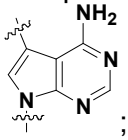
Z is selected from O, S, BH;

preferably, Z is O;

$base^1$ is selected from a base, a deaza base or a tautomer thereof, for example, adenine, 7-deazaadenine, thymine, uracil, cytosine, guanine, 7-deazaguanine or a tautomer thereof;

preferably, $base^1$ is selected from 

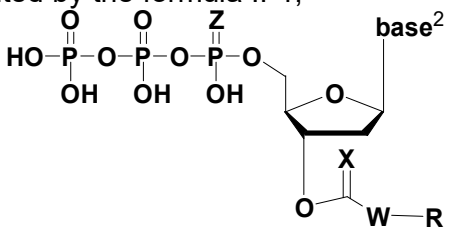
,



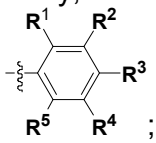
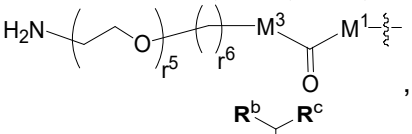
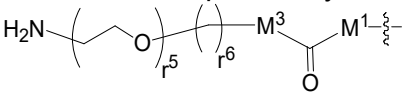
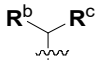
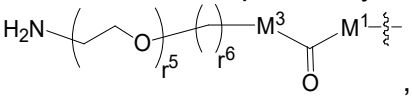
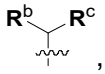
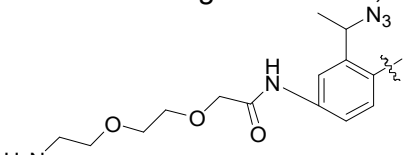
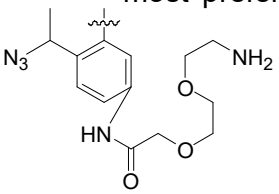
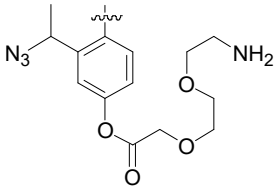
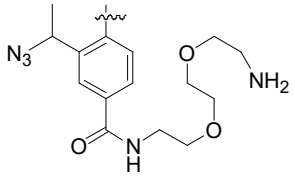
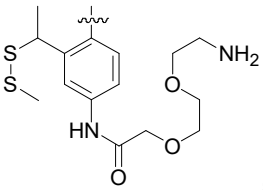
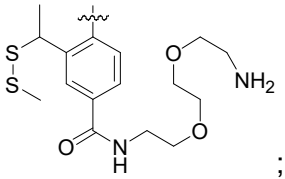
;

R' represents a reversible blocking group.

4. The compound or a salt thereof according to claim 1, wherein the compound is represented by the formula II-1,



formula II-1

wherein:
X is selected from O, S, NH;
preferably, X is selected from O, S;
more preferably, X is O;
W is selected from a direct bond, O, S, NH;
preferably, W is a direct bond;
R is ;
in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^3 or R^4) is , and the others, independently of each other, are selected from H, , azido, nitro, amino, sulfo, carboxyl, aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), F, I, Br, Cl, alkoxyl (e.g., C_1-C_6 alkoxyl);
preferably, in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^3 or R^4) is , and the others, independently of each other, are selected from H, ;
more preferably, in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^3 or R^4) is , another (e.g., R^1 or R^5) is , and the remaining three are H;
further preferably, in R^1, R^2, R^3, R^4, R^5, R^3 or R^4 is , R^1 is , and the remaining three are H;
most preferably, R is selected from , , , , , ;
r^5, r^6, independently of each other, are selected from any integer between 1 and 6;

preferably, r^5 is selected from 1, 2, 3;

more preferably, r^5 is 2;

preferably, r^6 is selected from 1, 2, 3;

more preferably, r^6 is selected from 1, 2;

M^1, M^3, independently of each other, are selected from a direct bond, NH, O, S;

preferably, M^1 is selected from a direct bond, NH, O;

preferably, M^3 is selected from a direct bond, NH;

in R^b, R^c, any one is selected from $-N_3$, $-SS-C_1-C_6$ alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), $-ONH_2$, $-OCOR_x$, $-OCONHR_x$, and the other is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl $-C_1-C_6$ alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), wherein each R_x, independently, is selected from aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl) or aromatic alkyl (e.g., phenyl C_1-C_6 alkyl);

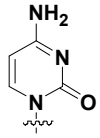
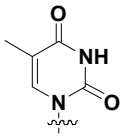
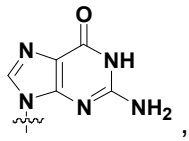
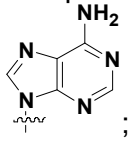
preferably, in R^b, R^c, any one is selected from $-N_3$, $-SS-C_1-C_6$ alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl;

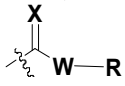
more preferably, in R^b, R^c, any one is $-N_3$ or -SS-Me, and the other is methyl;

Z is selected from O, S, BH;

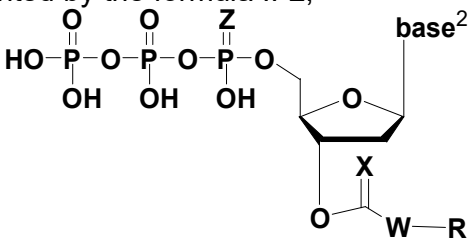
preferably, Z is O;

$base^2$ is selected from a base, a deaza base or a tautomer thereof, for example, adenine, 7-deazaadenine, thymine, uracil, cytosine, guanine, 7-deazaguanine or a tautomer thereof;

preferably, $base^2$ is selected from , , , ;

 represents a reversible blocking group.

5. The compound or a salt thereof according to claim 1, wherein the compound is represented by the formula II-2,



formula II-2

wherein:

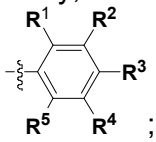
X is selected from O, S, NH;

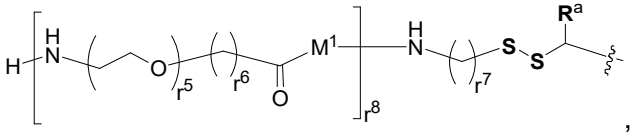
preferably, X is selected from O, S;

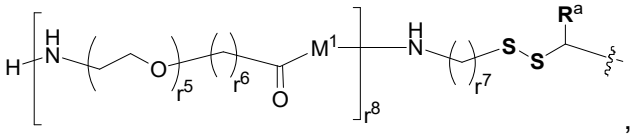
more preferably, X is O;

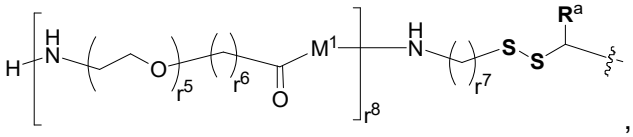
W is selected from a direct bond, O, S, NH;

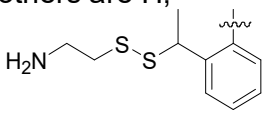
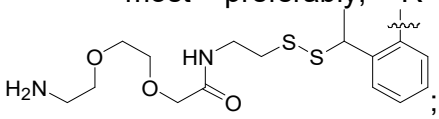
preferably, W is a direct bond;

R is  ;

in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^1 or R^5) is , and the others, independently of each other, are selected from H, azido, nitro, amino, sulfo, carboxyl, aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), F, I, Br, Cl, alkoxyl (e.g., C_1-C_6 alkoxyl);

preferably, in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^1 or R^5) is , and the others are H;

more preferably, in R^1, R^2, R^3, R^4, R^5, R^1 is , and the others are H;

most preferably, R is selected from , ;

r^5, r^6, r^7 are selected from any integer between 1 and 6;

preferably, r^5 is selected from 1, 2, 3;

more preferably, r^5 is 2;

preferably, r^6 is selected from 1, 2, 3;

more preferably, r^6 is 1;

preferably, r^7 is selected from 1, 2, 3;

more preferably, r^7 is 2;

r^8 is selected from 0, 1;

M^1 is selected from a direct bond, NH, O, S;

preferably, M^1 is a direct bond;

R^a is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl);

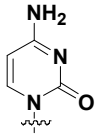
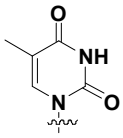
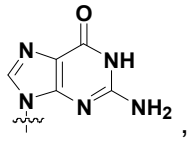
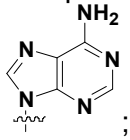
preferably, R^a is selected from C_1-C_6 alkyl;

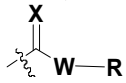
more preferably, R^a is methyl;

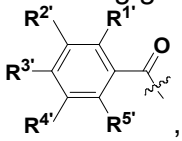
Z is selected from O, S, BH;

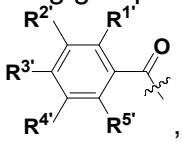
preferably, Z is O;

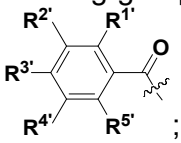
$base^2$ is selected from a base, a deaza base or a tautomer thereof, for example, adenine, 7-deazaadenine, thymine, uracil, cytosine, guanine, 7-deazaguanine or a tautomer thereof;

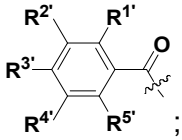
preferably, base[2] is selected from , , , ;

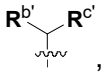
 represents a reversible blocking group.

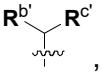
6. The compound or a salt thereof according to any one of claims 1 to 3, wherein the reversible blocking group R' is selected from N_3-C_1-C_6 alkyl, C_1-C_6 alkyl-SS-C_1-C_6 alkyl, , NH_2, -ONH_2, -$OCOR_z$, -$OCONHR_z$, wherein each R_z, independently, is selected from aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl) or aromatic alkyl (e.g., phenyl C_1-C_6 alkyl);

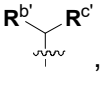
preferably, the reversible blocking group R' is selected from N_3-C_1-C_6 alkyl, C_1-C_6 alkyl-SS-C_1-C_6 alkyl, , NH_2;

more preferably, the reversible blocking group R' is selected from N_3-C_1-C_6 alkyl, C_1-C_6 alkyl-SS-C_1-C_6 alkyl, ;

most preferably, the reversible blocking group R' is selected from N_3-CH_2-, CH_3-CH_2-S-S-CH_2-, ;

in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, any one (e.g., $R^{1'}$ or $R^{5'}$) is , and the others, independently of each other, are selected from H, azido, nitro, amino, sulfo, carboxyl, aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), F, I, Br, Cl, alkoxyl (e.g., C_1-C_6 alkoxyl),

preferably, in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, any one (e.g., $R^{1'}$ or $R^{5'}$) is , and the others are H,

more preferably, in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, $R^{1'}$ is , and the others are H,

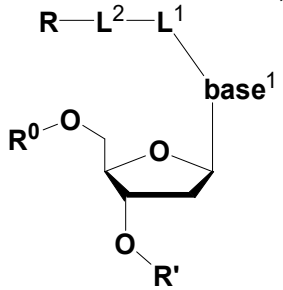
in $R^{b'}$, $R^{c'}$, any one is selected from -N_3, -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), -ONH_2, -$OCOR_x$, -$OCONHR_x$, and the other is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl),

wherein each R_x, independently, is selected from aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl) or aromatic alkyl (e.g., phenyl C_1-C_6 alkyl),

preferably, in $R^{b'}$, $R^{c'}$, any one is selected from -N_3, -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl,

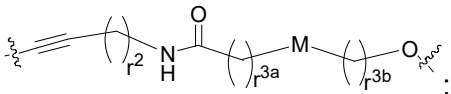
more preferably, in $R^{b'}$, $R^{c'}$, any one is selected from -N_3, -SS-Me, and the other is methyl.

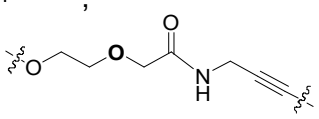
7. A compound of formula III or a salt thereof,

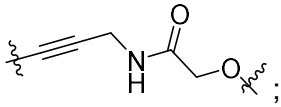


formula III

wherein:

L^1 is selected from ;

preferably, L^1 is selected from ,

;

r^2 is selected from 1, 2, 3;

preferably, r^2 is 1;

r^{3a} is selected from 1, 2, 3;

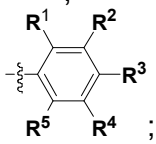
preferably, r^{3a} is 1;

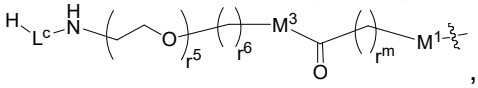
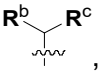
r^{3b} is selected from 0, 1, 2, 3;

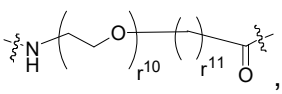
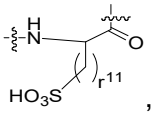
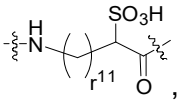
preferably, r^{3b} is selected from 0, 2;

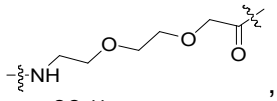
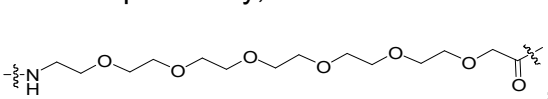
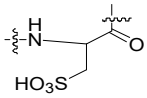
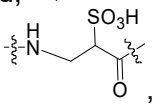
M is selected from a direct bond, O;

L^2 is ;

R is ;

in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^3) is , another (e.g., R^1 or R^2) is selected from , and the remaining three are H;

L^c is selected from a direct bond, , , , preferably, the NH end in L^c is linked to H, the =O end in L^c is linked to NH;

preferably, L^c is selected from a direct bond, , , , , preferably, the NH end in L^c is linked to H, the =O end in L^c is linked to NH;

r^m is selected from 0, 1, 2, 3;

preferably, r^m is selected from 0, 1;

r^5 is selected from 1, 2, 3;

preferably, r^5 is 2;

r^6 is selected from 1, 2, 3;

preferably, r^6 is 1 or 2;

r^{10} is selected from any integer between 1 and 10;

preferably, r^{10} is selected from any integer between 2 and 6;

more preferably, r^{10} is 2 or 6;

r^{11} is selected from any integer between 1 and 6;

preferably, r^{11} is selected from 1, 2, 3;

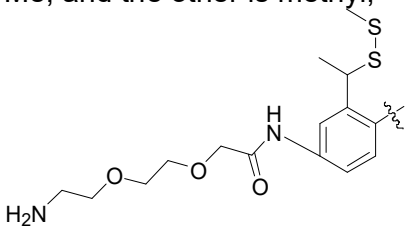
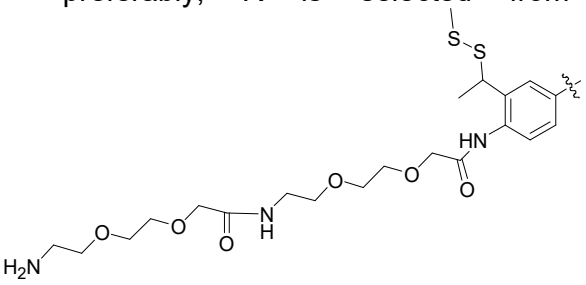
more preferably, r^{11} is 1;

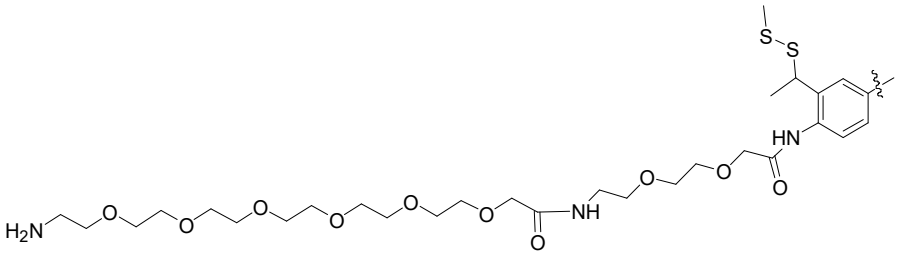
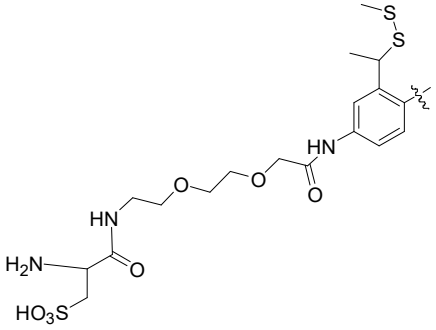
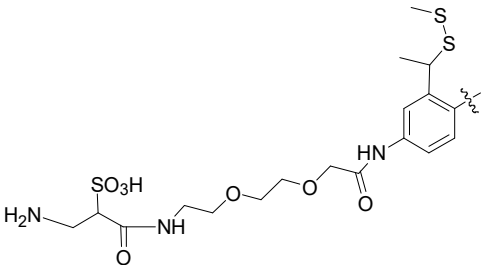
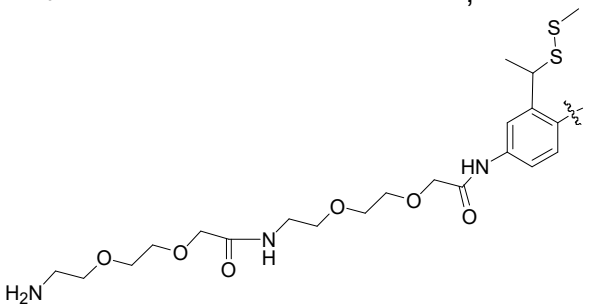
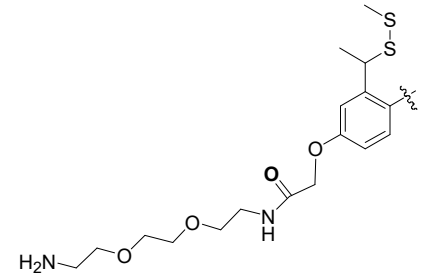
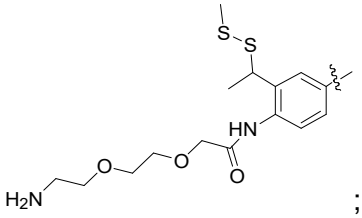
M^1 is selected from NH, O;

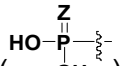
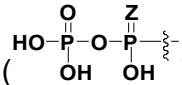
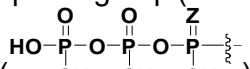
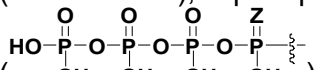
M^3 is selected from a direct bond, NH;

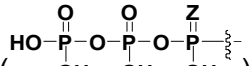
in R^b, R^c, any one is selected from -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl;

preferably, in R^b, R^c, any one is -SS-Me, and the other is methyl;

preferably, R is selected from , ,


,

,

,

,

,

;

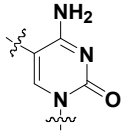
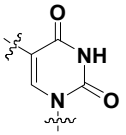
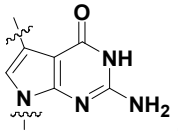
R^0 is selected from H, monophosphate group (), diphosphate group (), triphosphate group (), tetraphosphate group ();

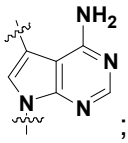
preferably, R^0 is a triphosphate group ();

each Z, independently, is selected from O, S, BH;

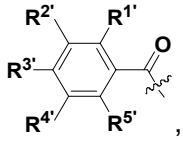
preferably, Z is O;

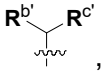
$base^1$ is selected from a base, a deaza base or a tautomer thereof, for example, adenine, 7-deazaadenine, thymine, uracil, cytosine, guanine, 7-deazaguanine or a tautomer thereof;

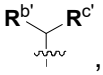
preferably, $base^1$ is selected from , , ,


;

in formula III, R' represents a reversible blocking group.

8. The compound or a salt thereof according to claim 7, wherein the reversible blocking group R' is ,

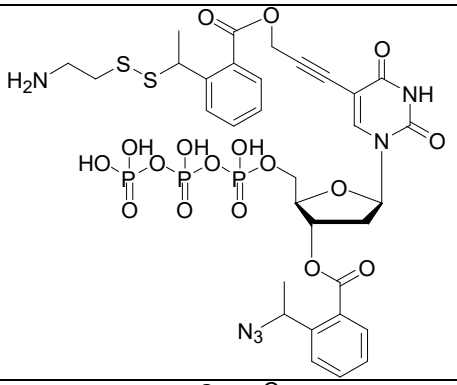
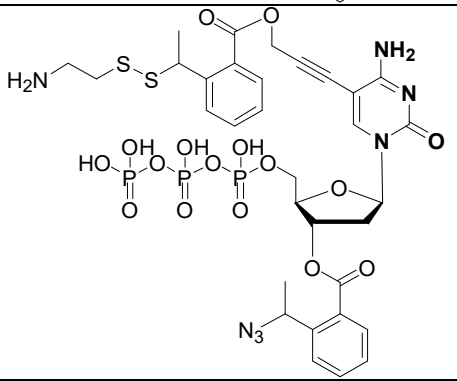
in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, any one (e.g., $R^{1'}$ or $R^{5'}$) is , another (e.g., $R^{3'}$) is selected from H, C_1-C_6 alkoxyl (e.g., methoxy), and the others are H,

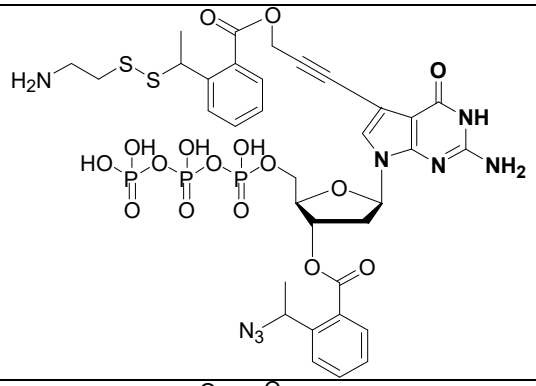
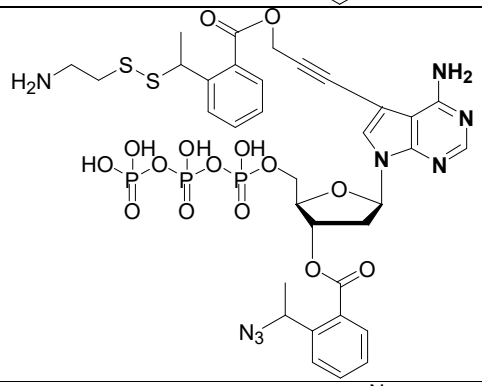
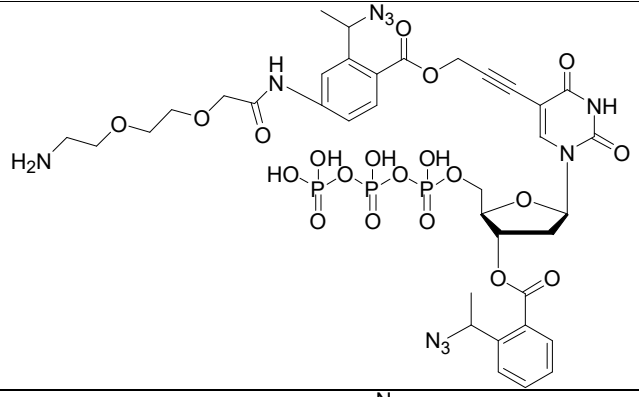
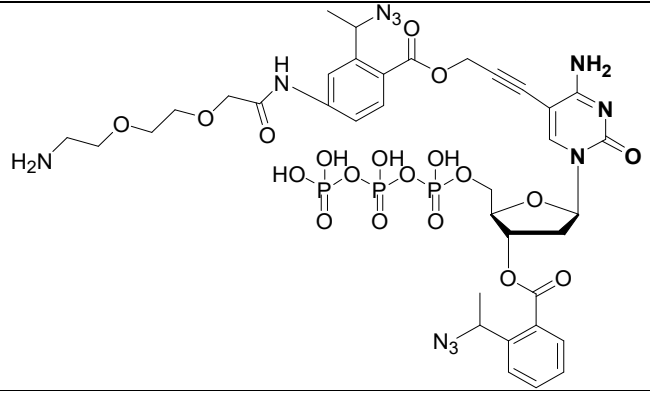
preferably, in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, $R^{1'}$ is , $R^{3'}$ is selected from H, C_1-C_6 alkoxyl (e.g., methoxy), and the others are H,

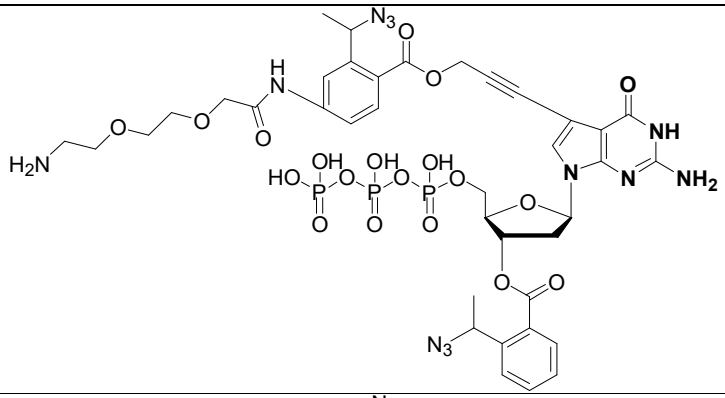
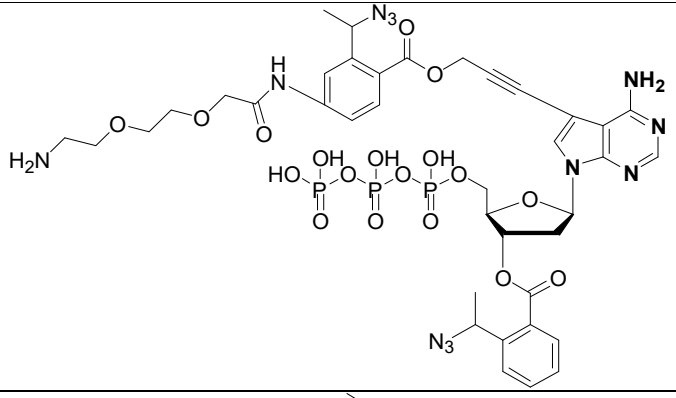
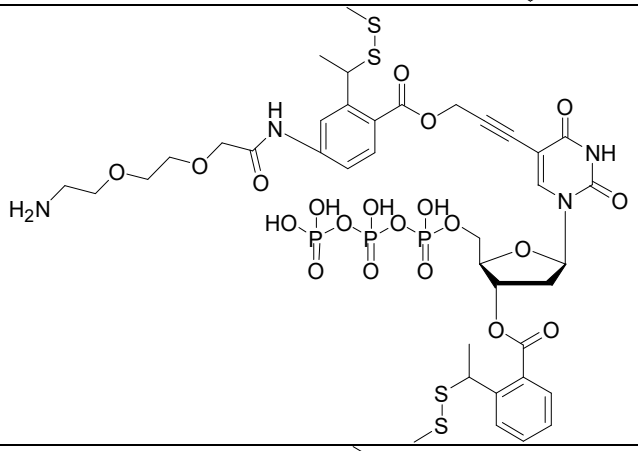
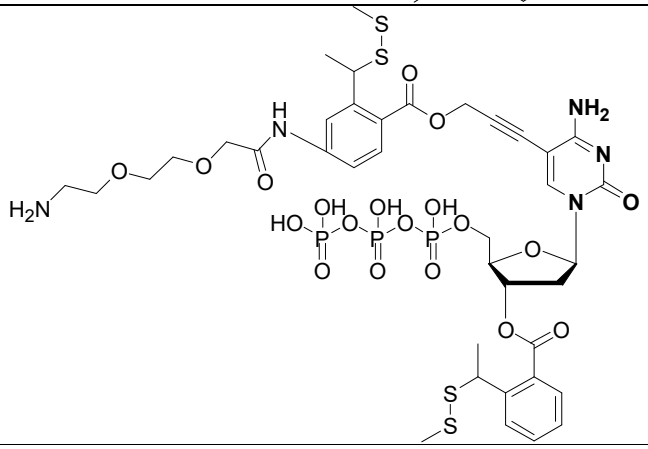
in $R^{b'}$, $R^{c'}$, any one is selected from $-N_3$, -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl,

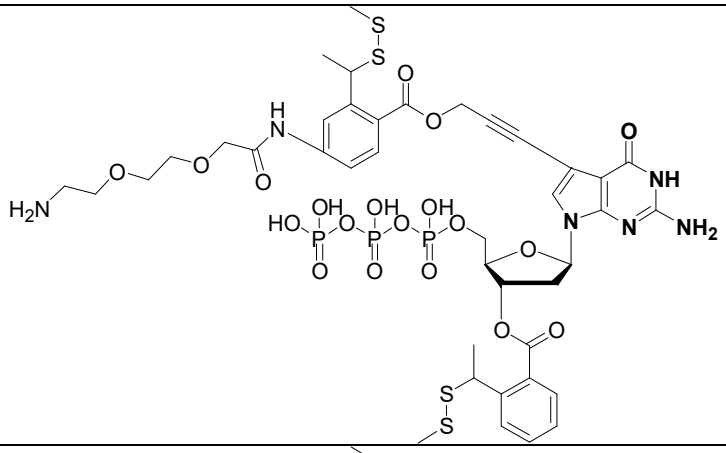
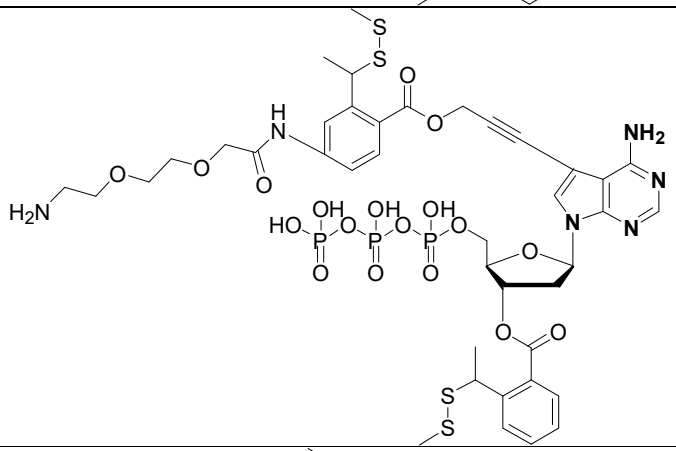
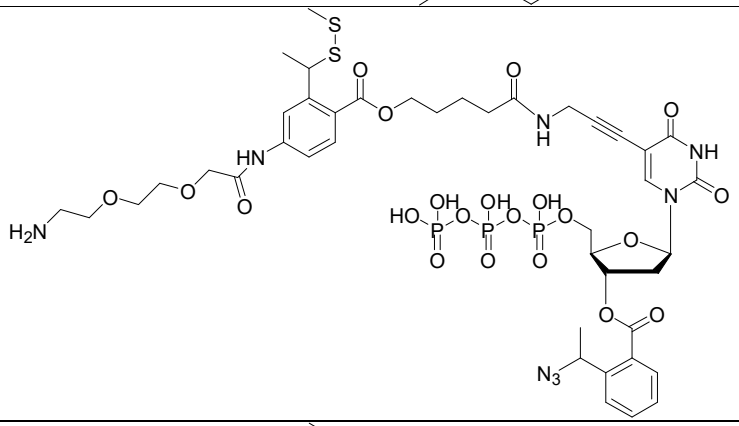
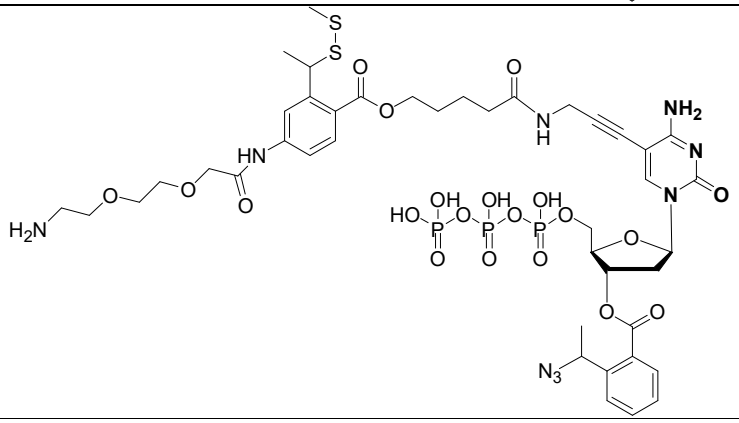
preferably, in $R^{b'}$, $R^{c'}$, any one is $-N_3$, -SS-Me, and the other is methyl.

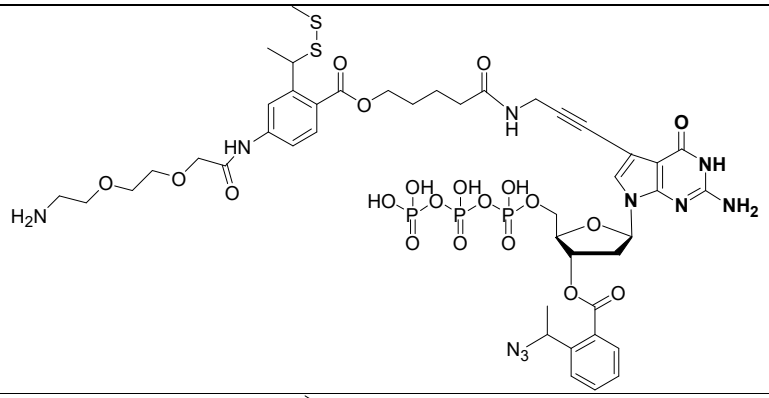
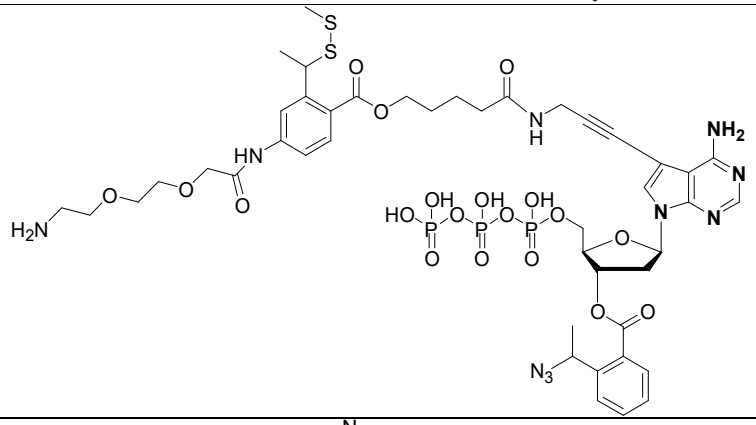
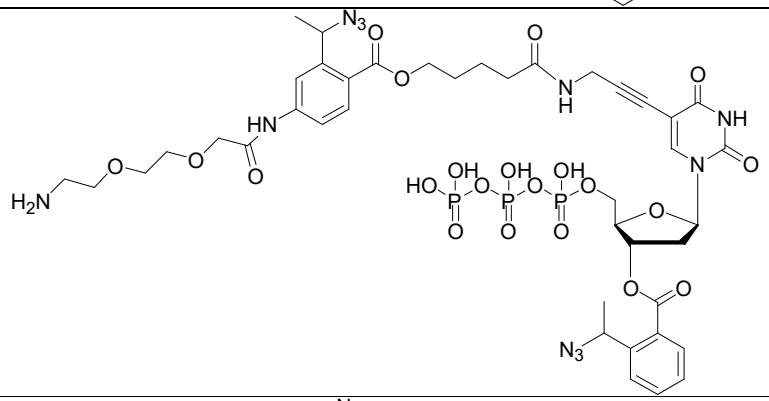
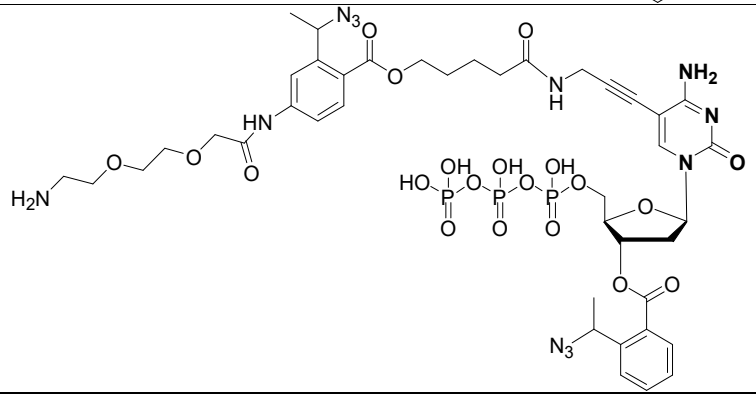
9. The compound or a salt thereof according to any one of claims 1 to 8, wherein the compound is selected from:

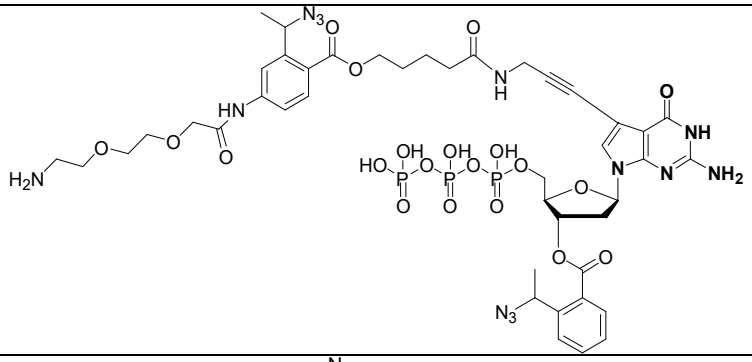
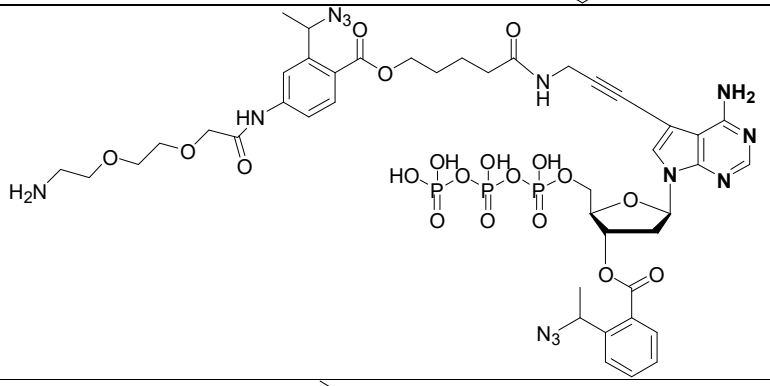
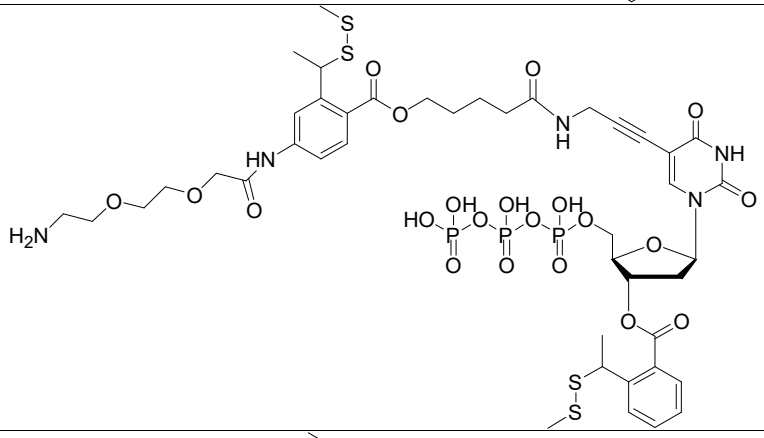
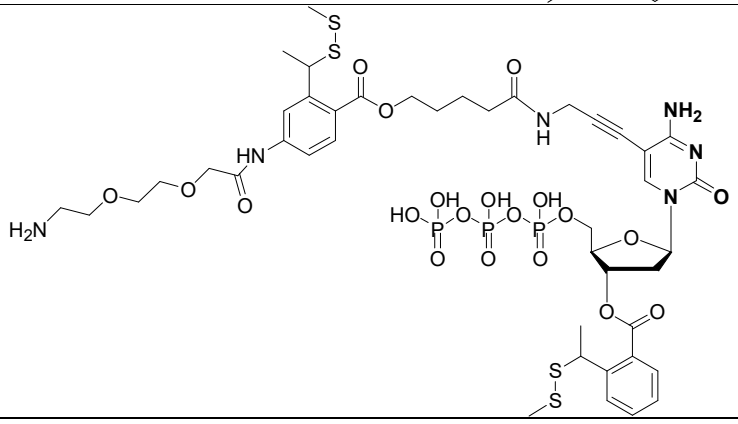
Serial Number	Structural formulae
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1B	

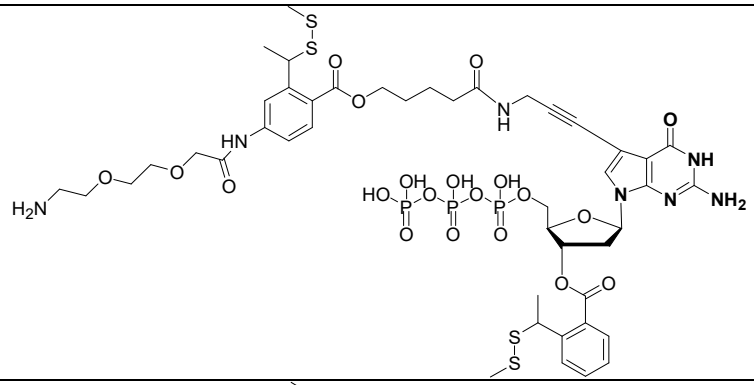
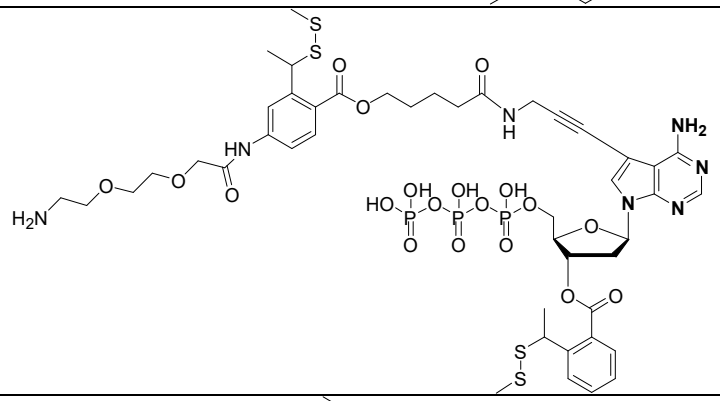
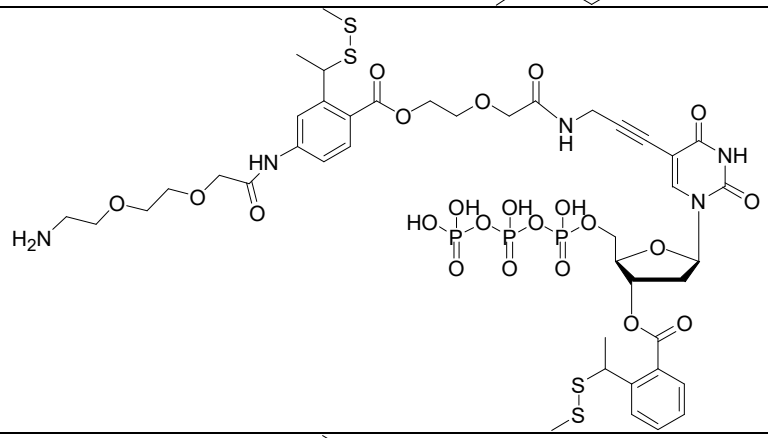
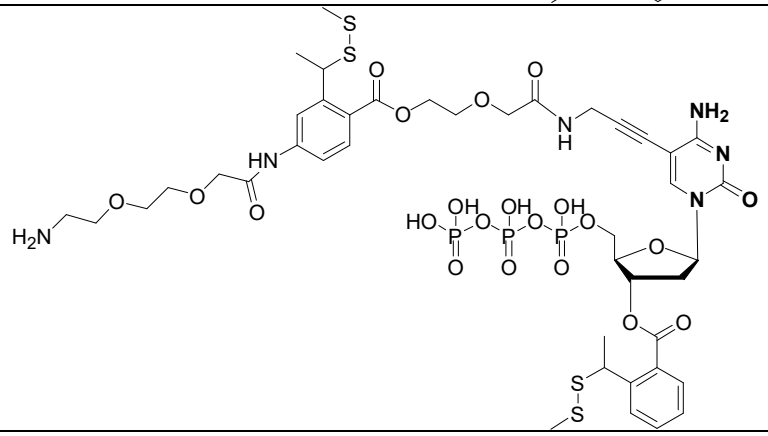
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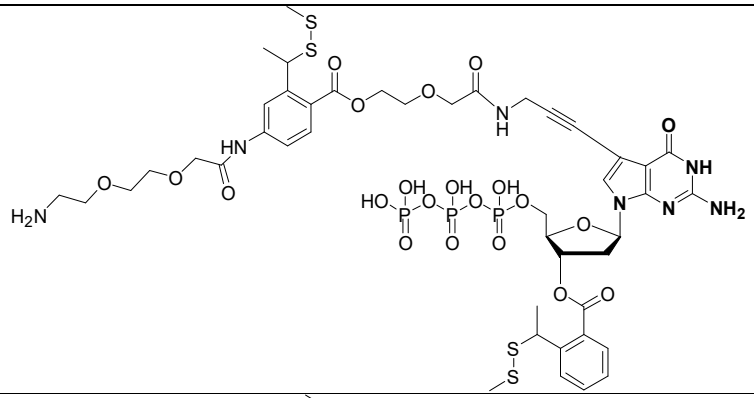
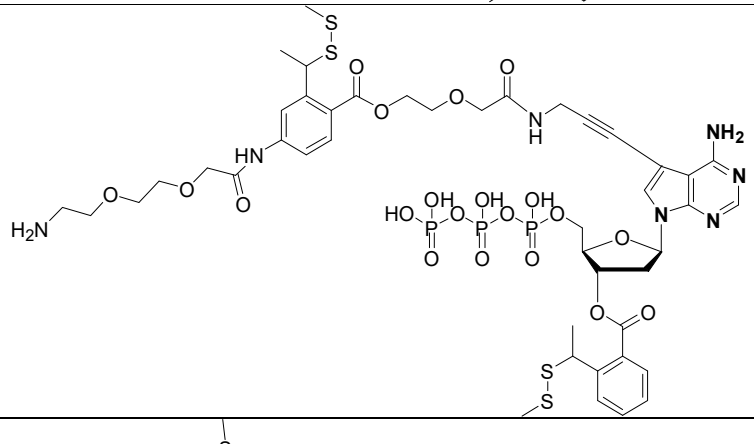
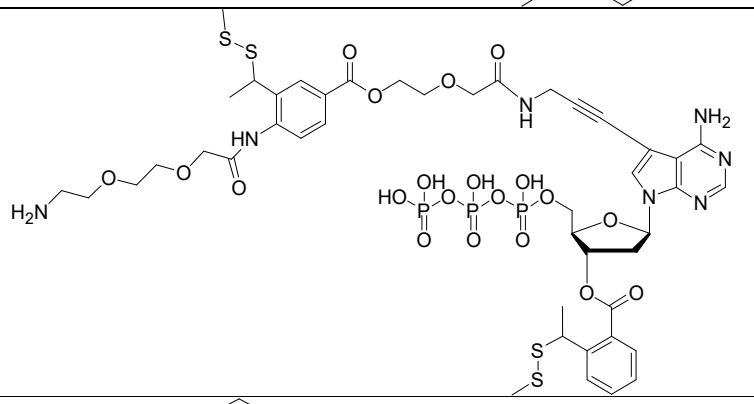
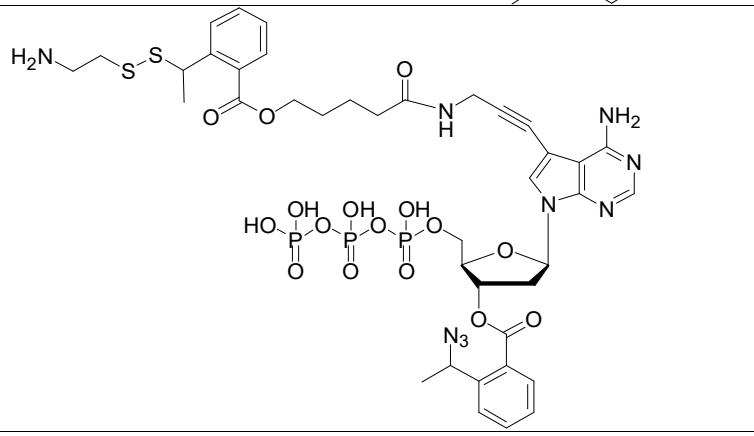
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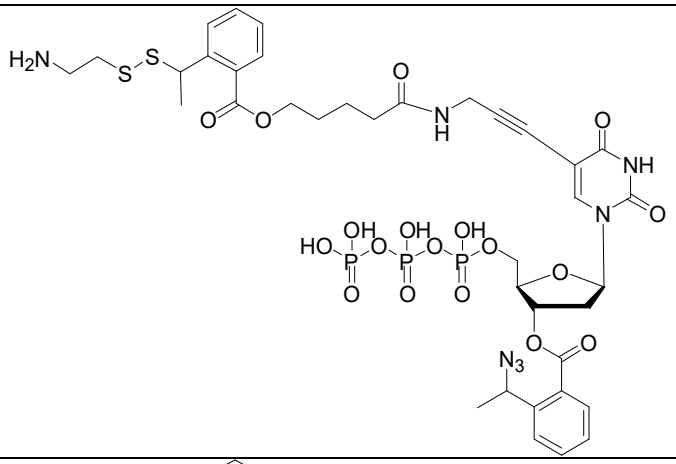
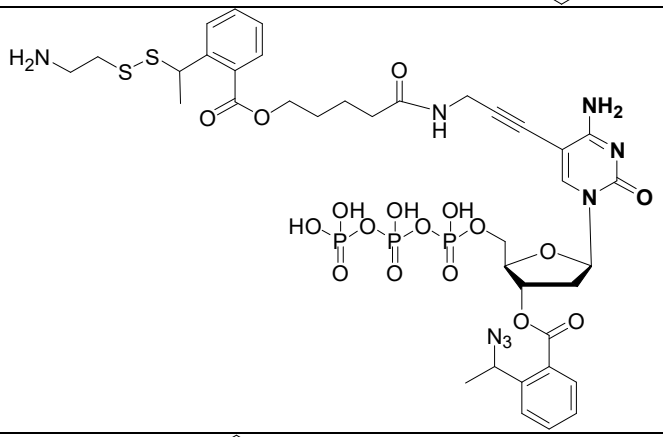
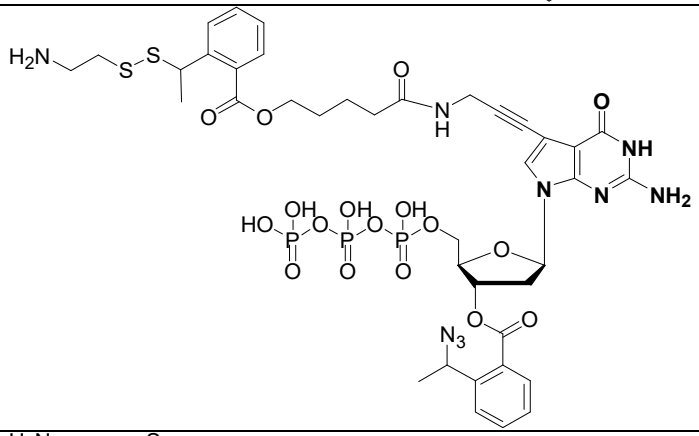
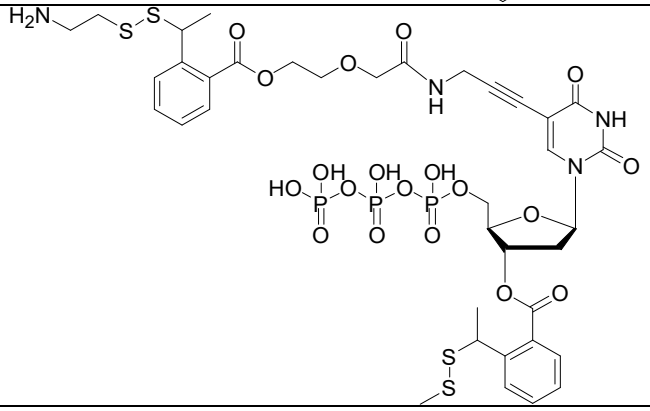
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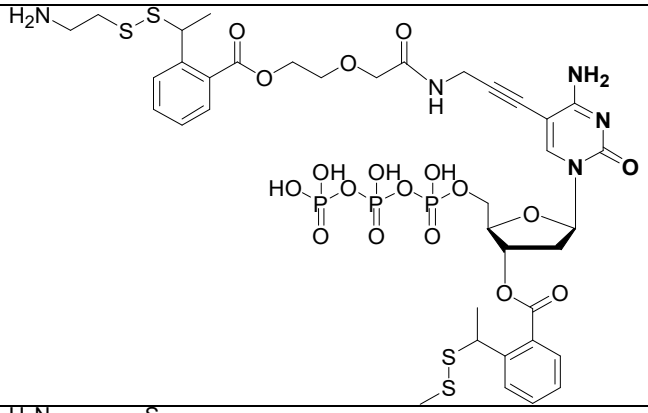
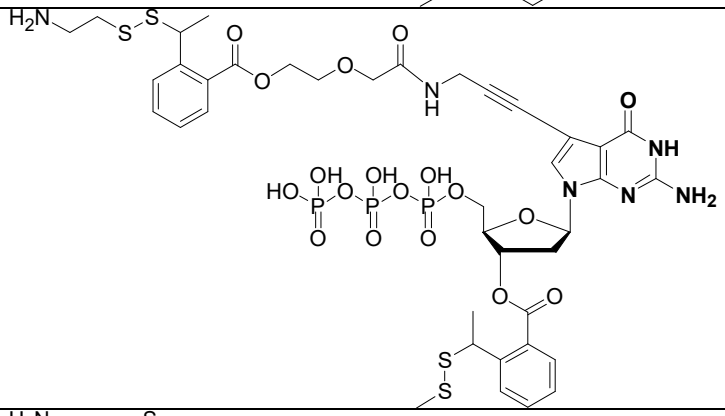
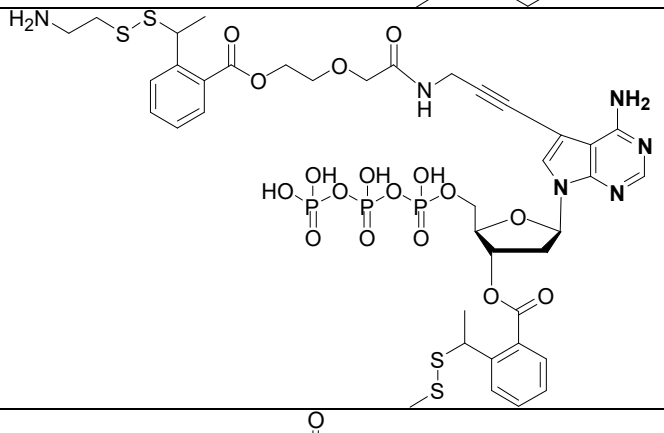
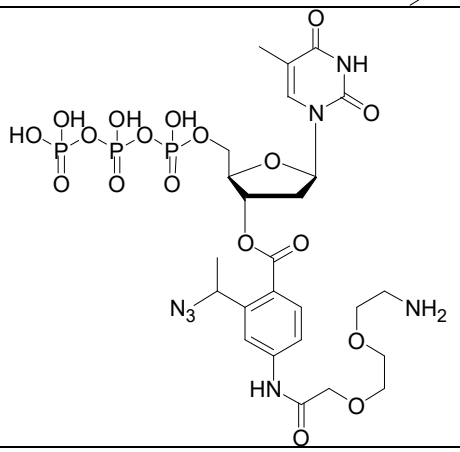
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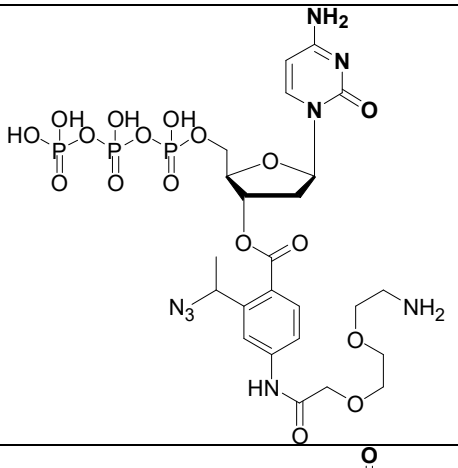
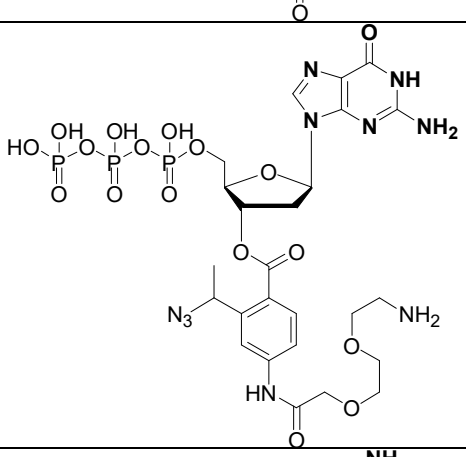
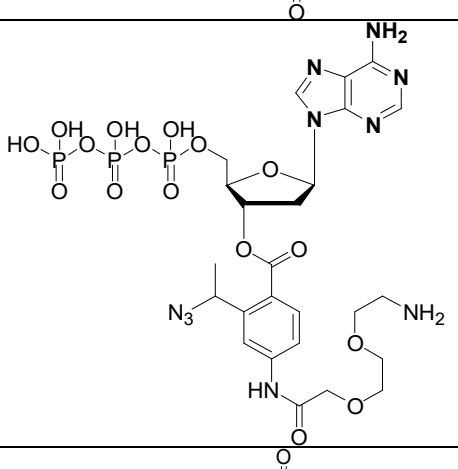
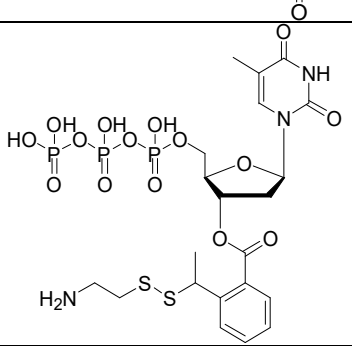
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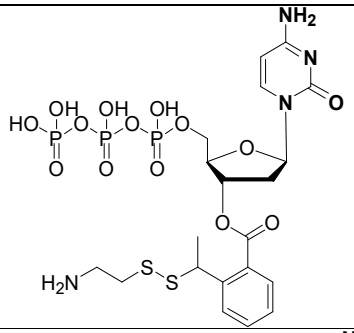
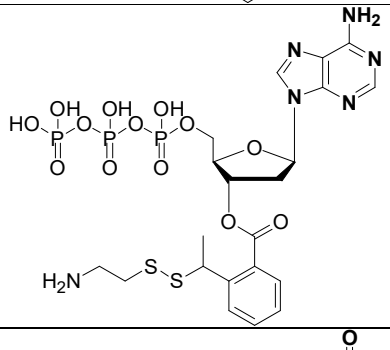
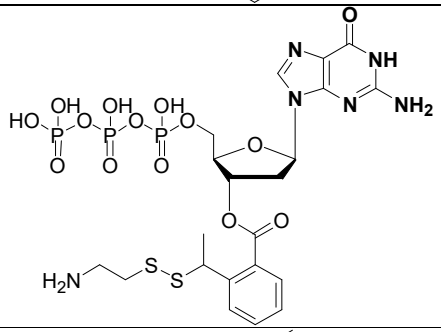
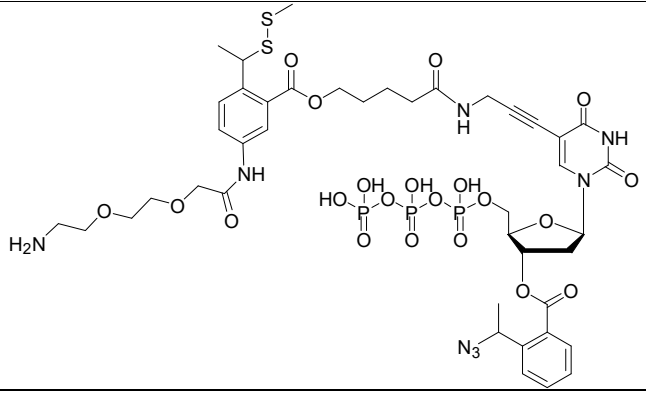
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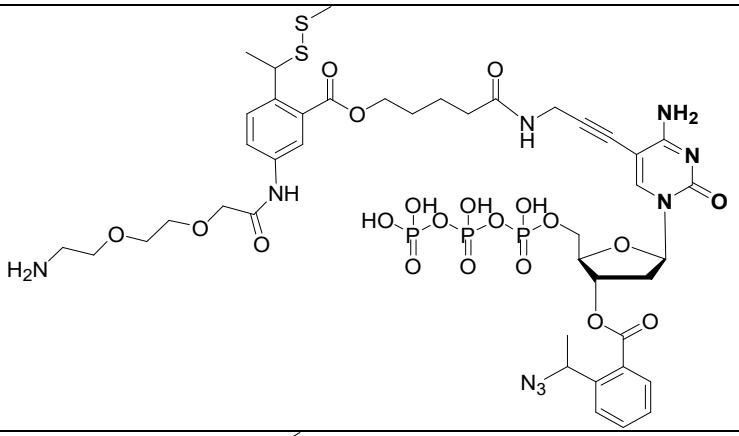
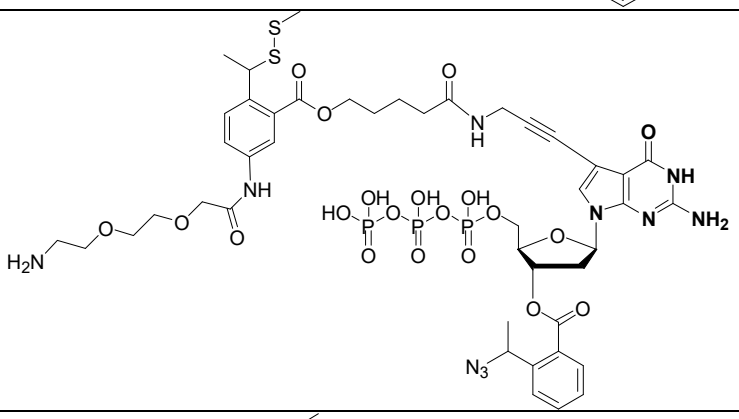
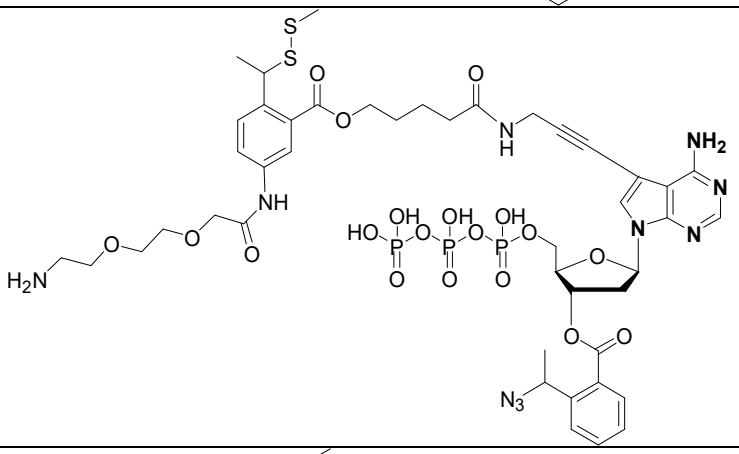
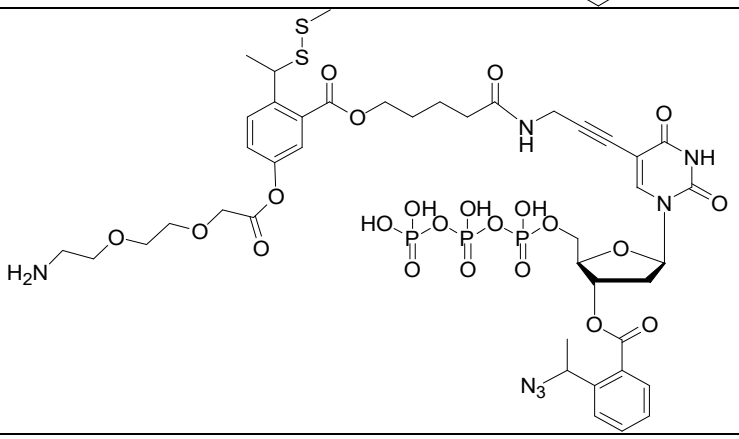
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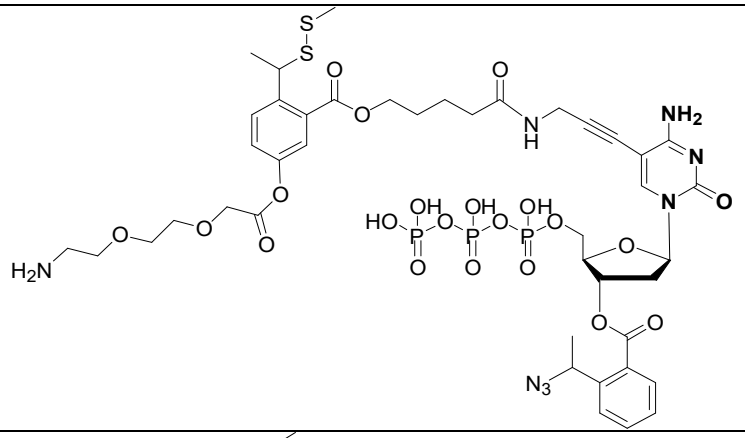
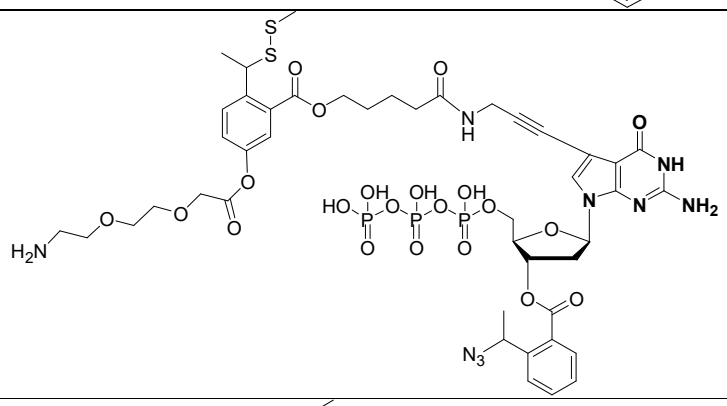
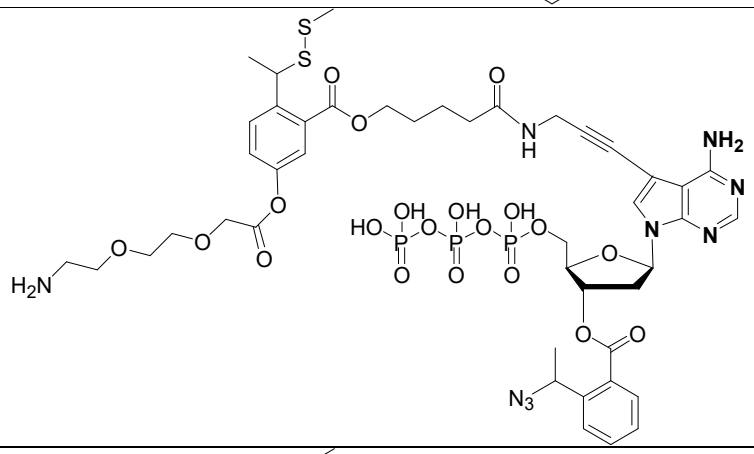
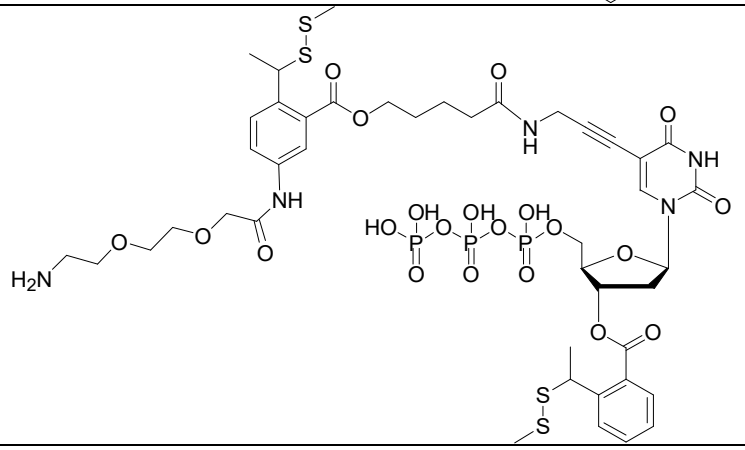
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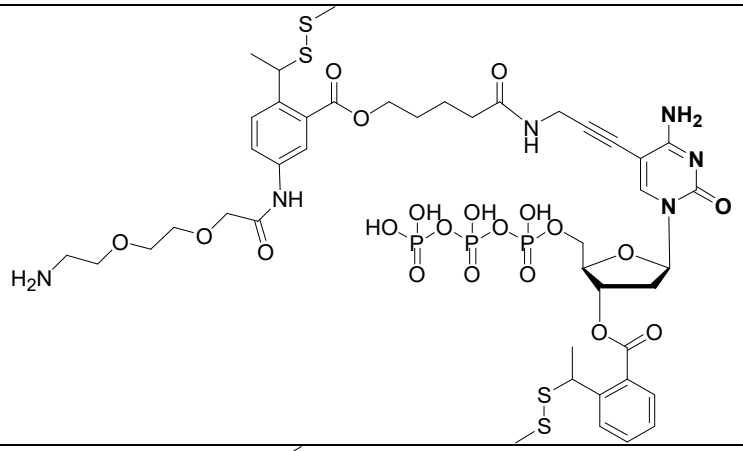
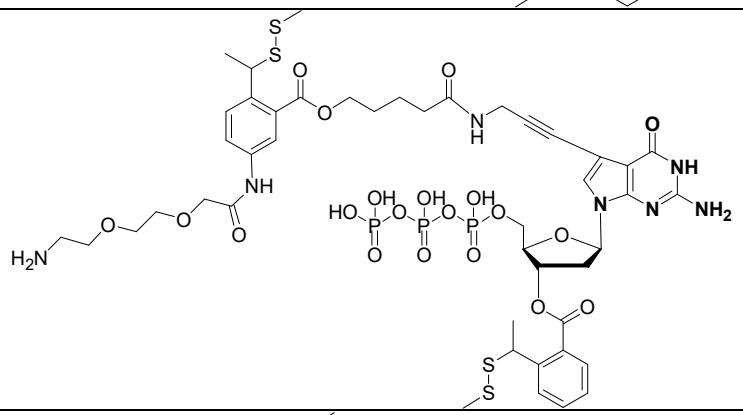
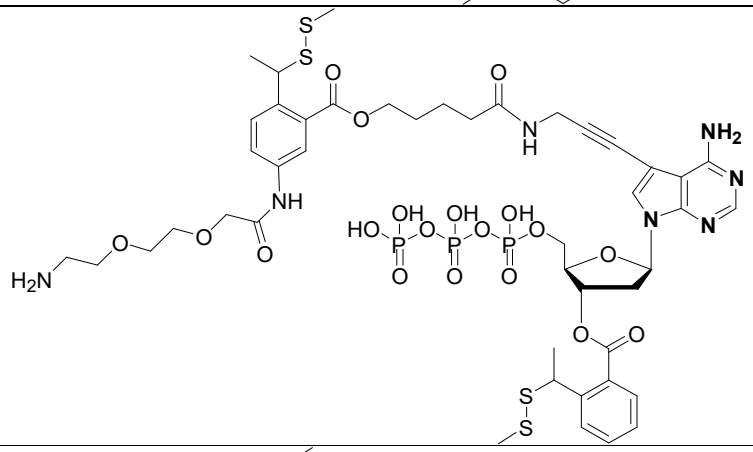
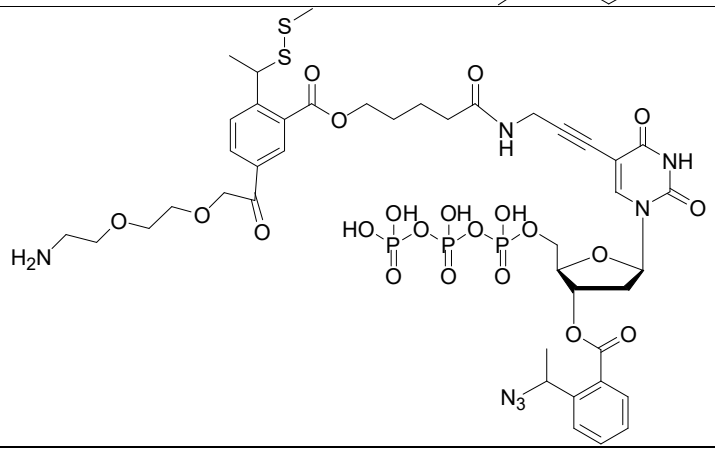
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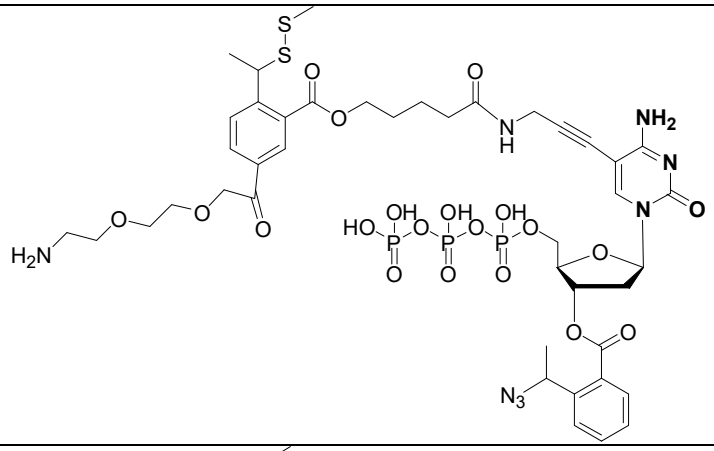
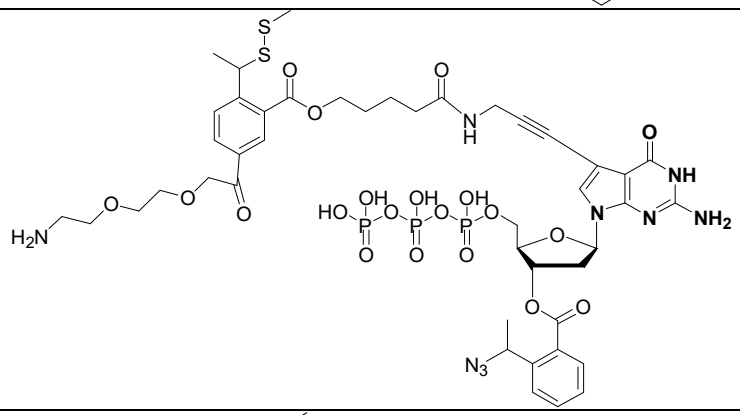
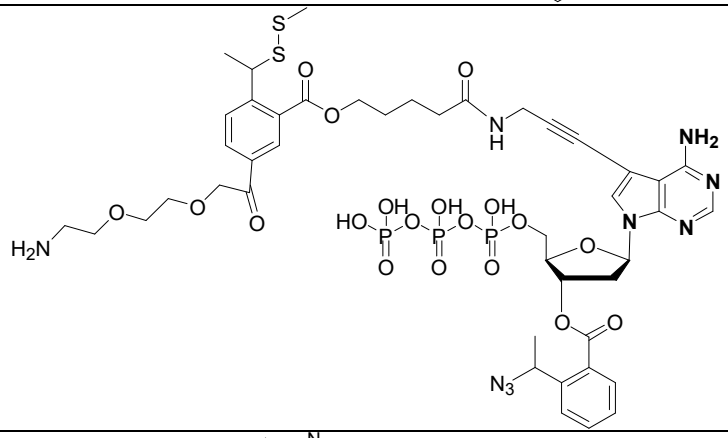
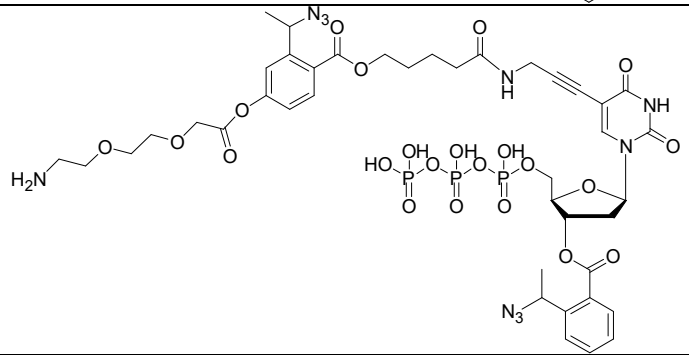
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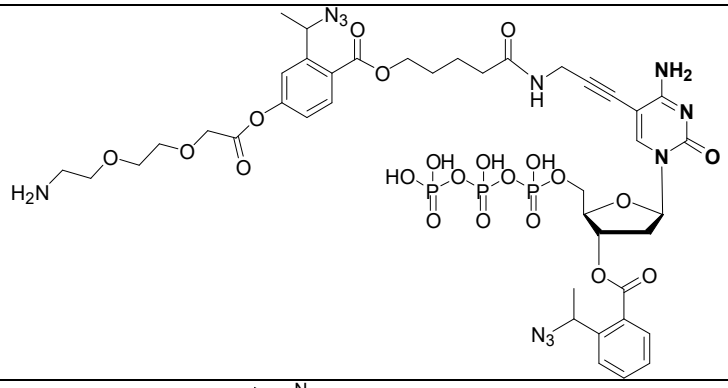
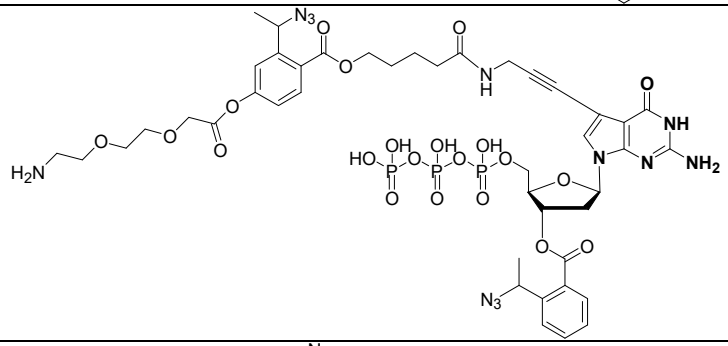
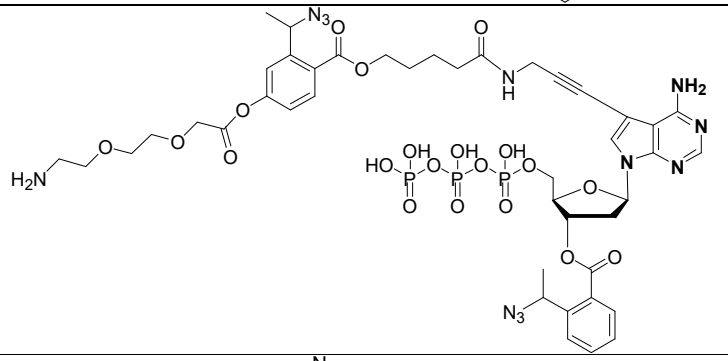
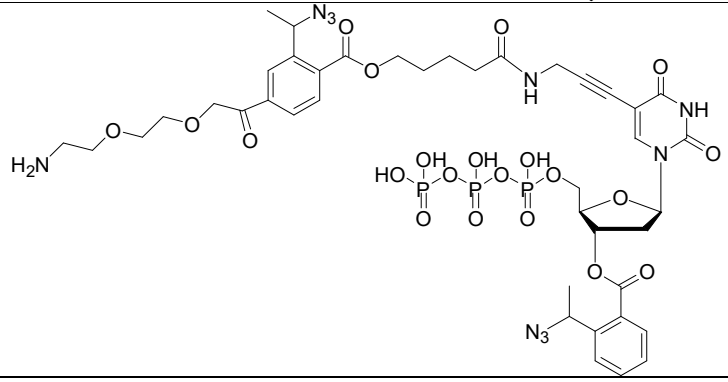
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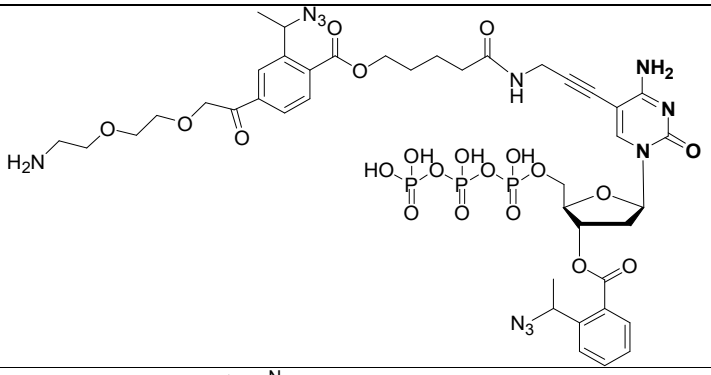
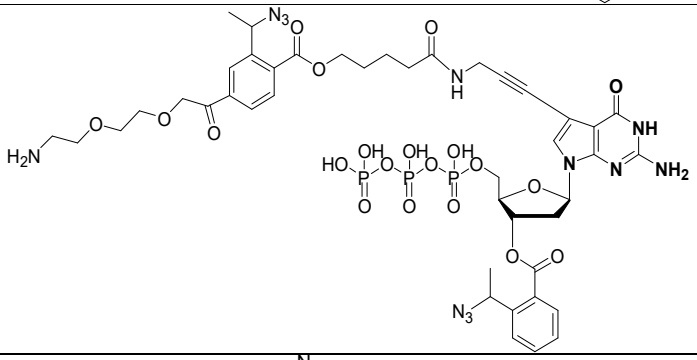
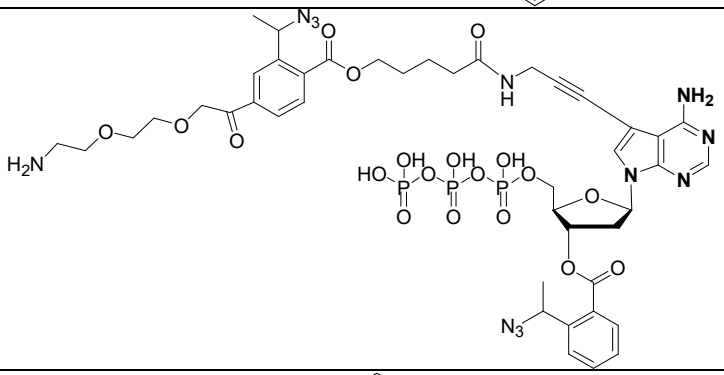
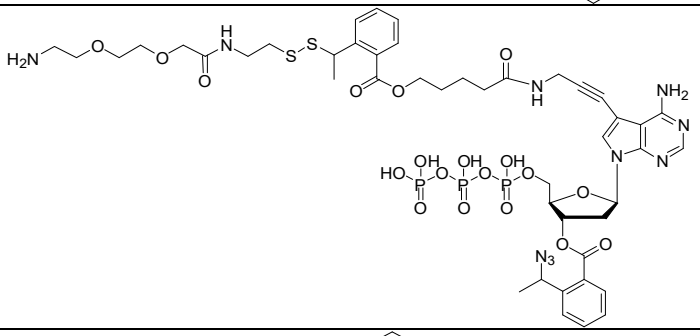
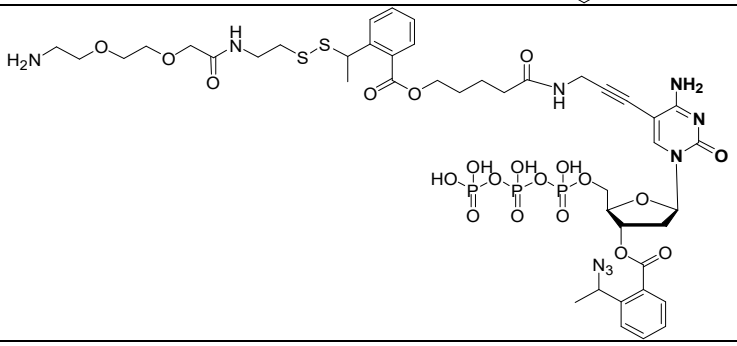
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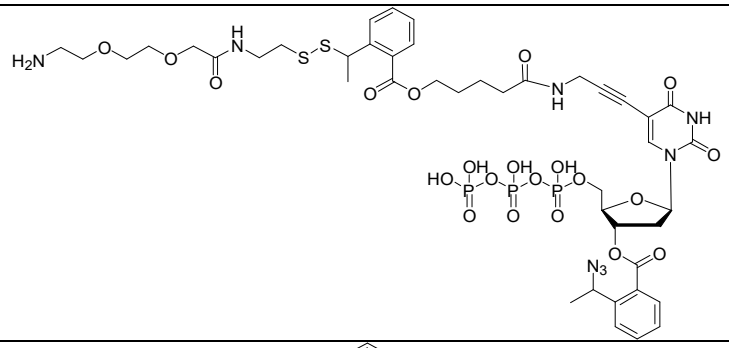
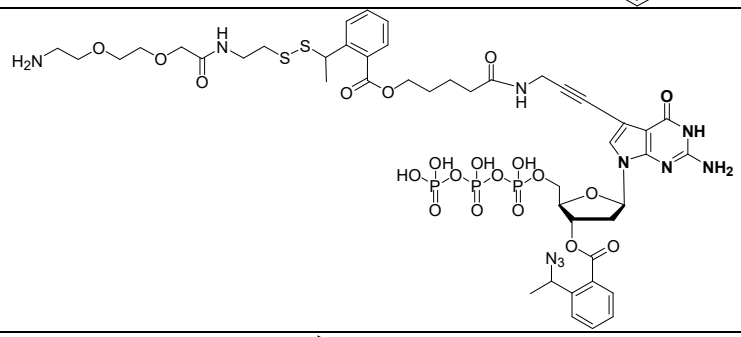
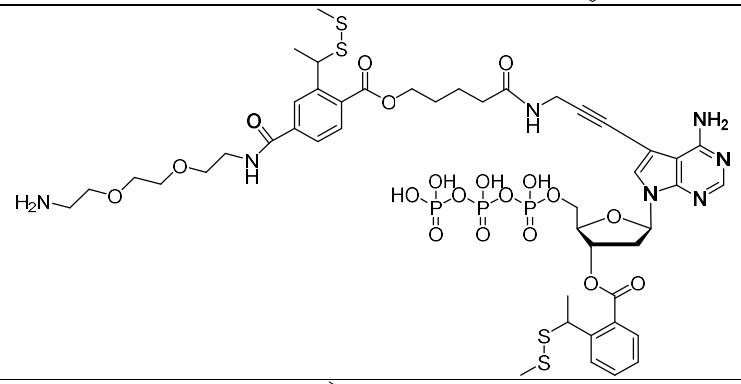
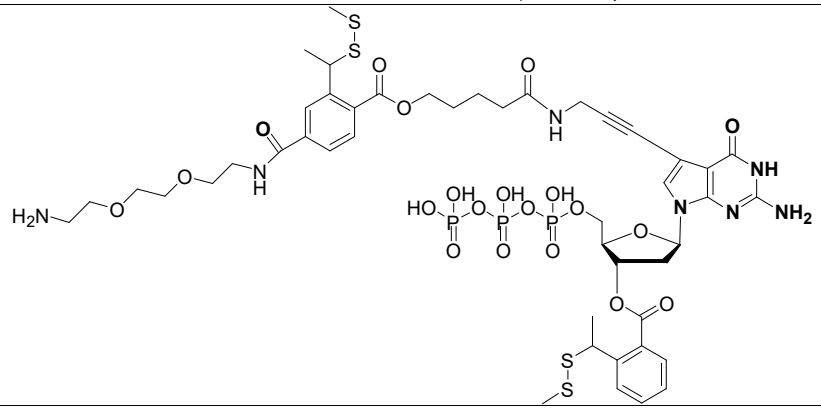
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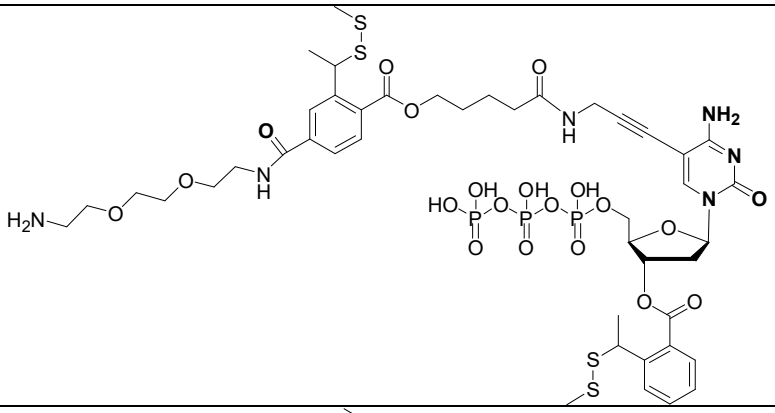
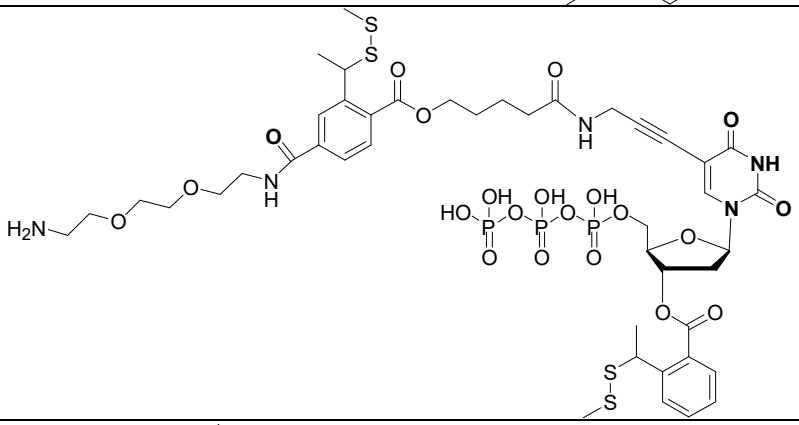
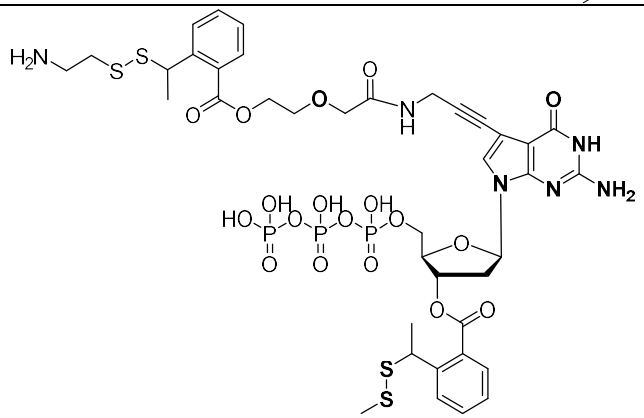
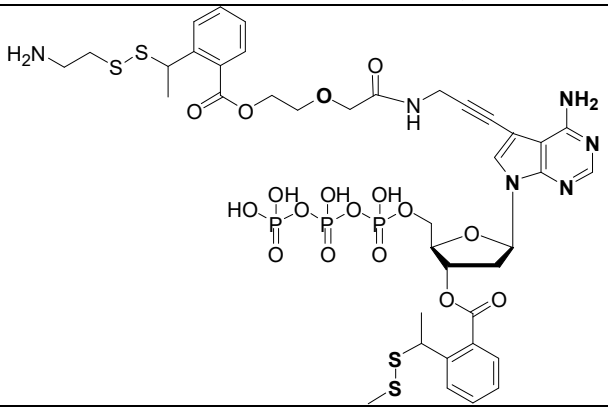
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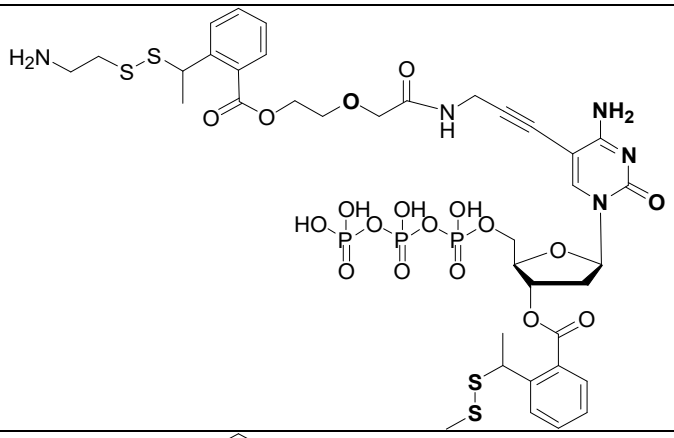
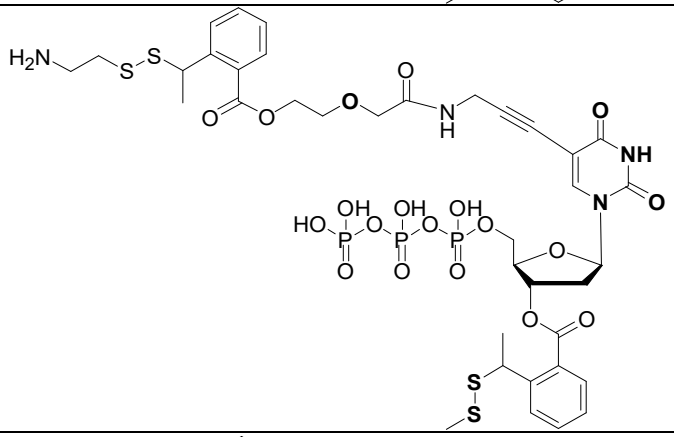
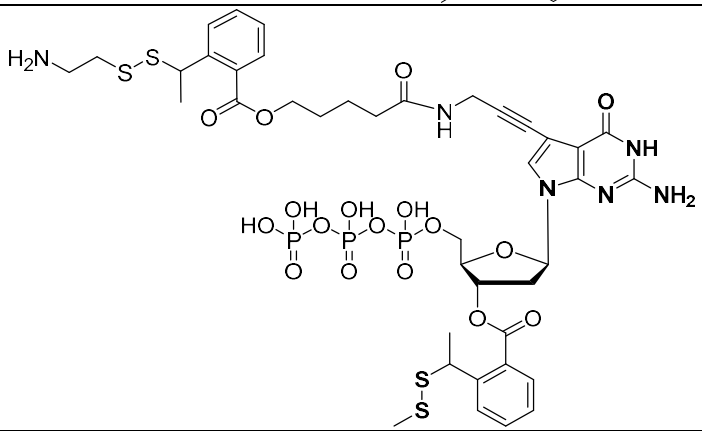
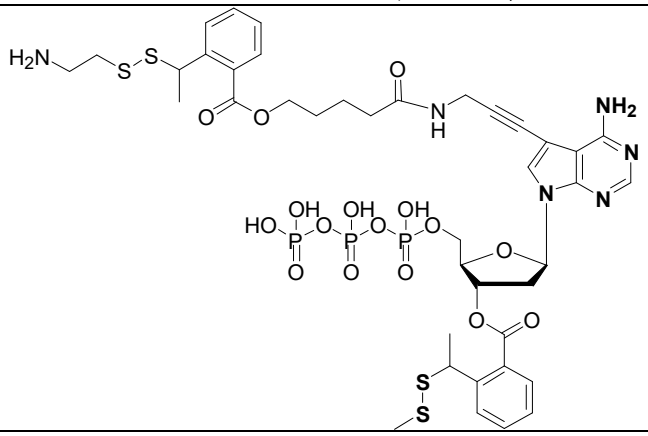
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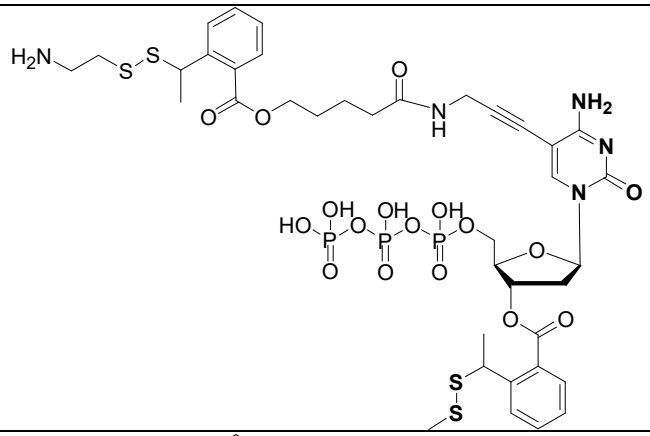
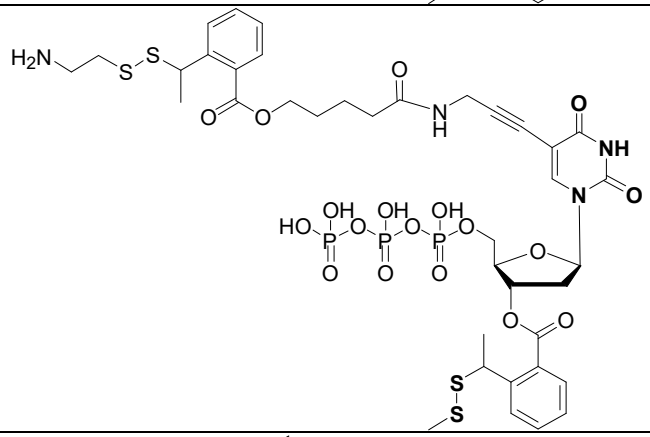
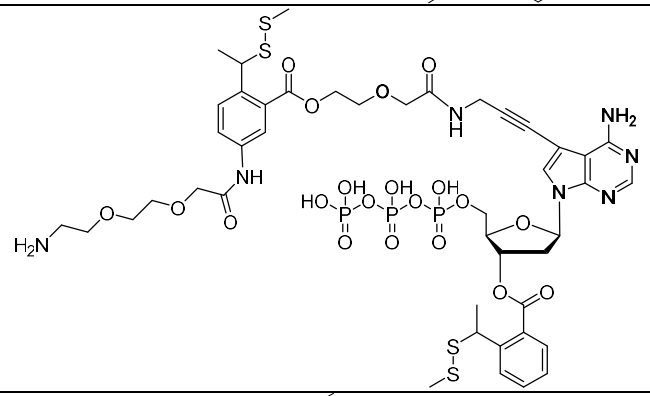
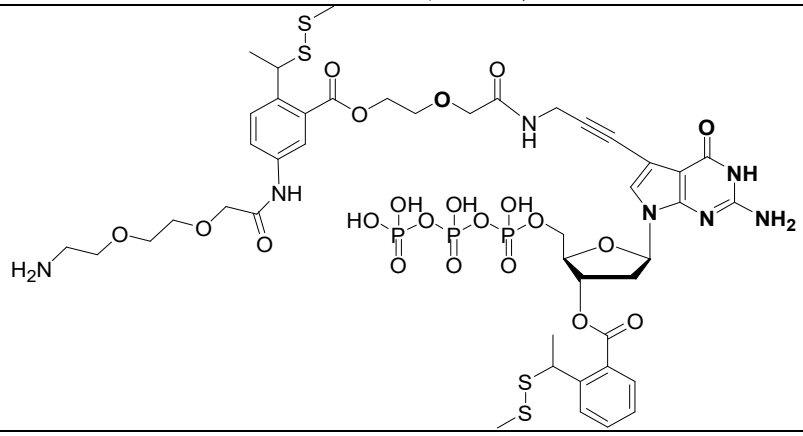
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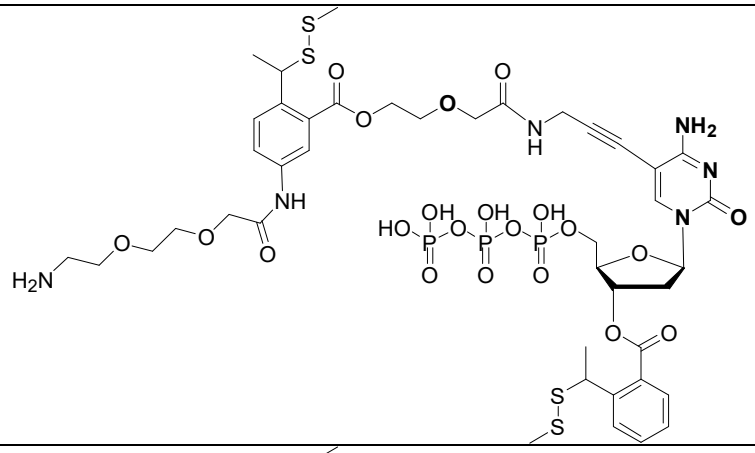
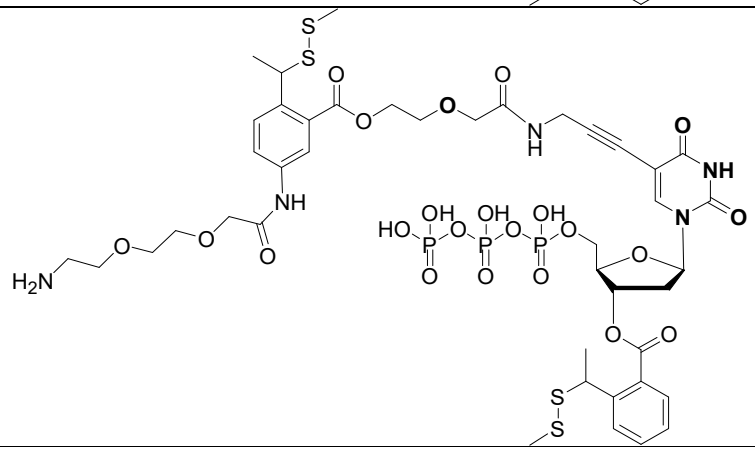
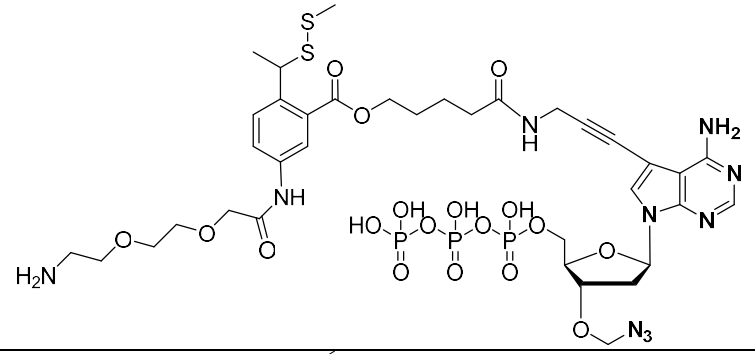
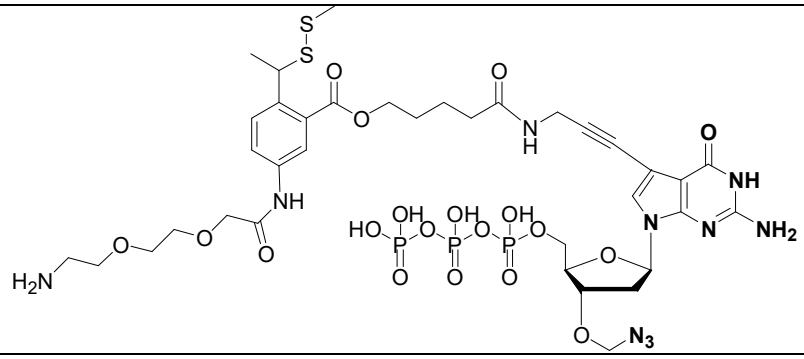
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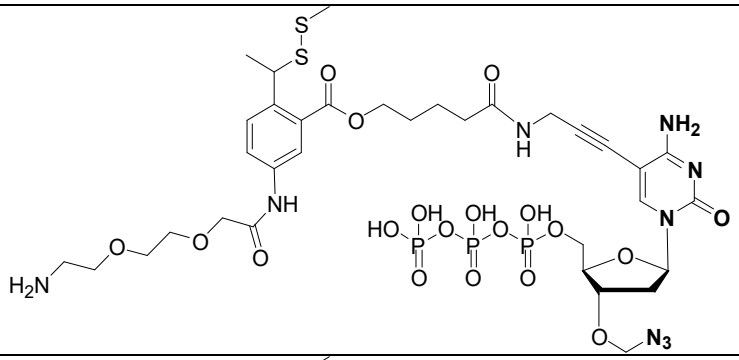
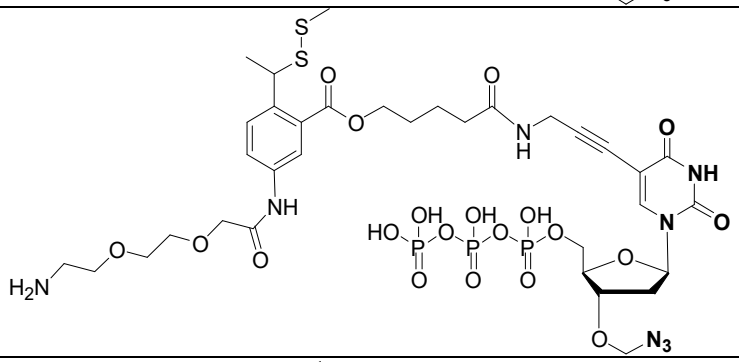
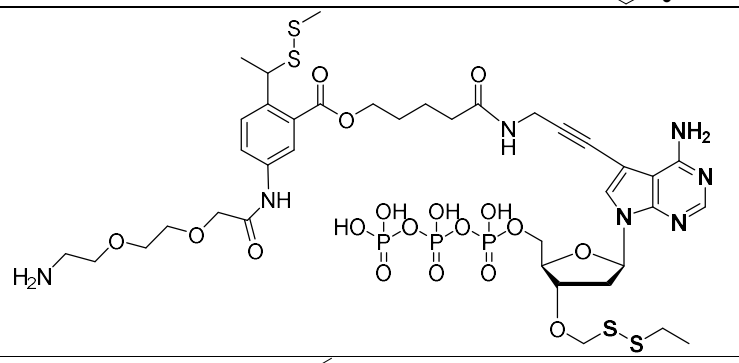
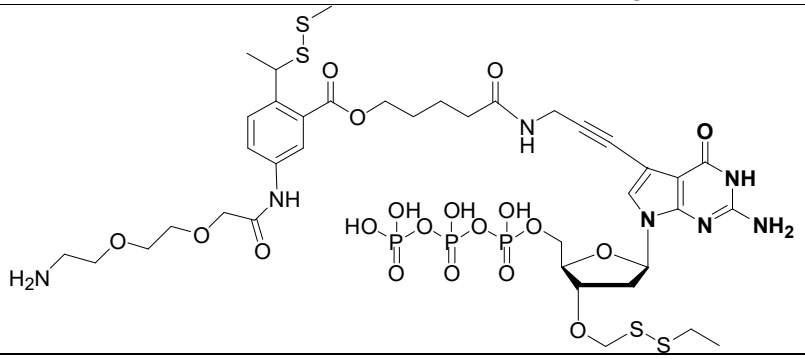
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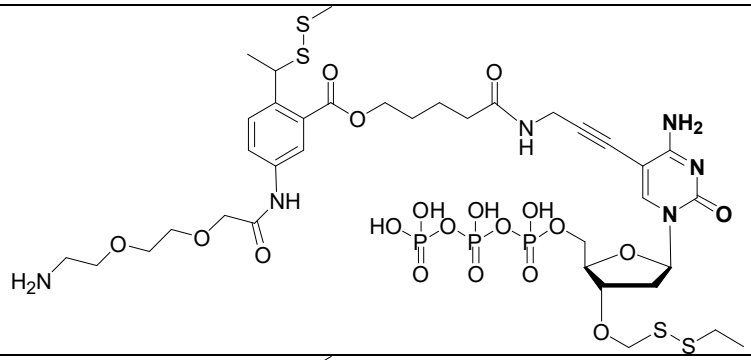
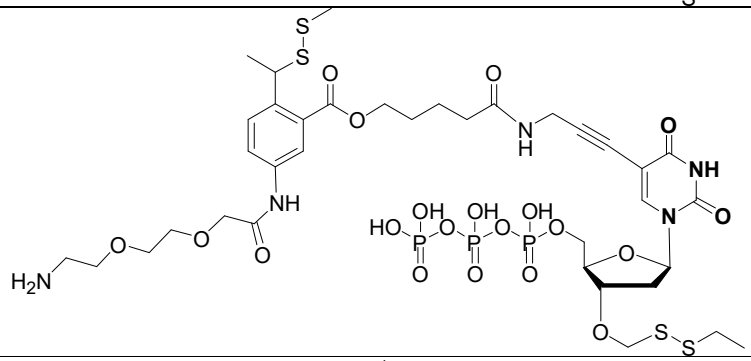
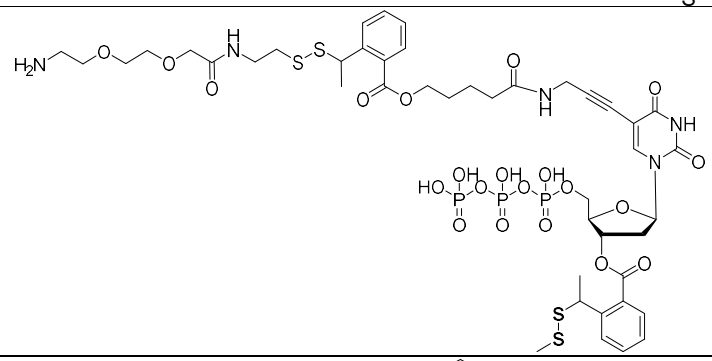
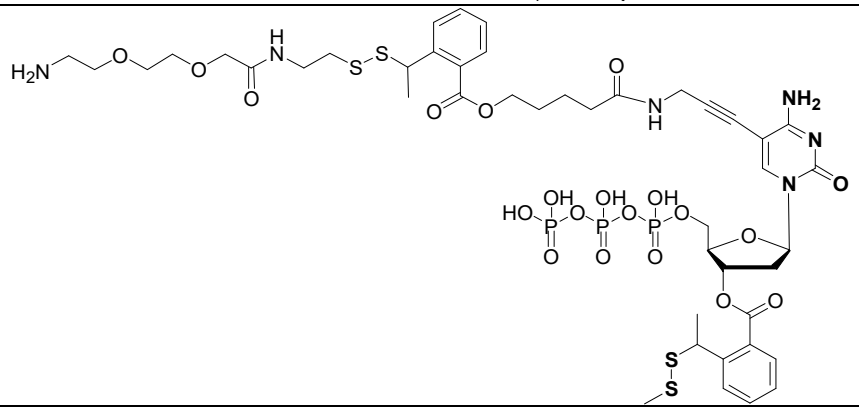
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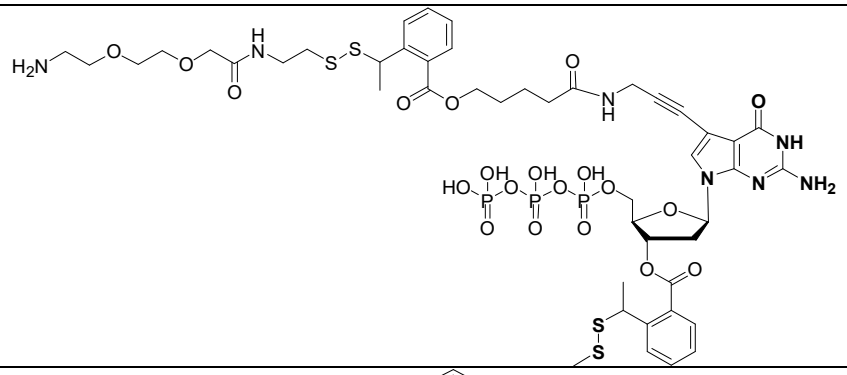
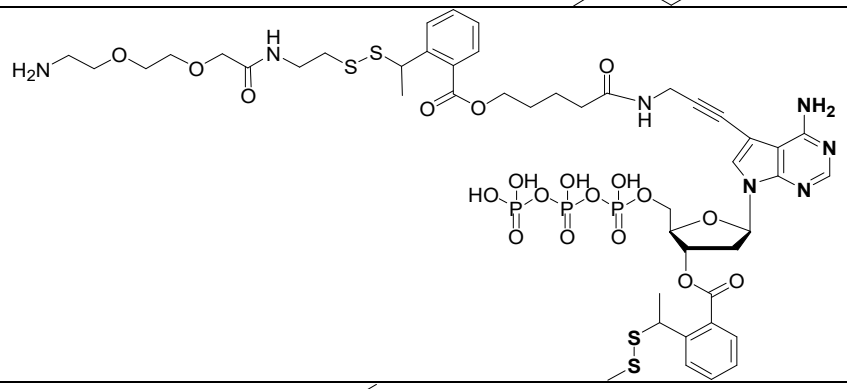
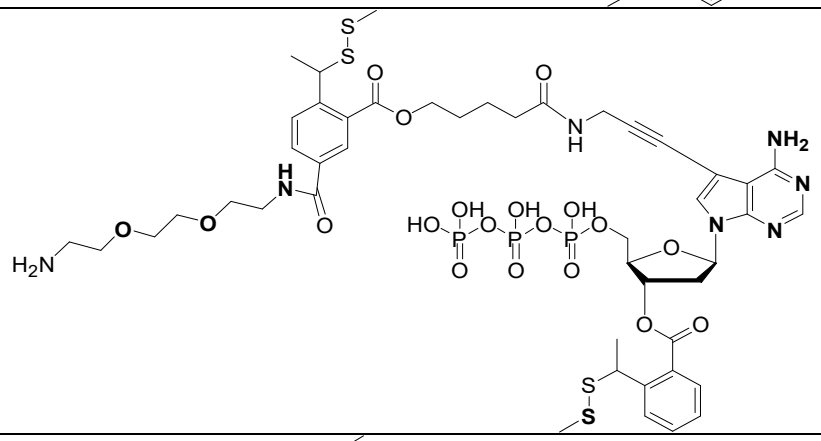
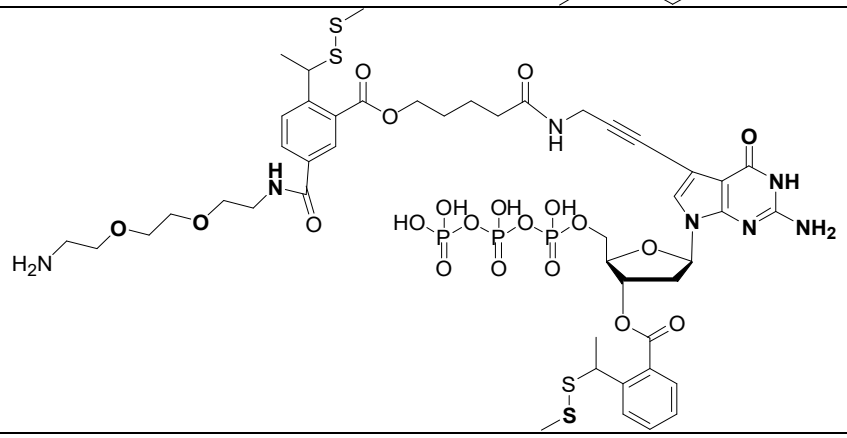
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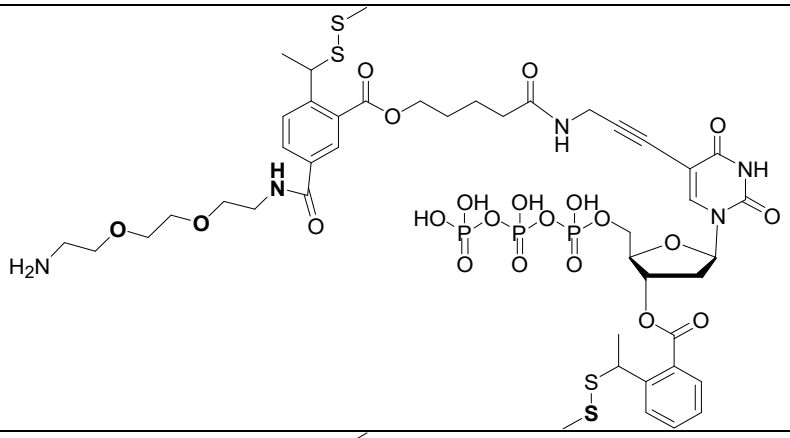
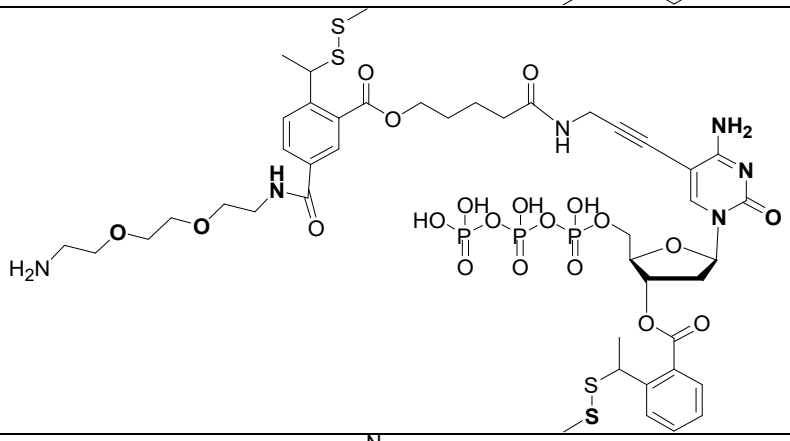
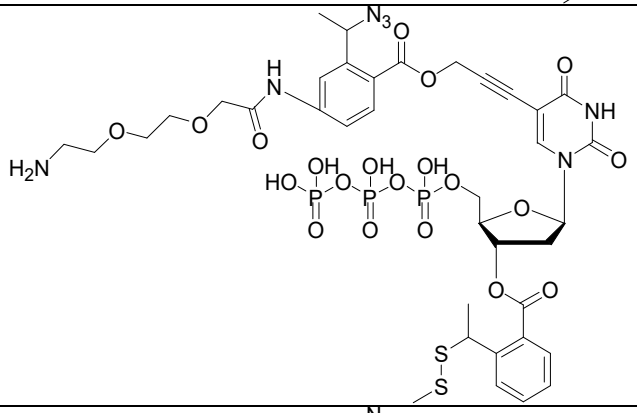
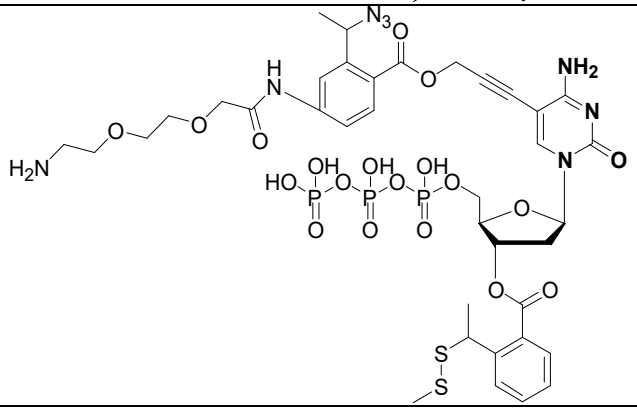
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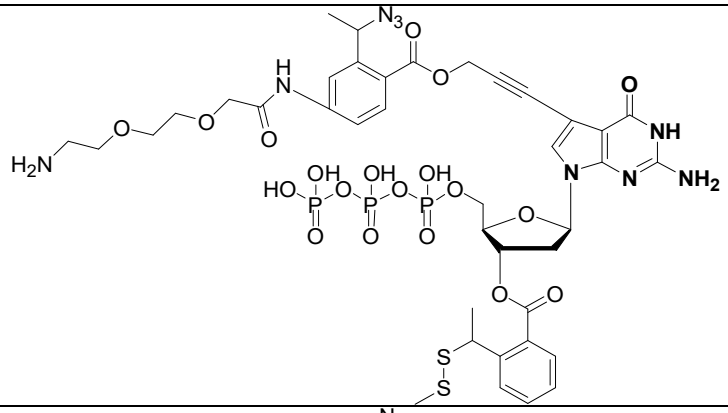
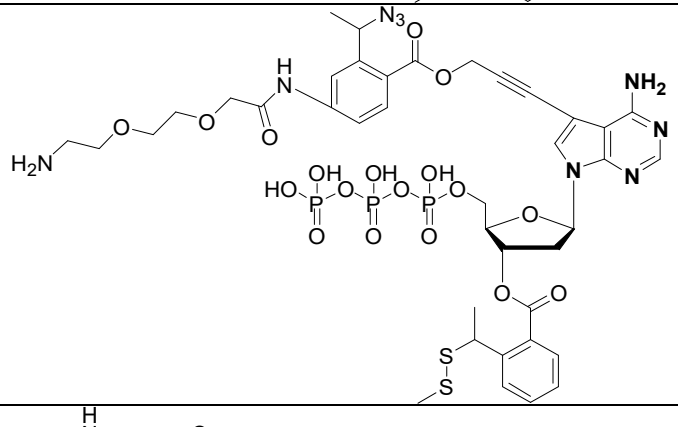
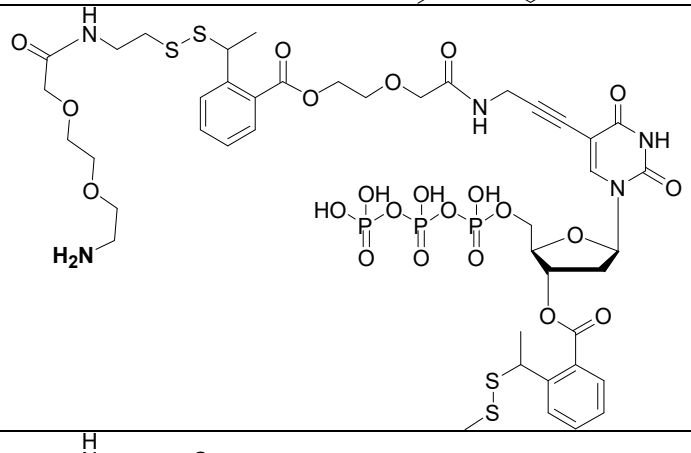
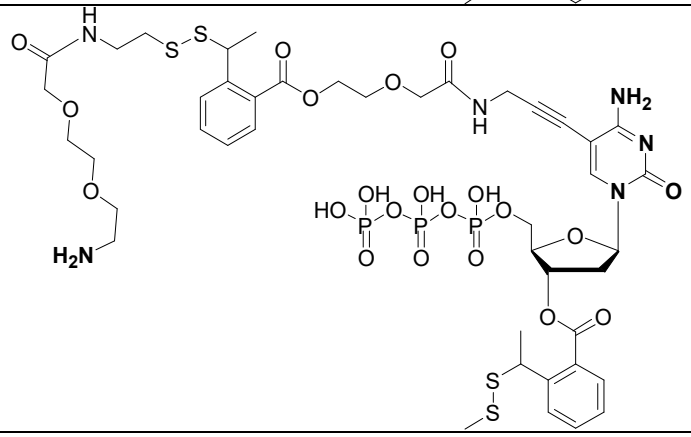
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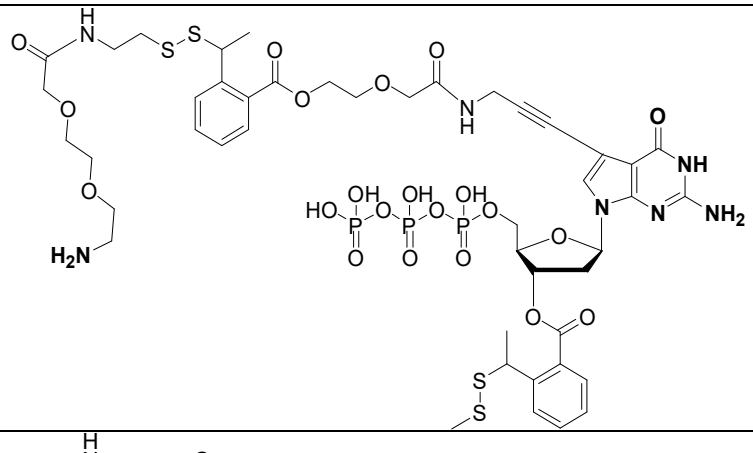
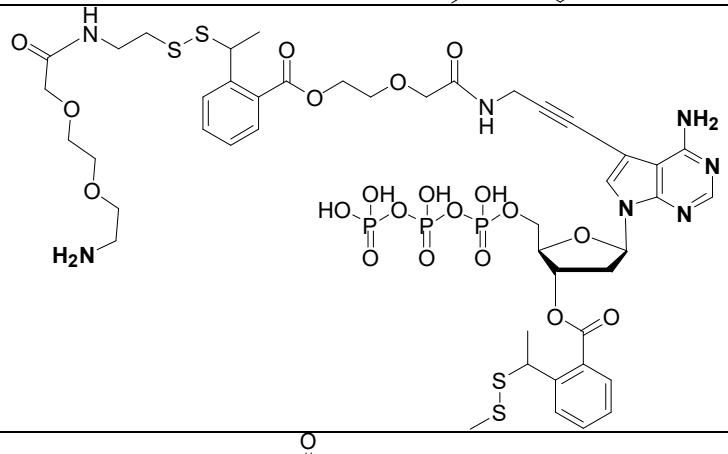
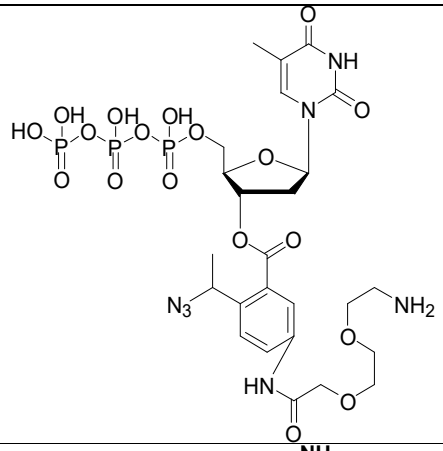
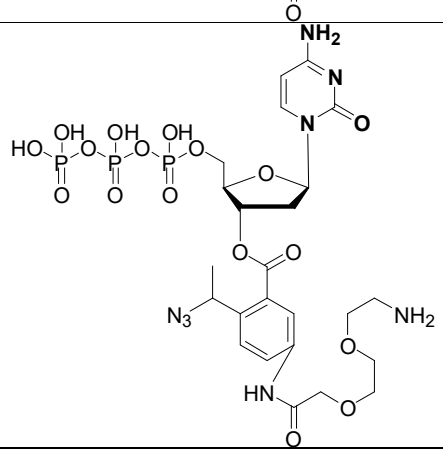
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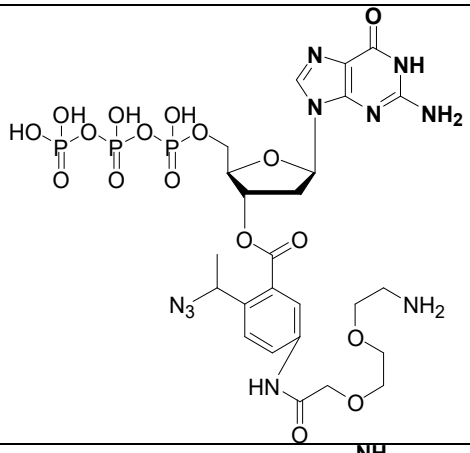
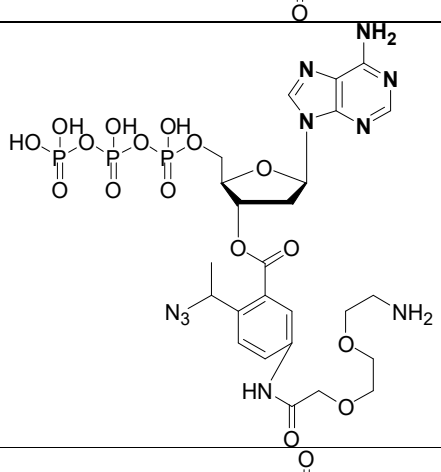
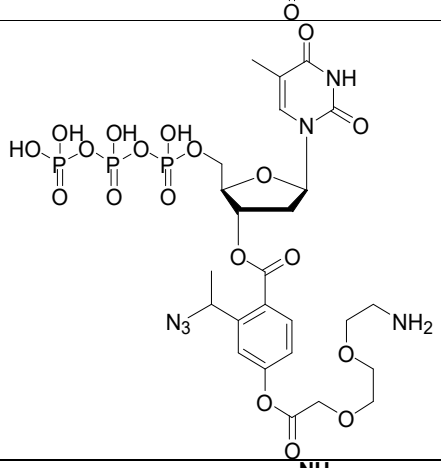
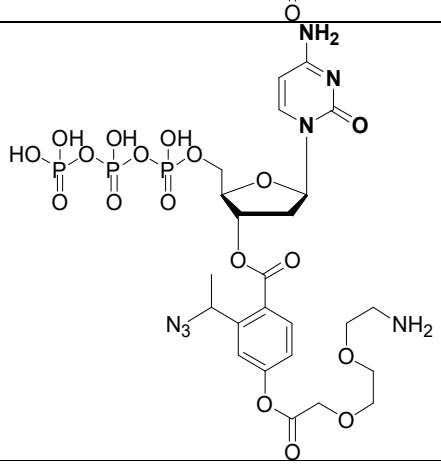
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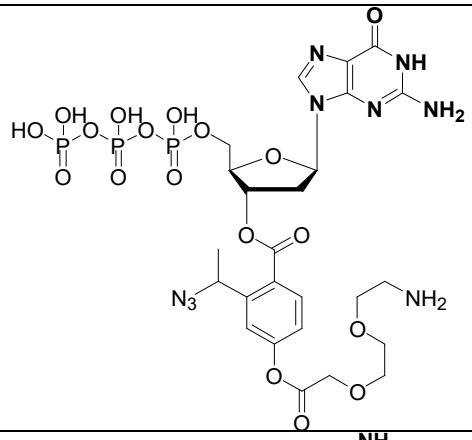
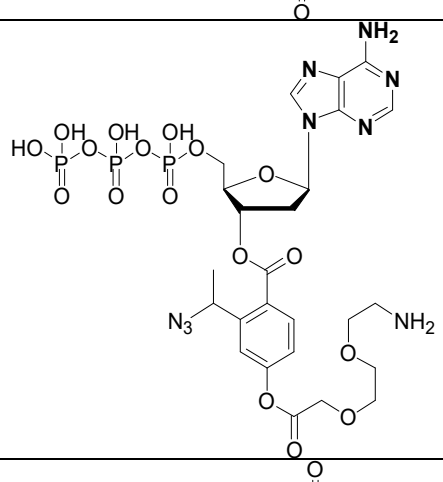
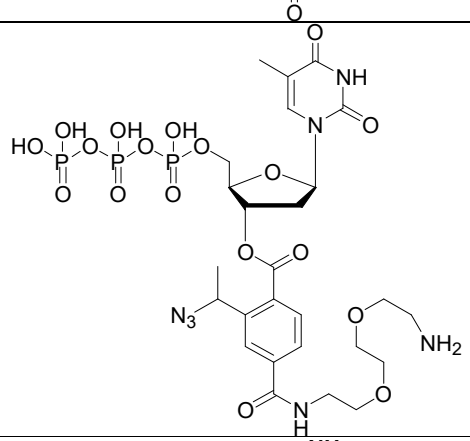
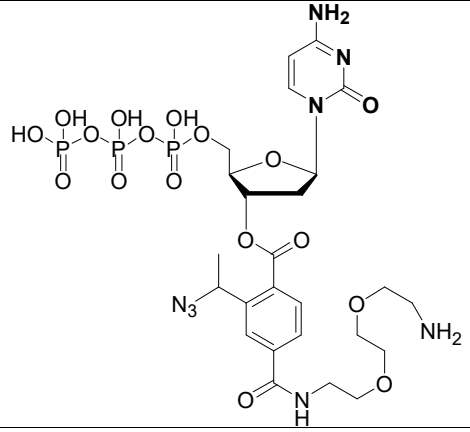
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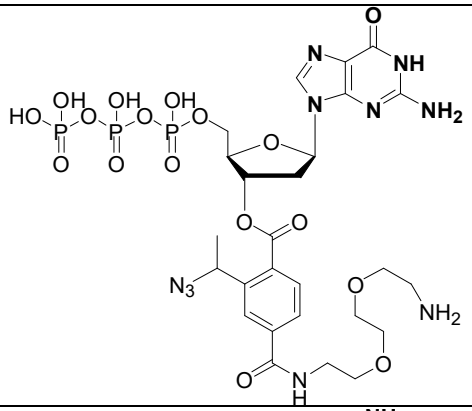
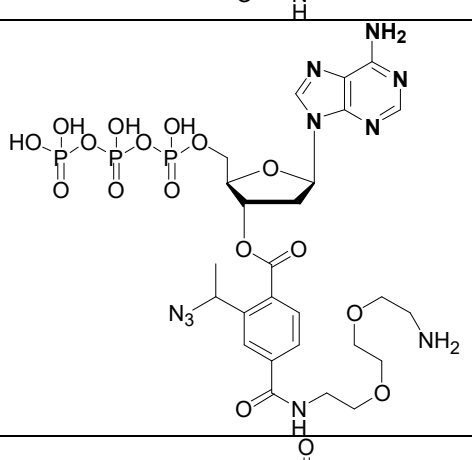
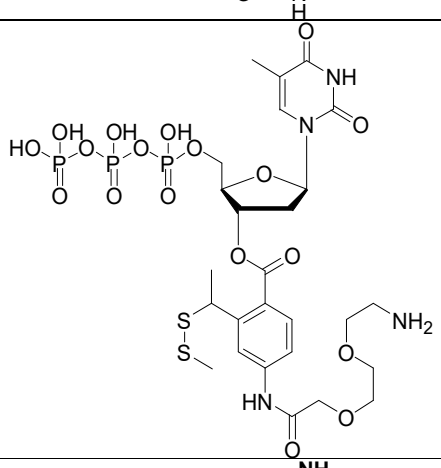
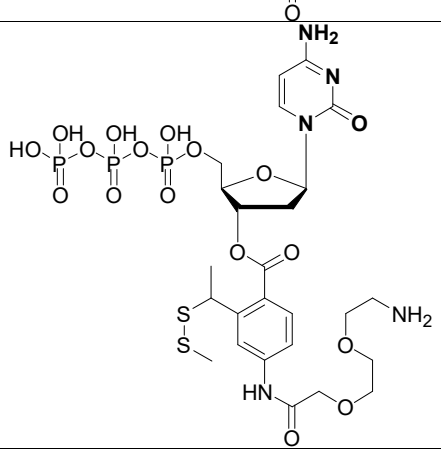
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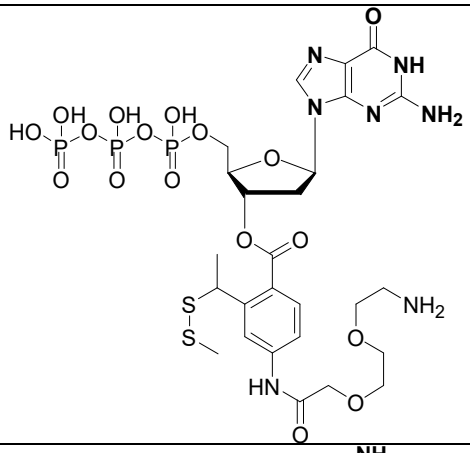
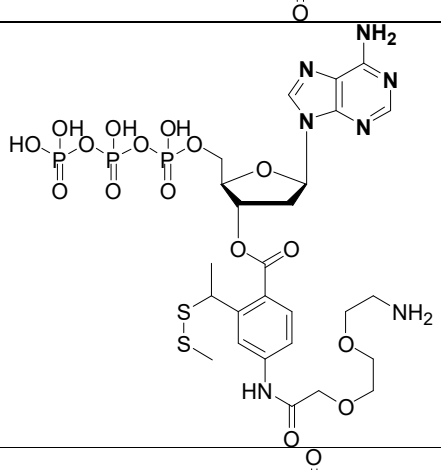
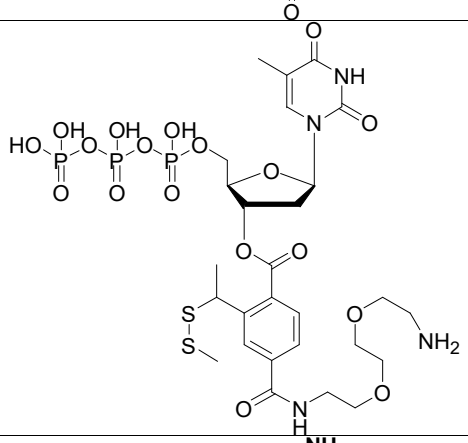
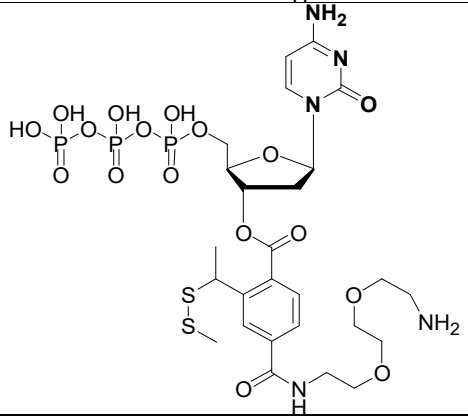
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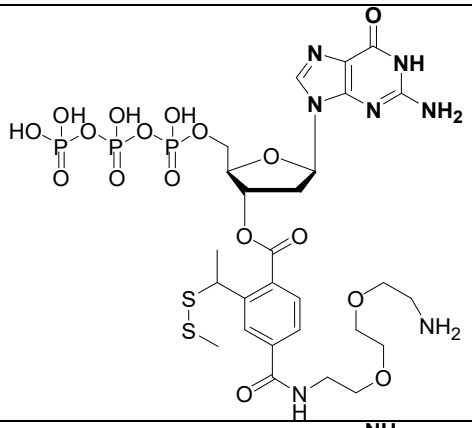
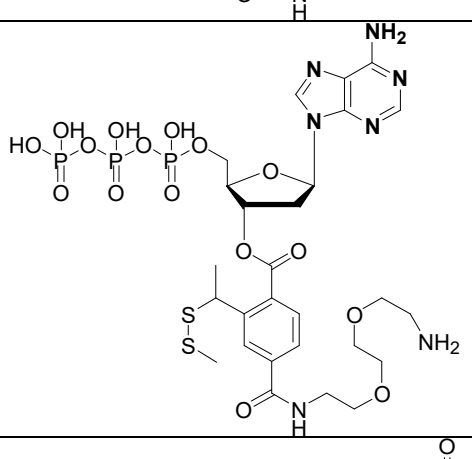
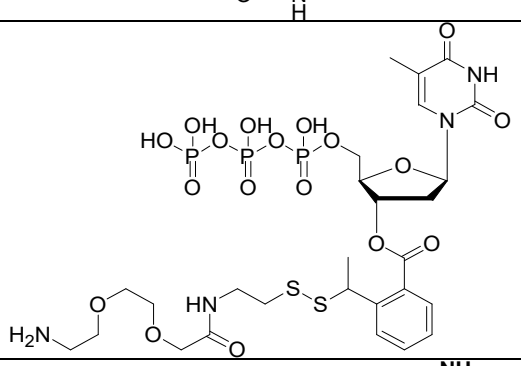
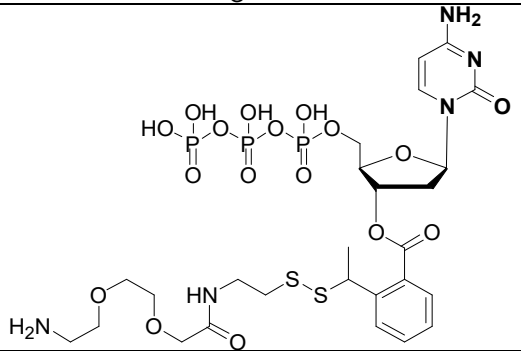
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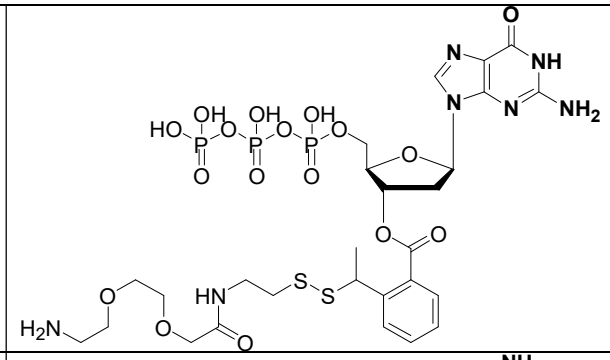
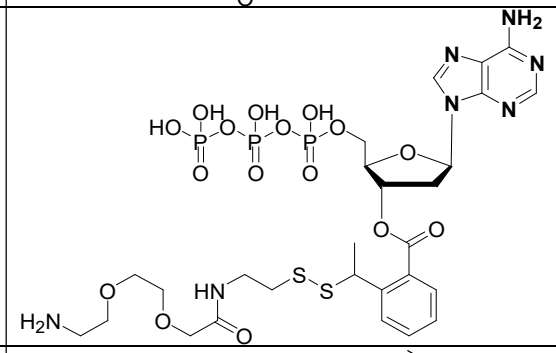
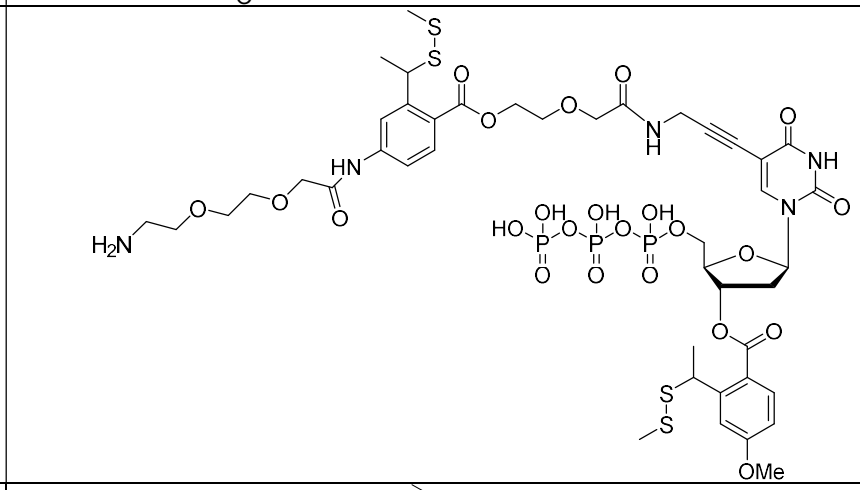
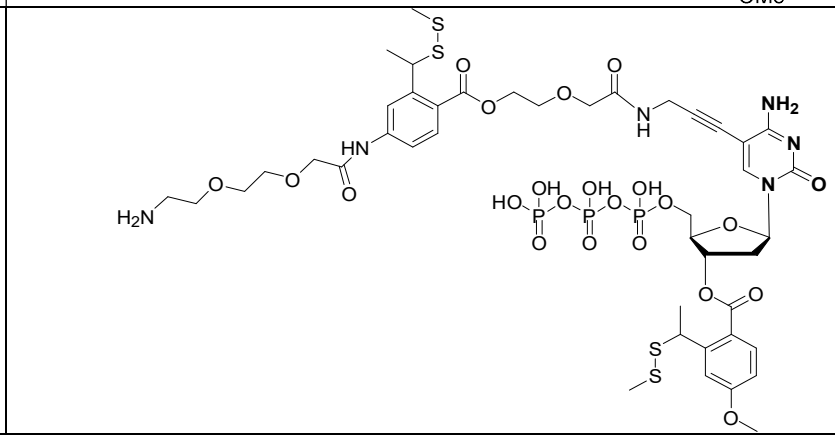
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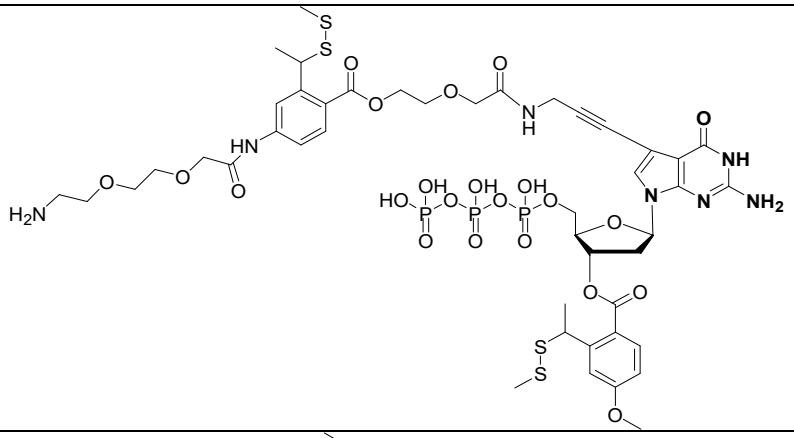
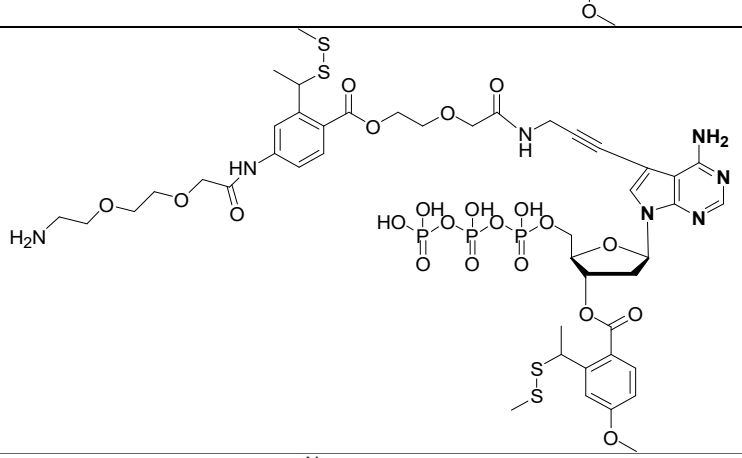
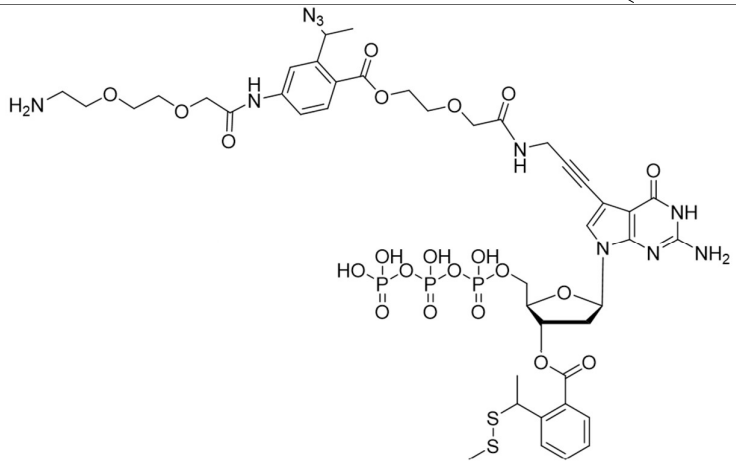
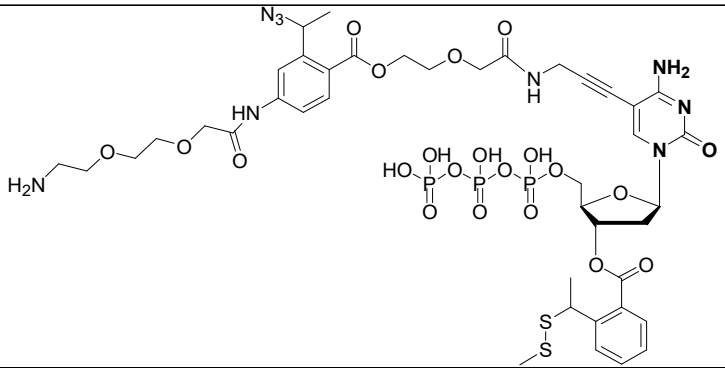
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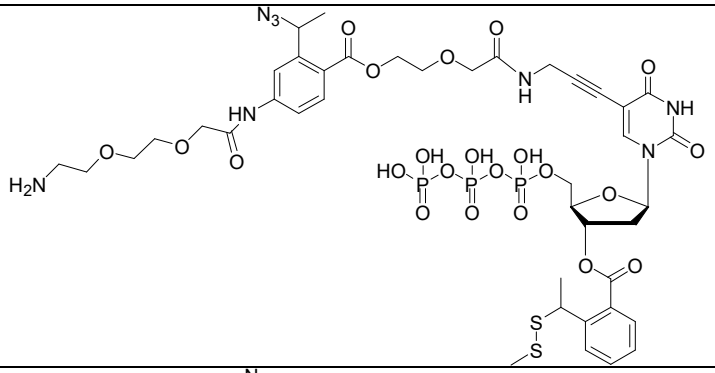
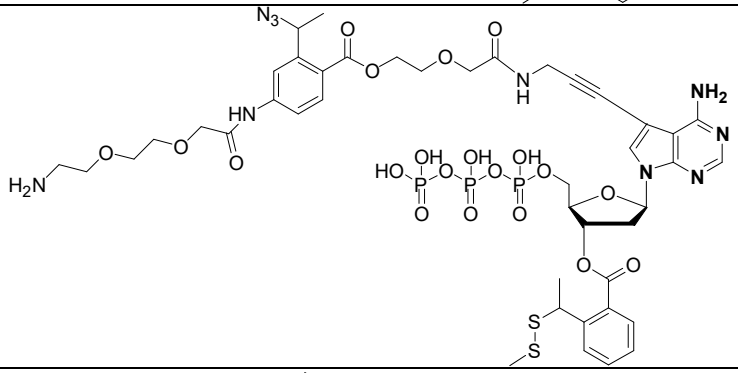
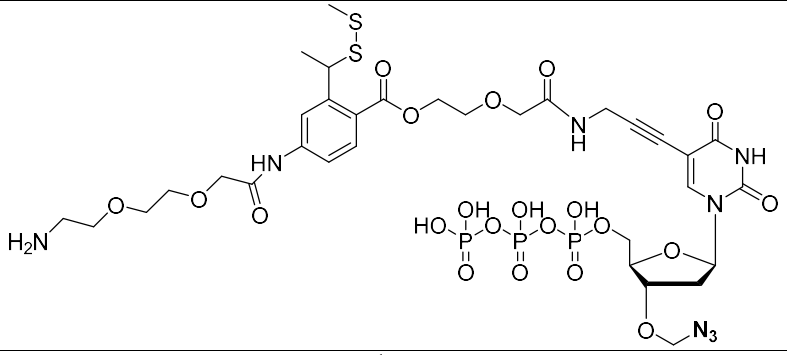
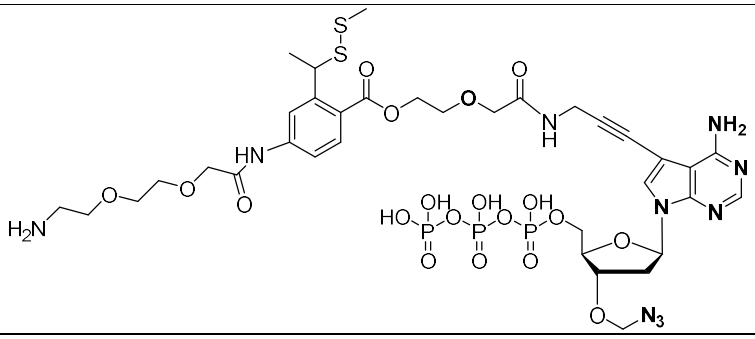
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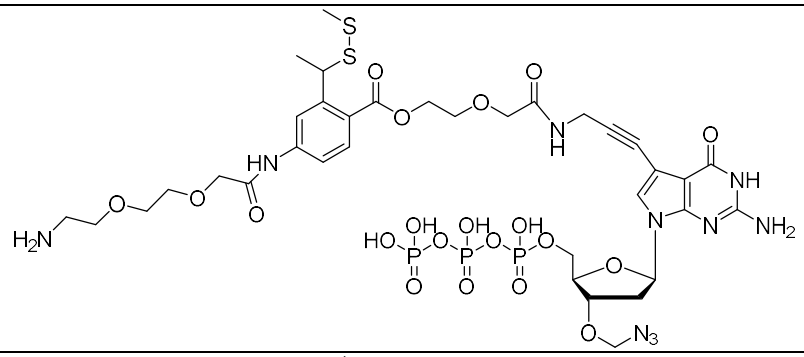
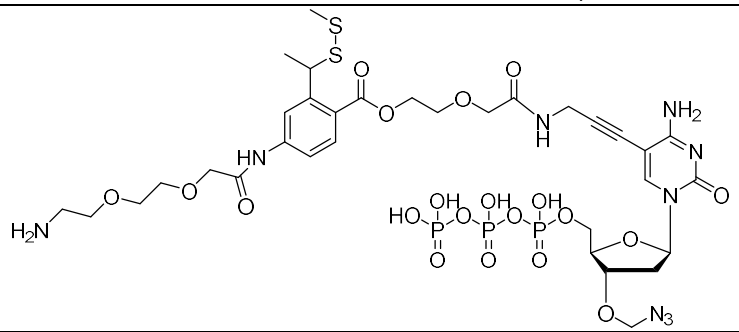
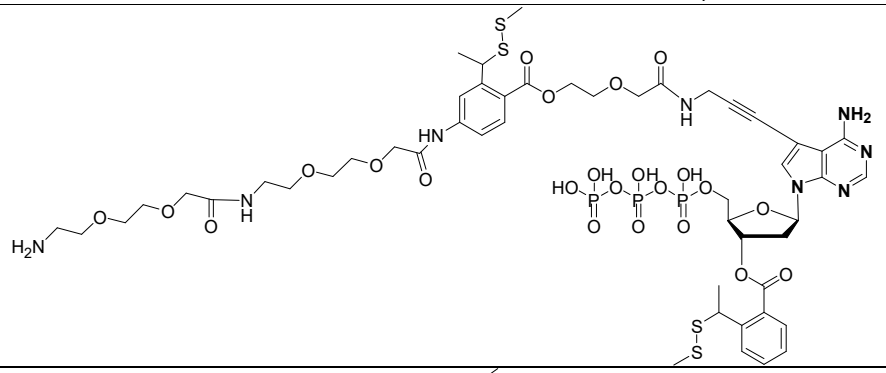
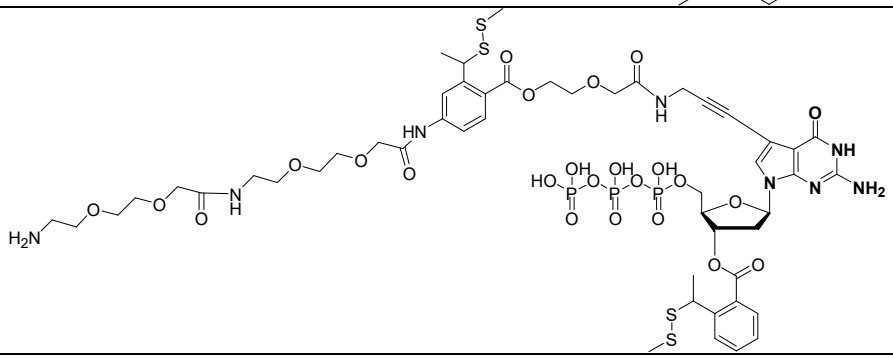
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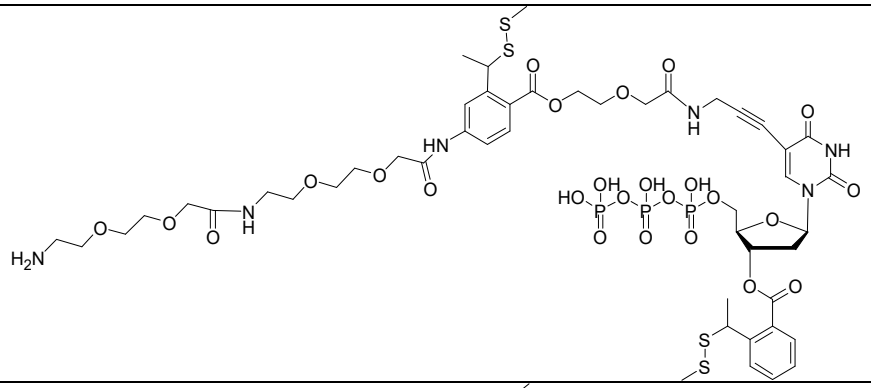
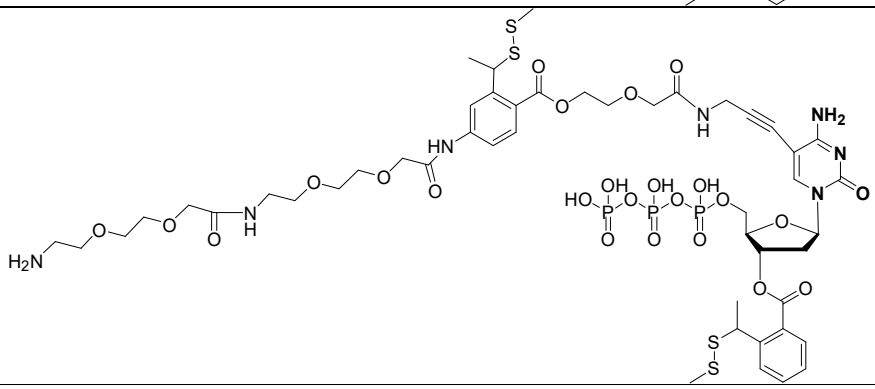
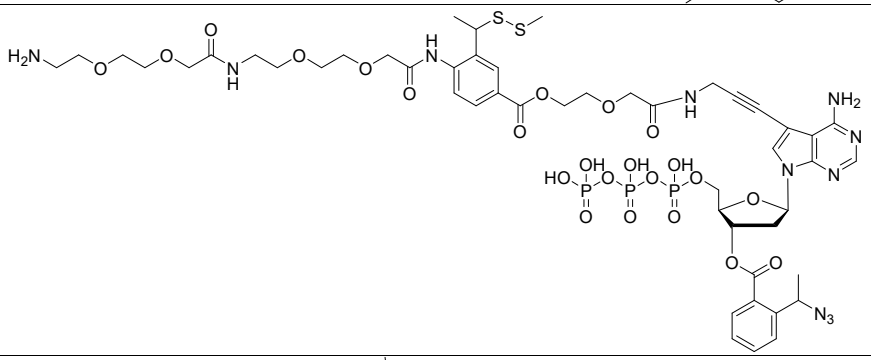
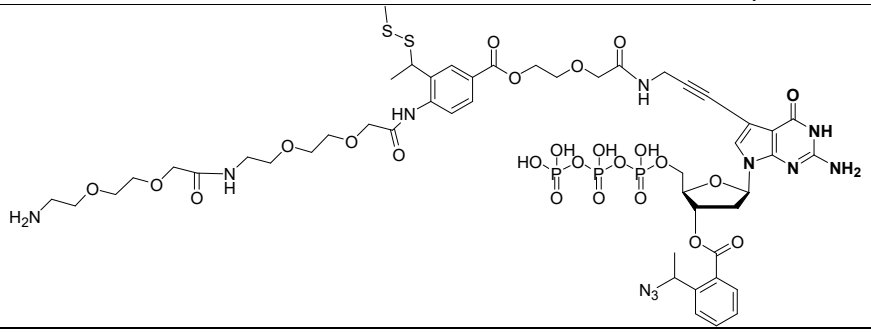
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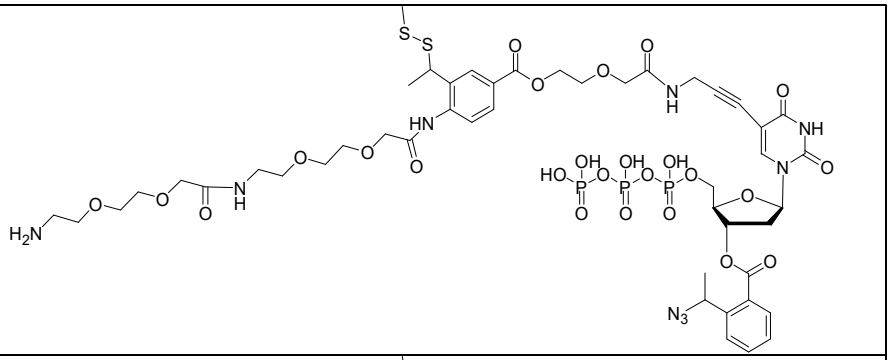
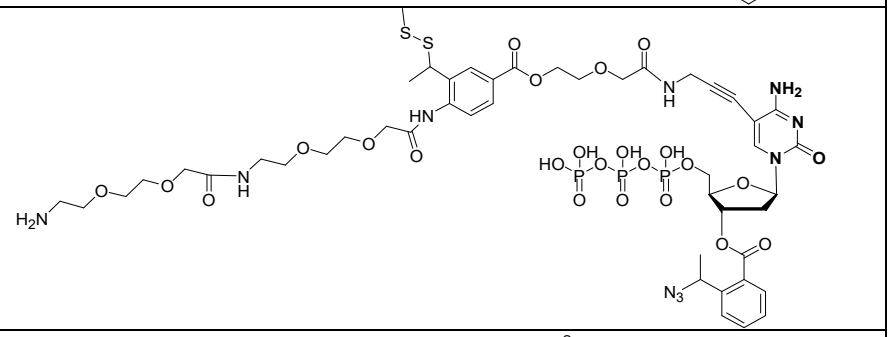
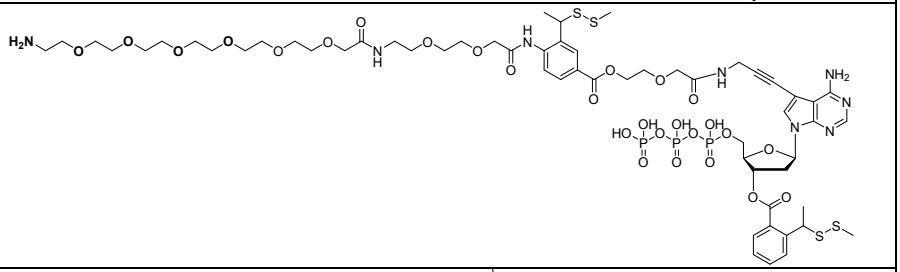
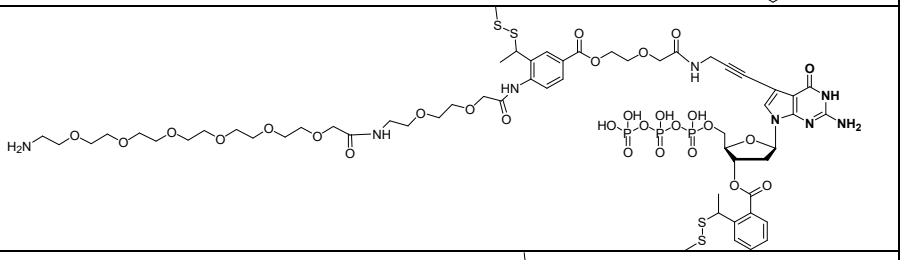
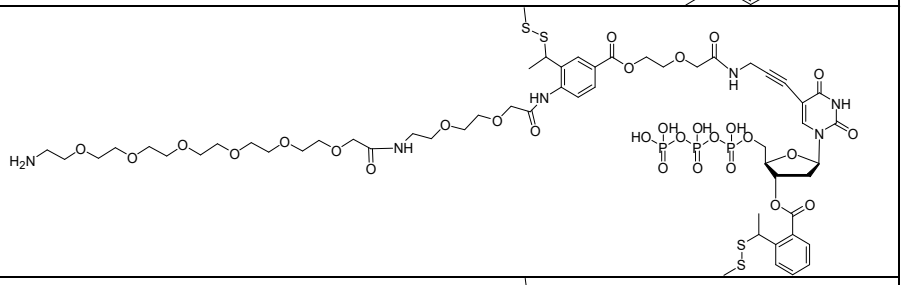
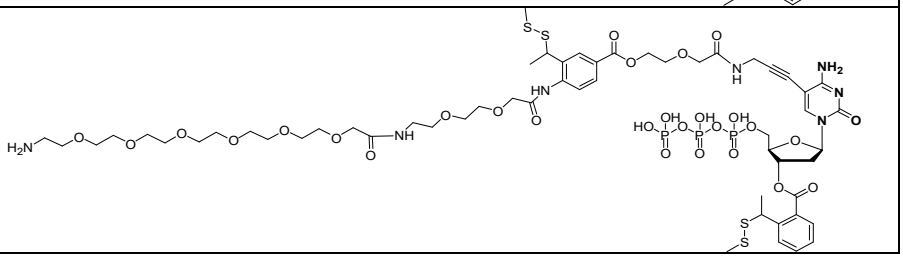
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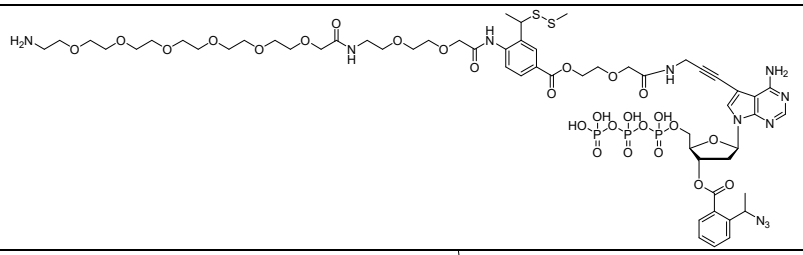
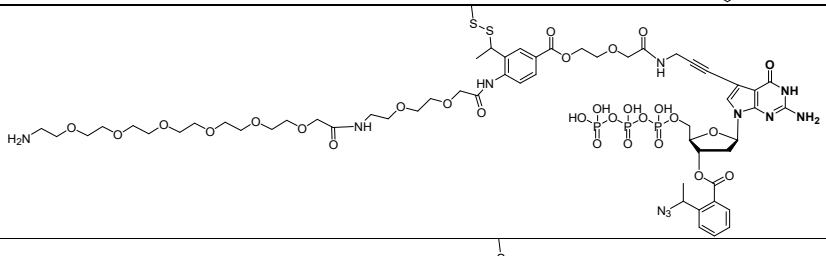
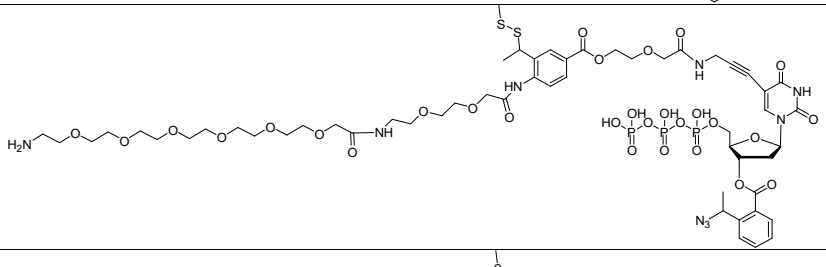
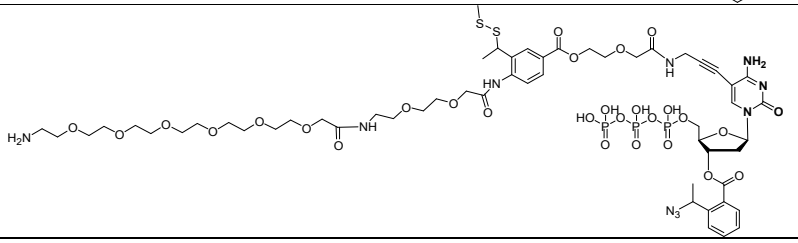
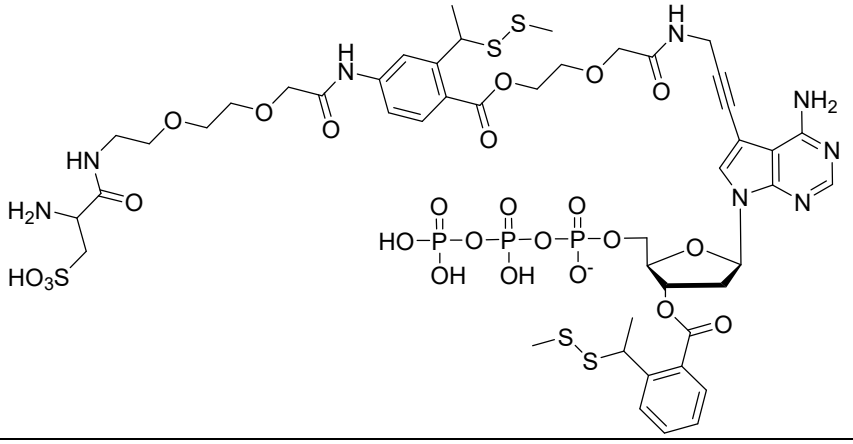
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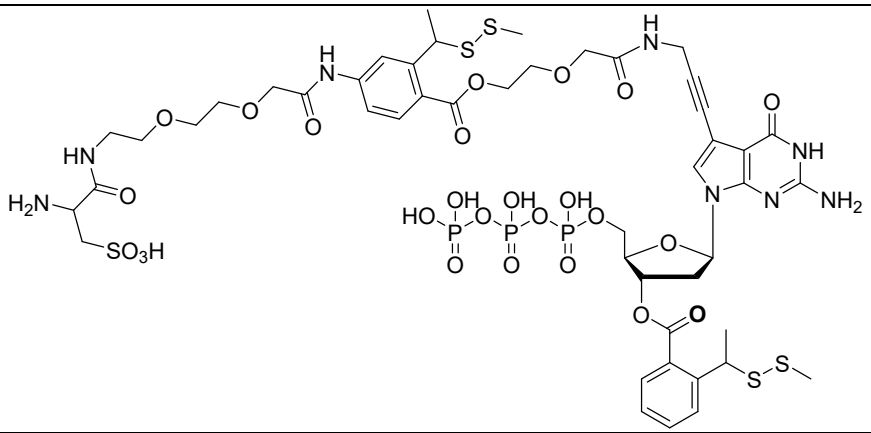
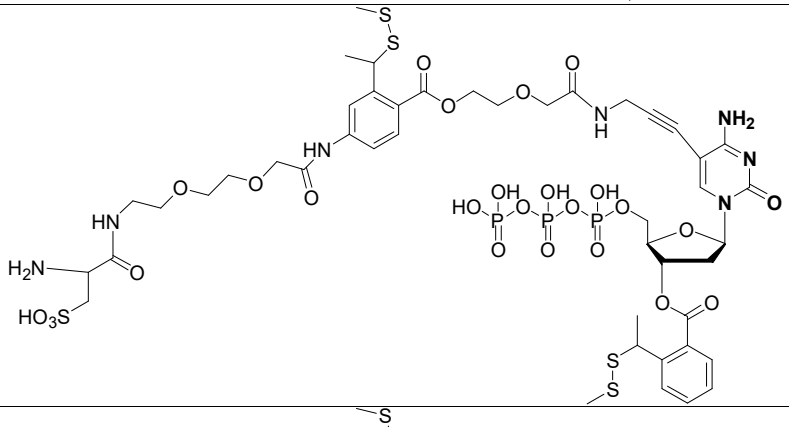
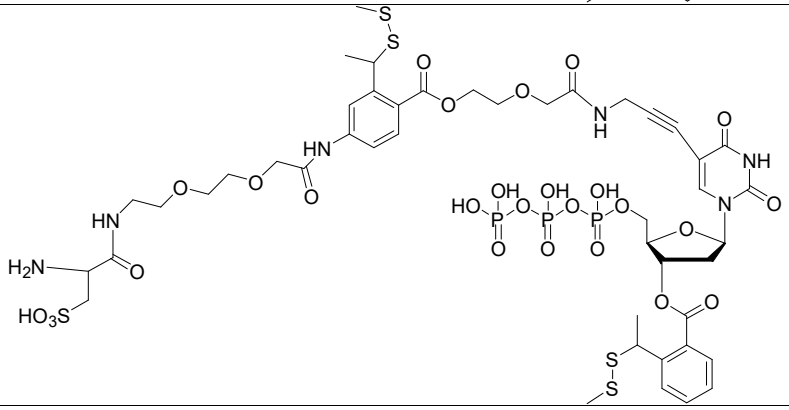
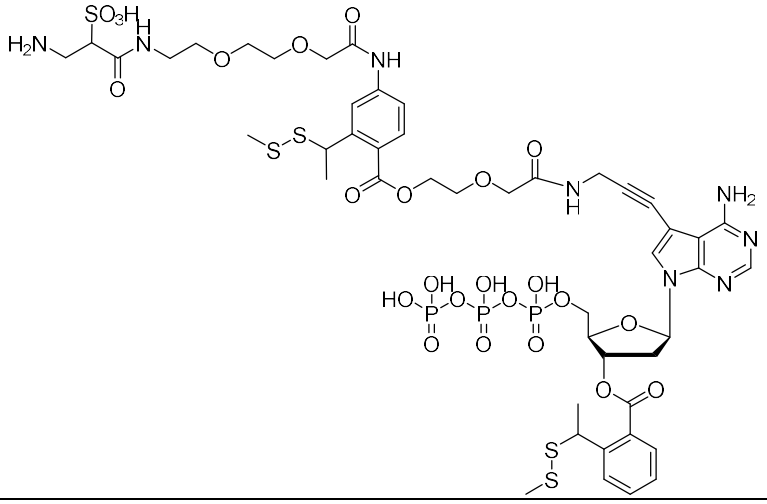
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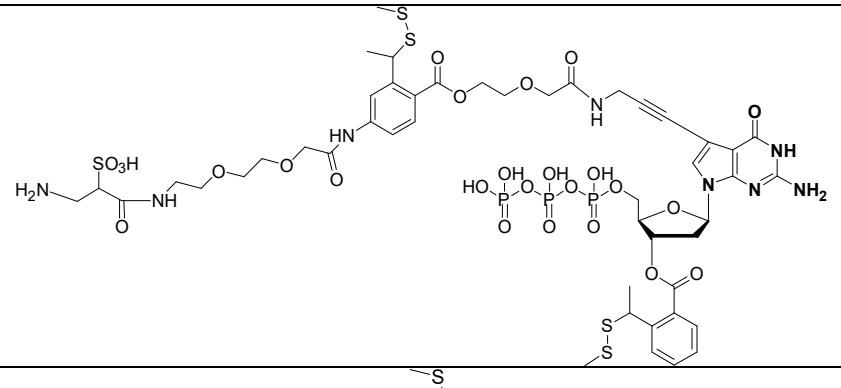
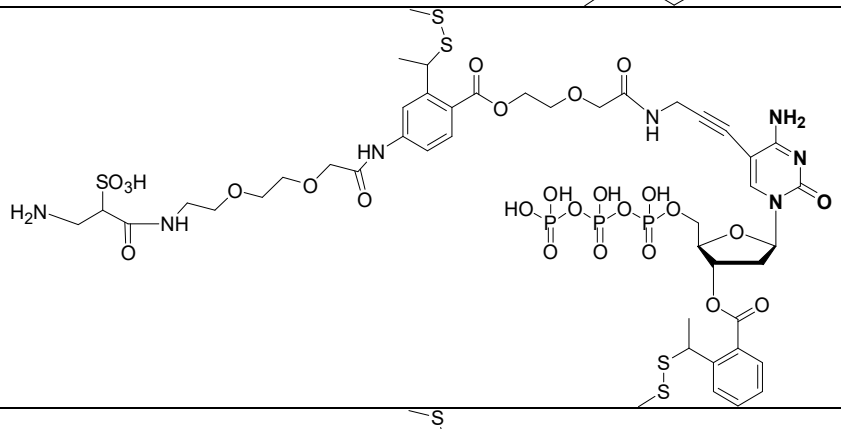
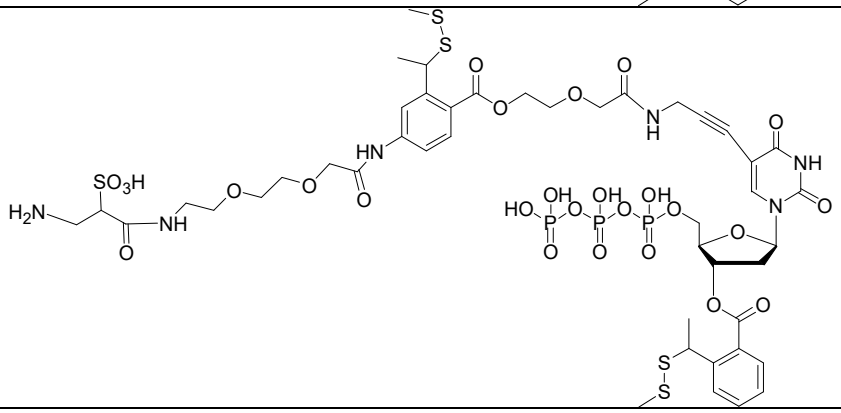
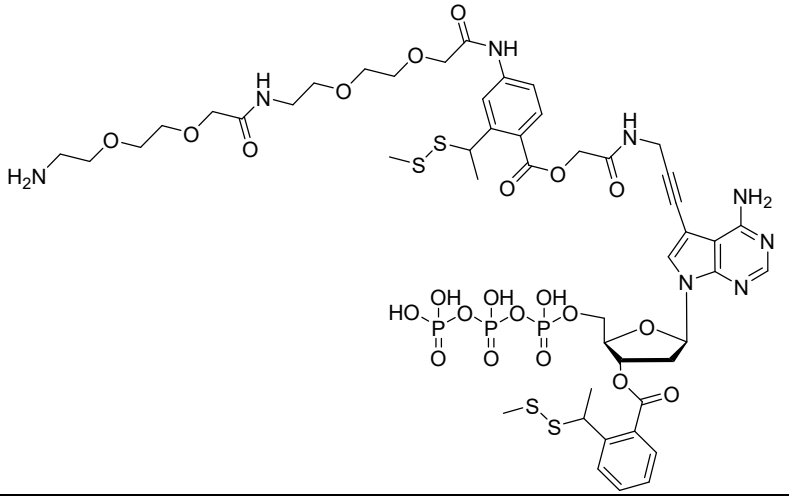
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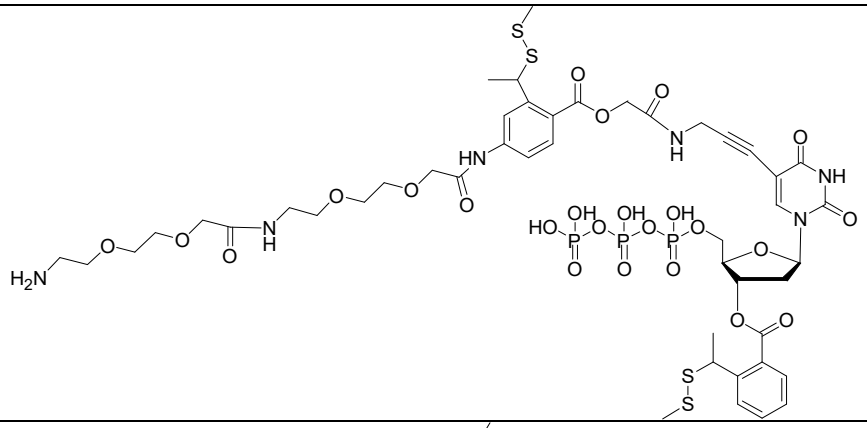
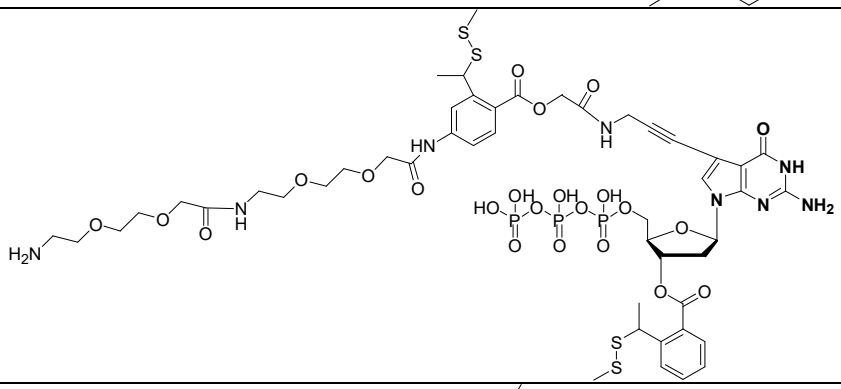
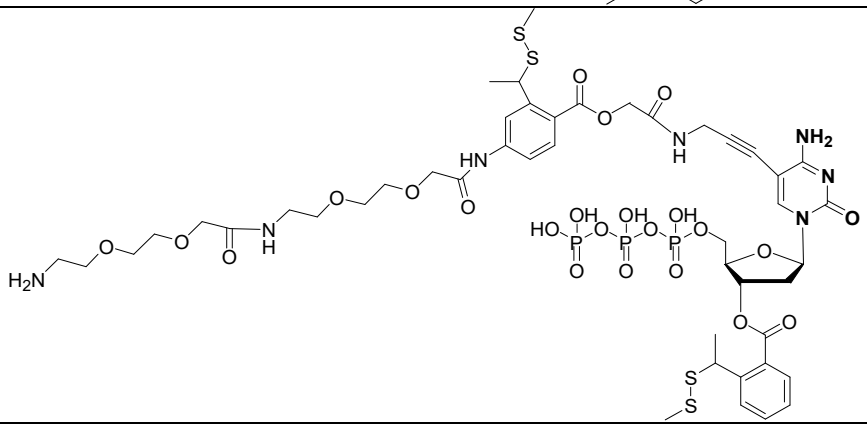
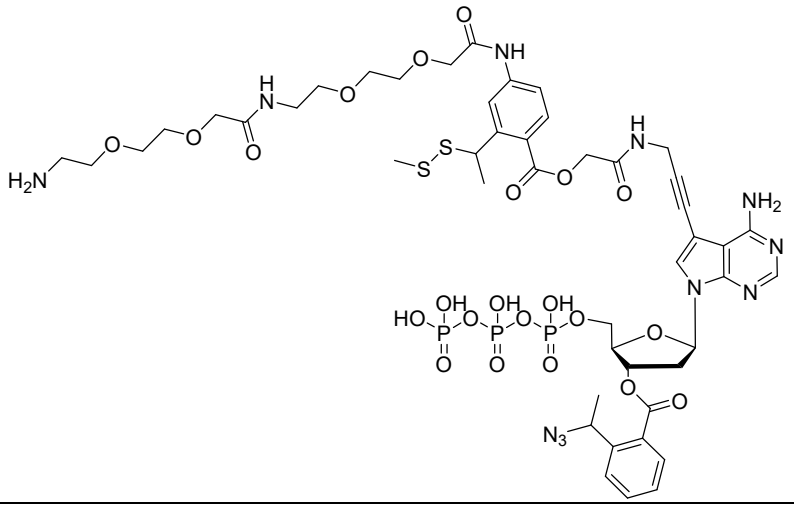
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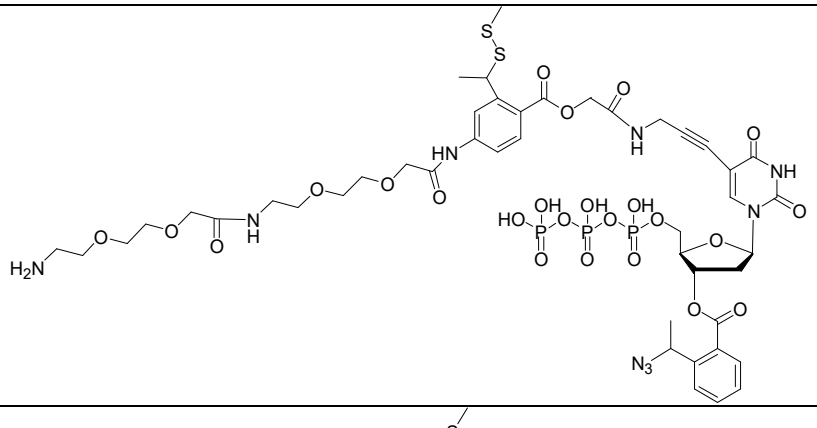
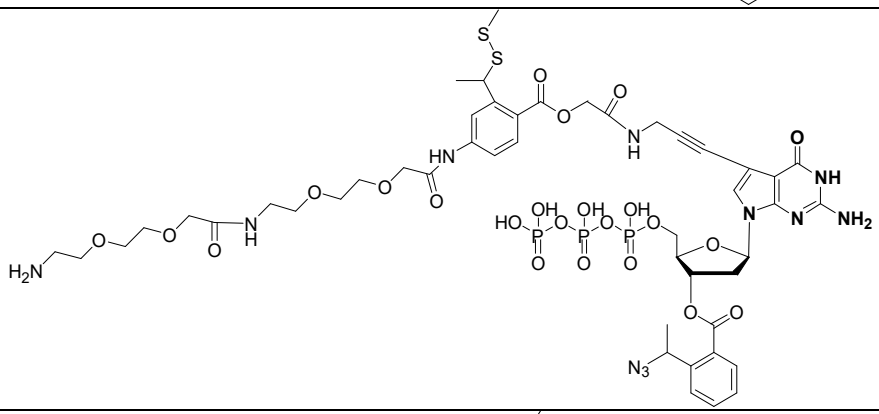
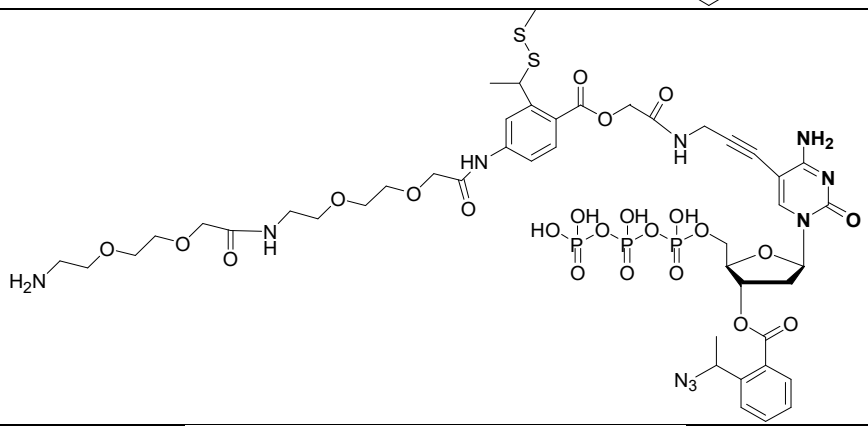
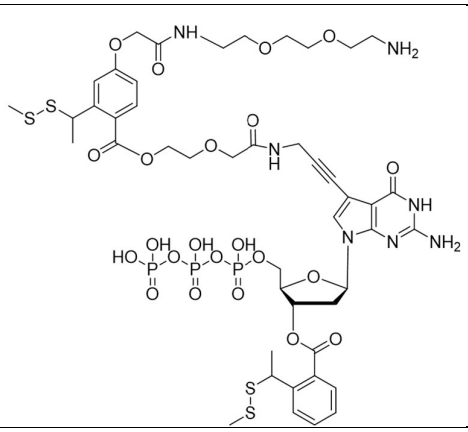
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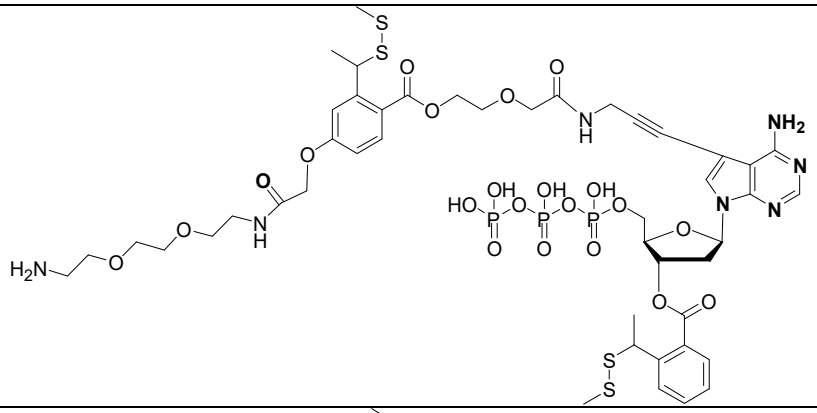
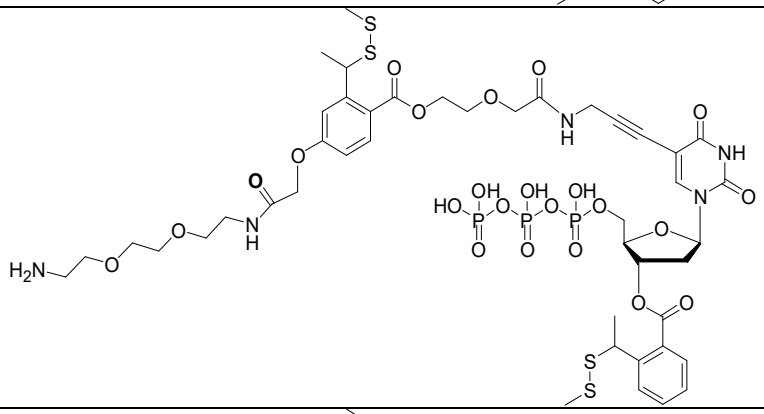
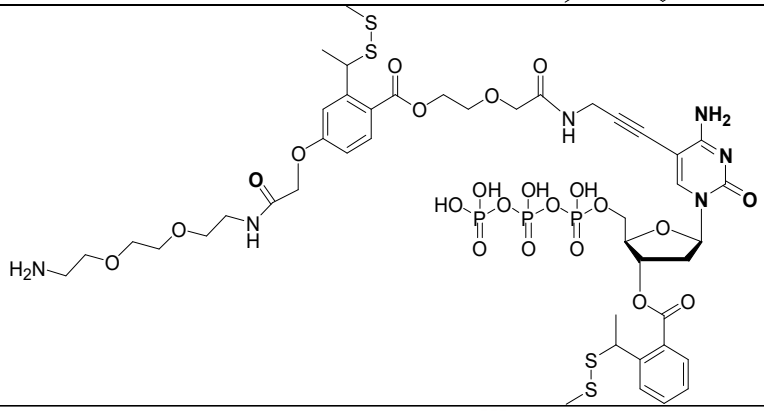
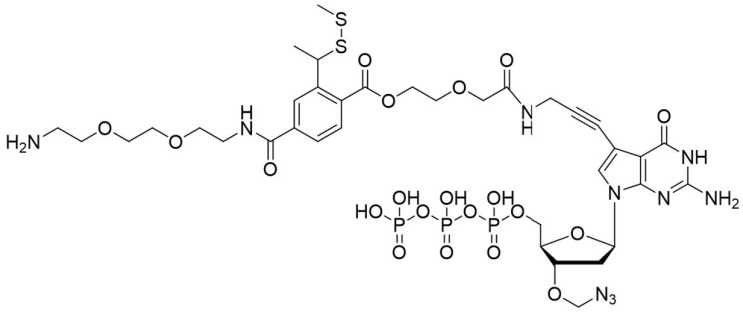
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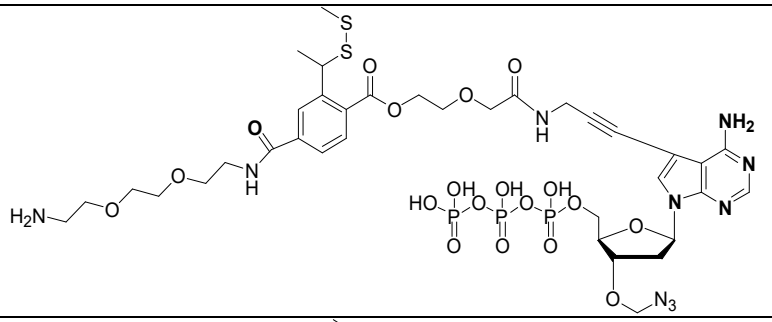
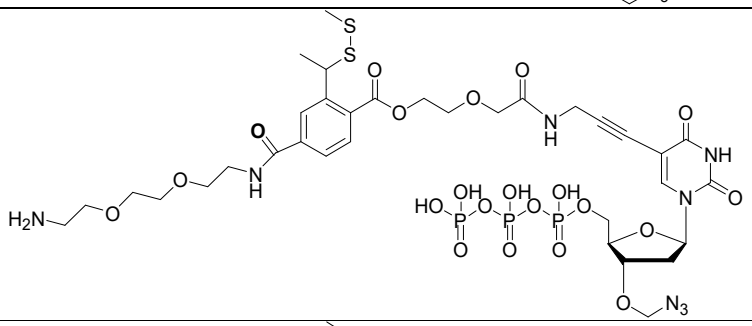
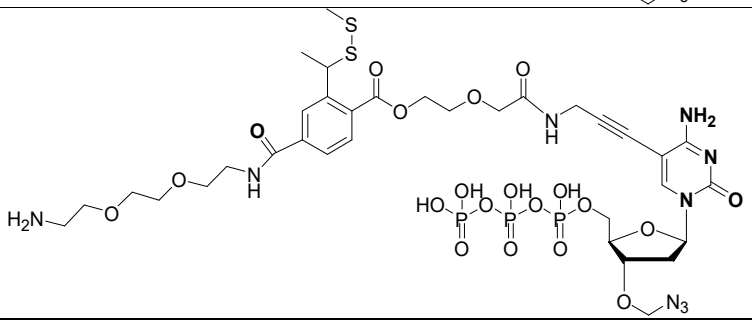
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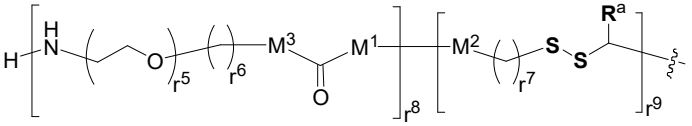
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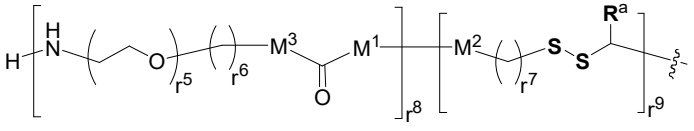
.

10. The compound or a salt thereof according to any one of claims 1 to 9, wherein the compound or a salt thereof carries an additional detectable label;

preferably, the additional detectable label carried by the compound or a salt thereof is introduced by affinity reagent (e.g., antibody, aptamer, Affimer, Knottin), wherein the affinity reagent carries the detectable label, and the affinity reagent can specifically recognize and bind to an epitope of the compound or a salt thereof;

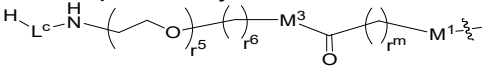
or preferably, the detectable label is linked to the R in the compound of formula I, formula II, formula I-1, formula I-2, formula II-1 or formula II-2 or to a structural moiety corresponding to the R in the compound according to claim 9;

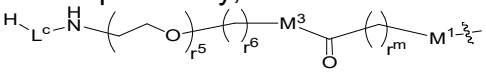
preferably, the detectable label is linked to the terminal amino group in  or a structural moiety correspondent thereto;

preferably, the carboxyl in the detectable label is linked to the terminal amino group in  or a

structural moiety correspondent thereto via formation of an amide bond;

or preferably, the detectable label is linked to the R in the compound of formula III or to a structural moiety corresponding to the R in the compound according to claim 9;

or preferably, the detectable label is linked to the terminal amino group in  or a structural moiety correspondent thereto;

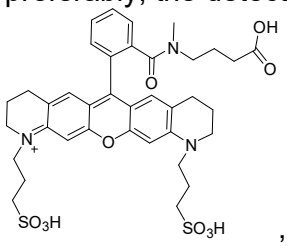
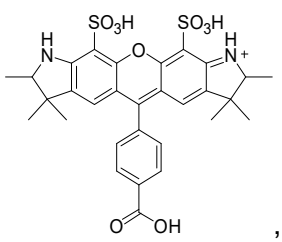
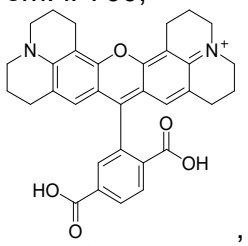
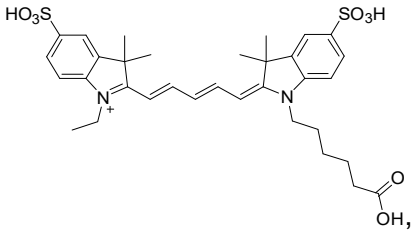
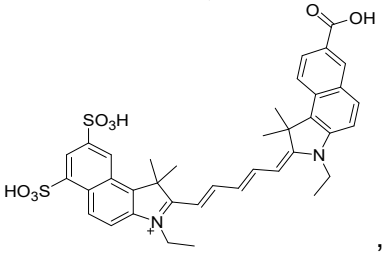
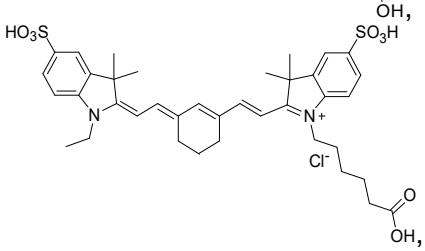
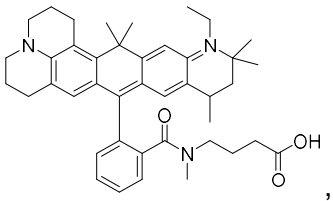
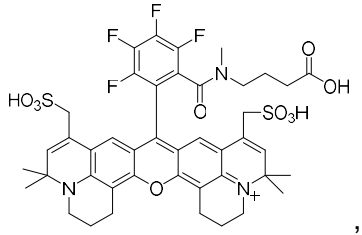
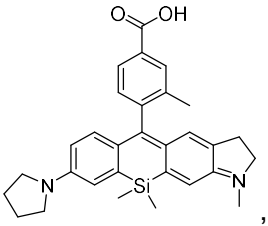
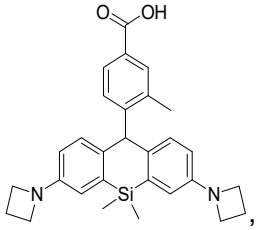
or preferably, the detectable label is linked to the terminal amino group in  or a structural moiety correspondent thereto via formation of an amide bond;

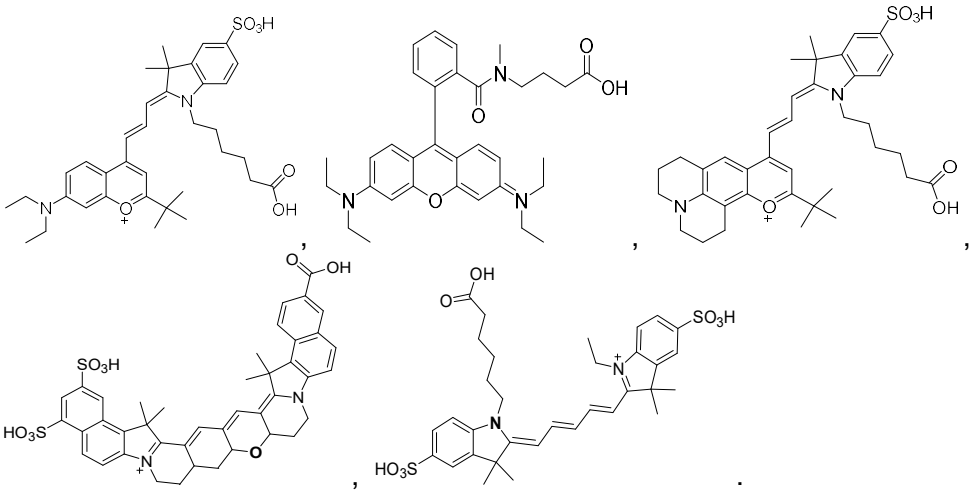
preferably, base[1] is different, and the additional detectable label carried by the compound of formula I varies;

preferably, base[2] is different, and the additional detectable label carried by the compound of formula II varies;

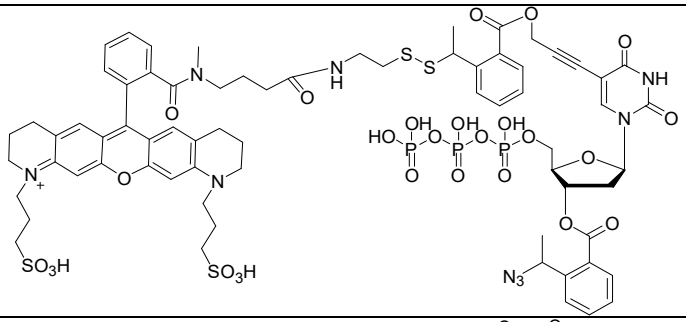
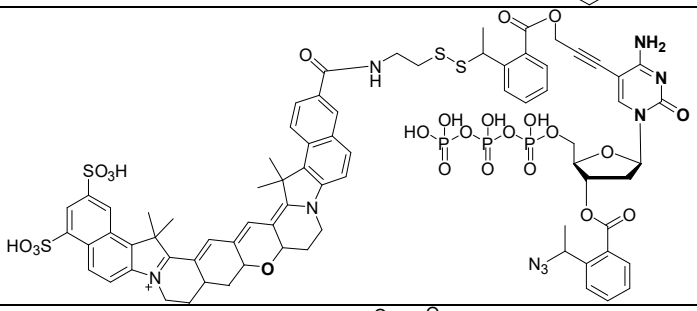
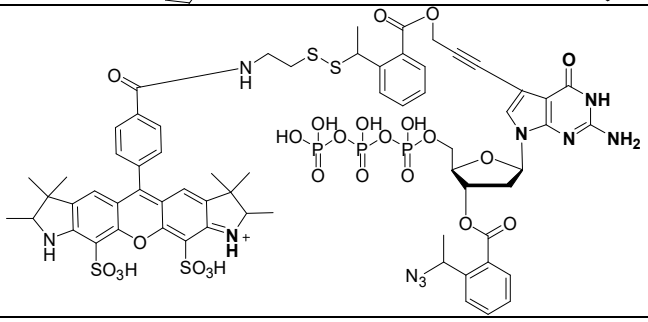
preferably, the detectable label is a fluorescent label;

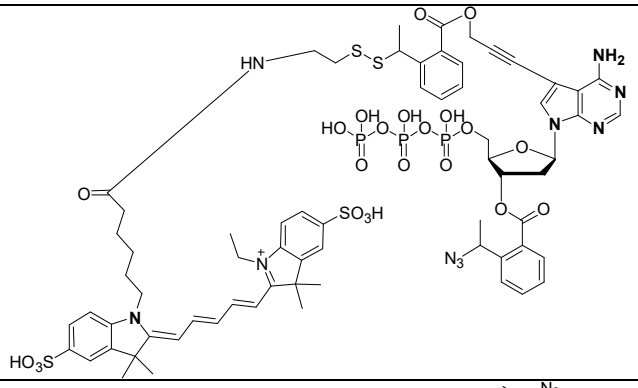
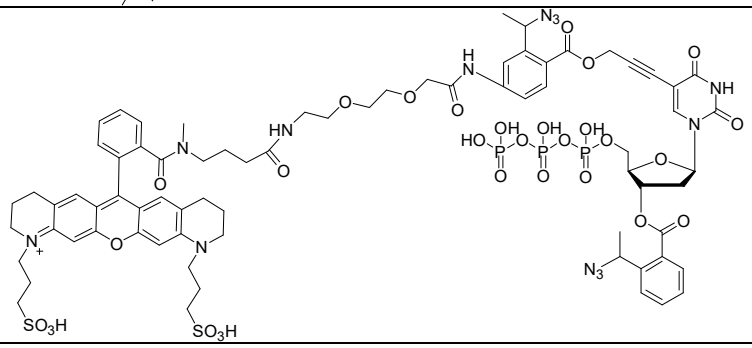
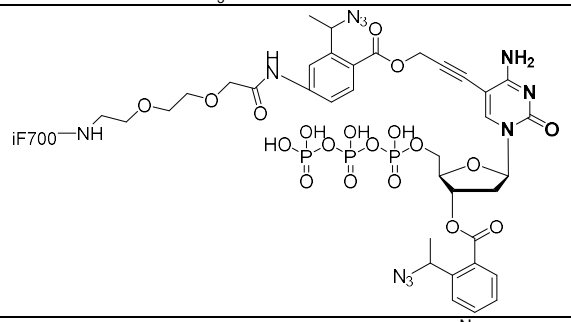
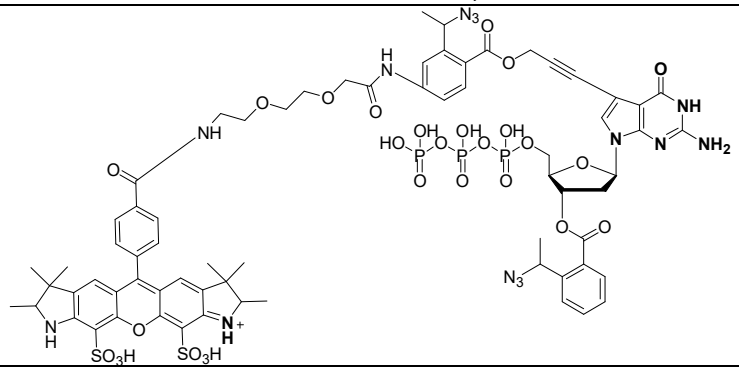
preferably, the detectable label is selected from: iF700,

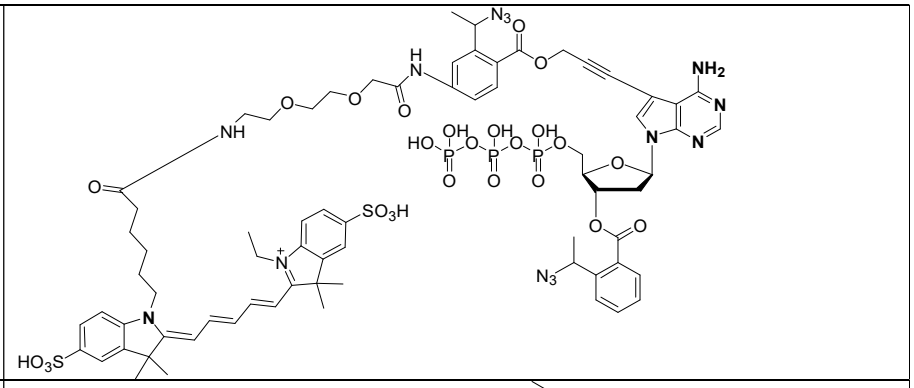
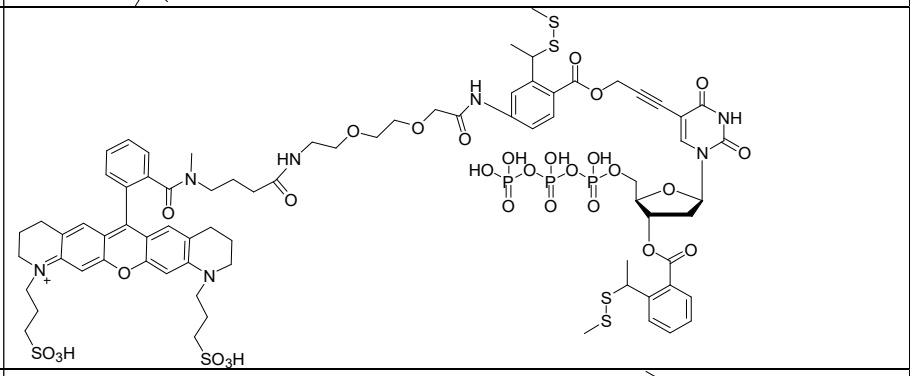
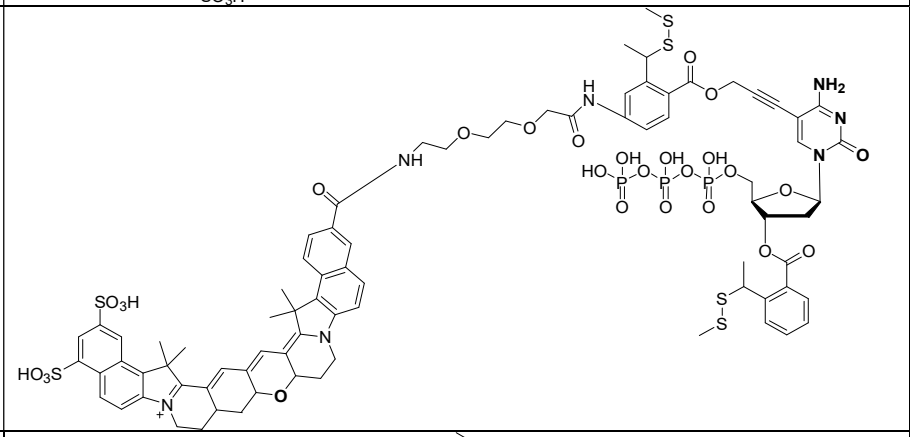
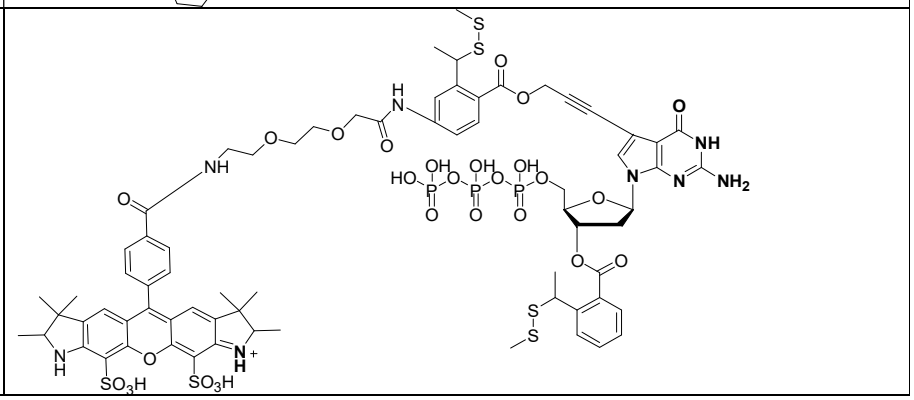











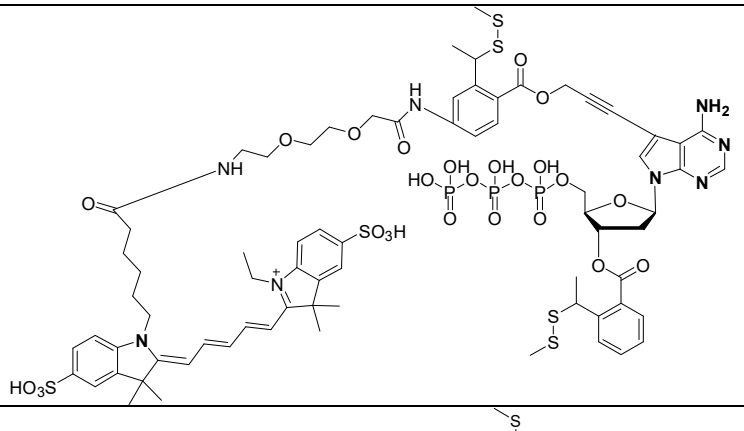
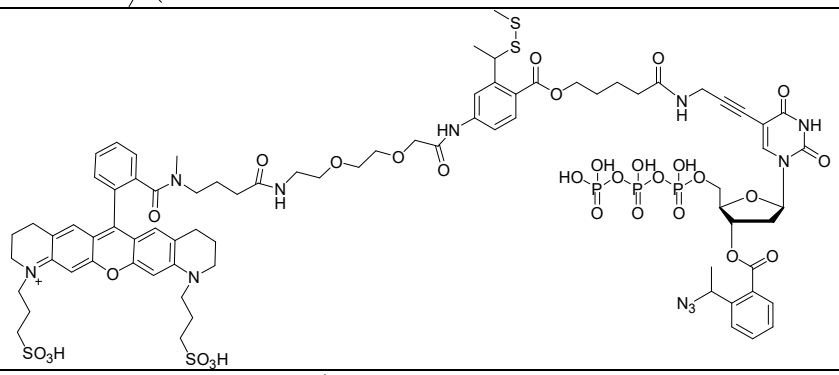
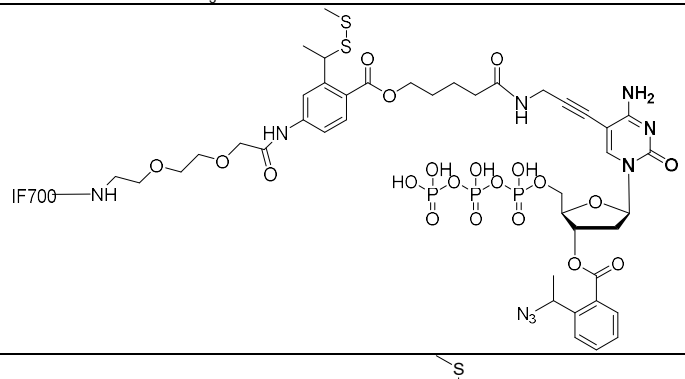
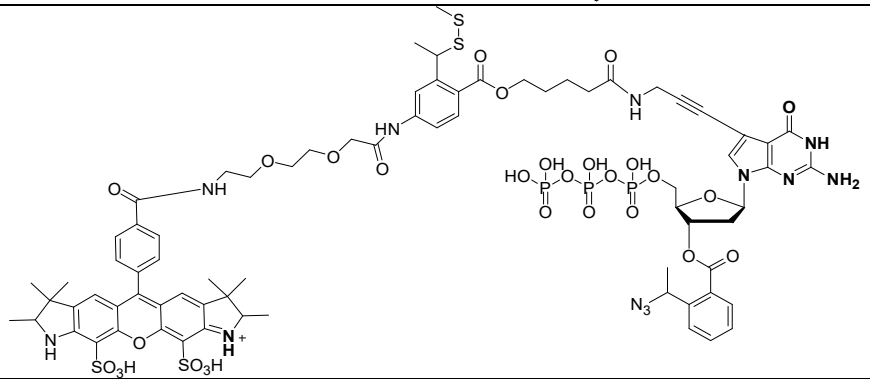


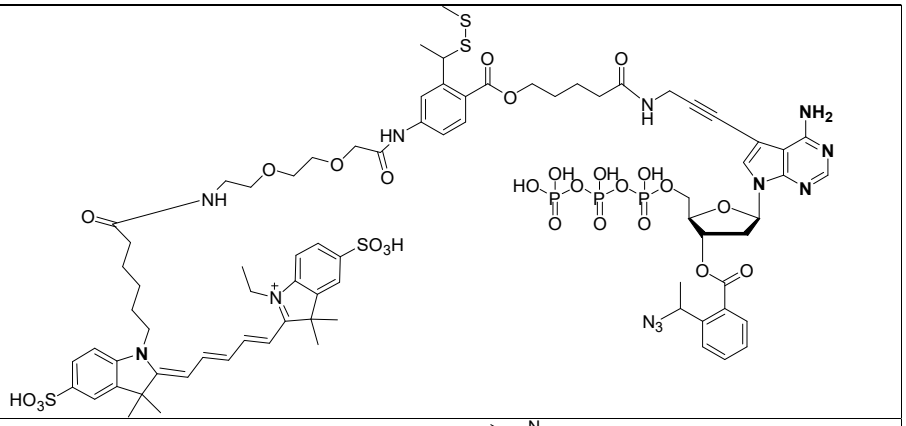
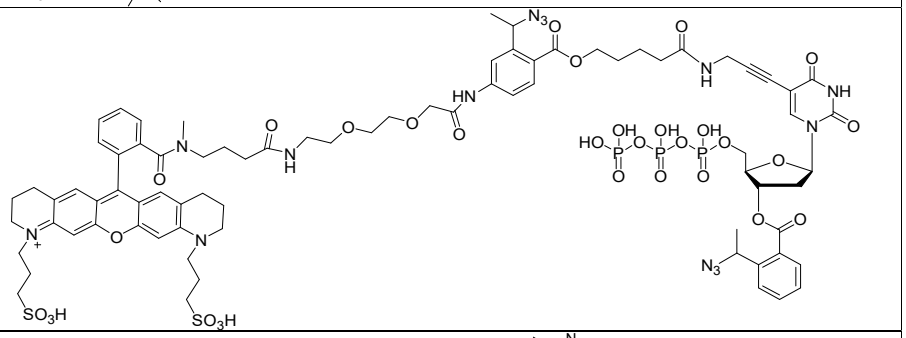
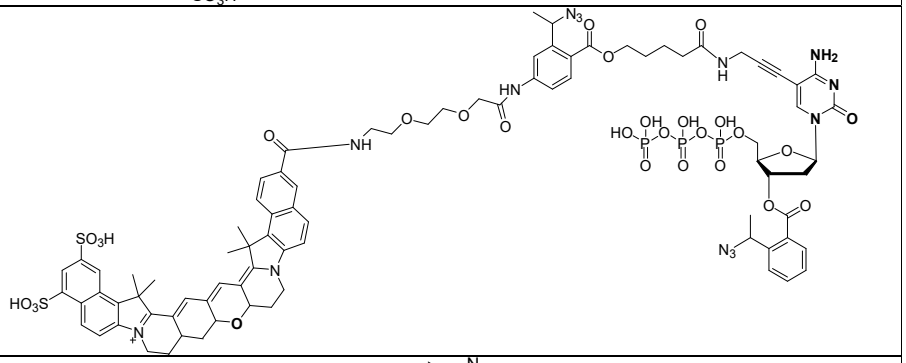
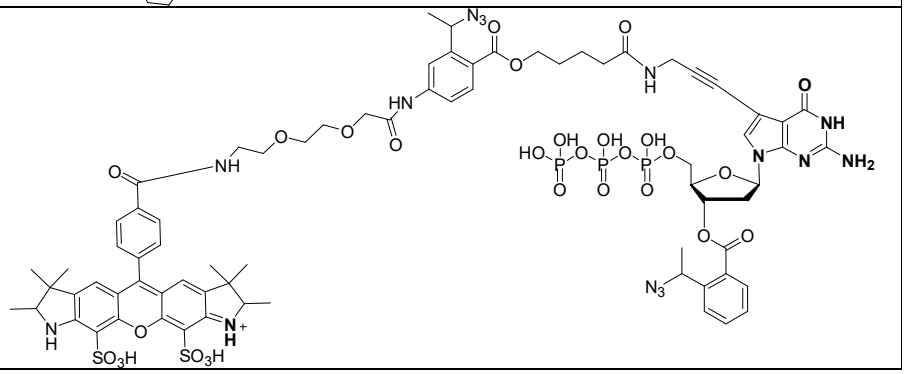
11. The compound or a salt thereof according to claim 10, wherein the compound is selected from:

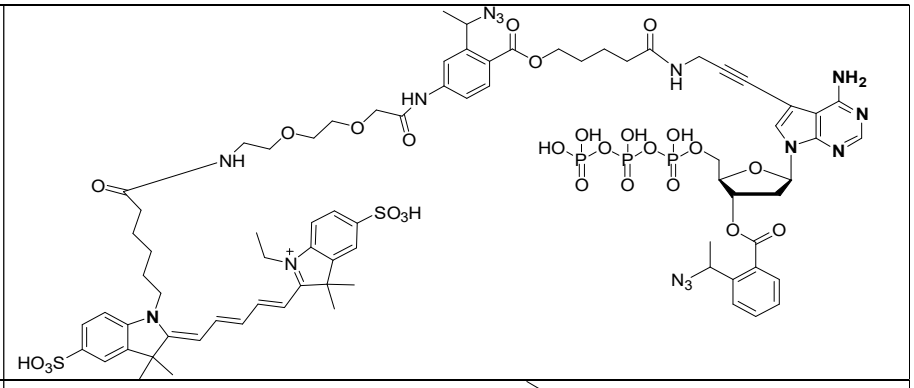
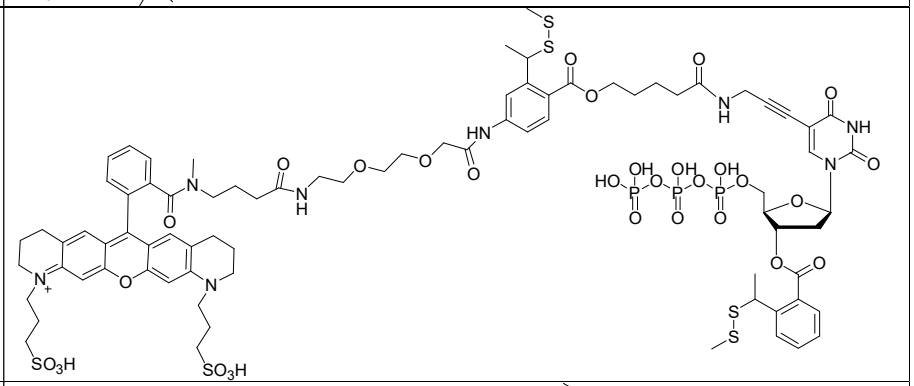
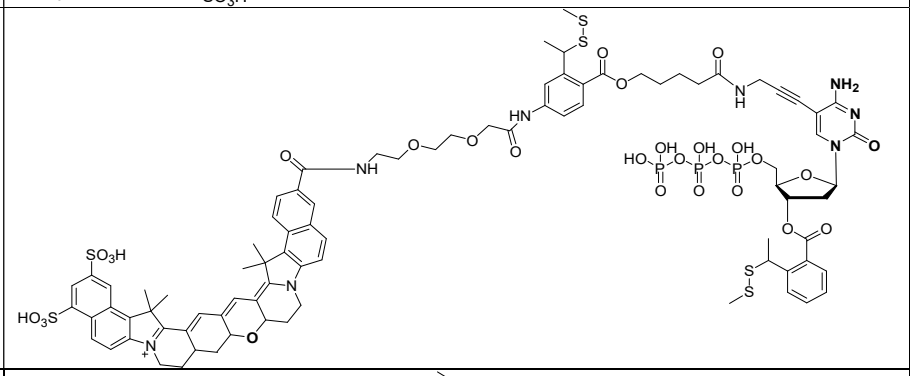
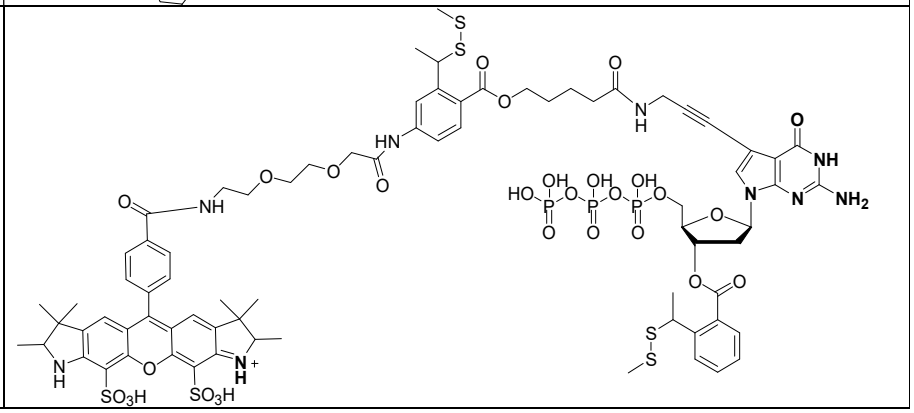
Serial Number	Structural formulae
1A'	
1B'	
1C'	

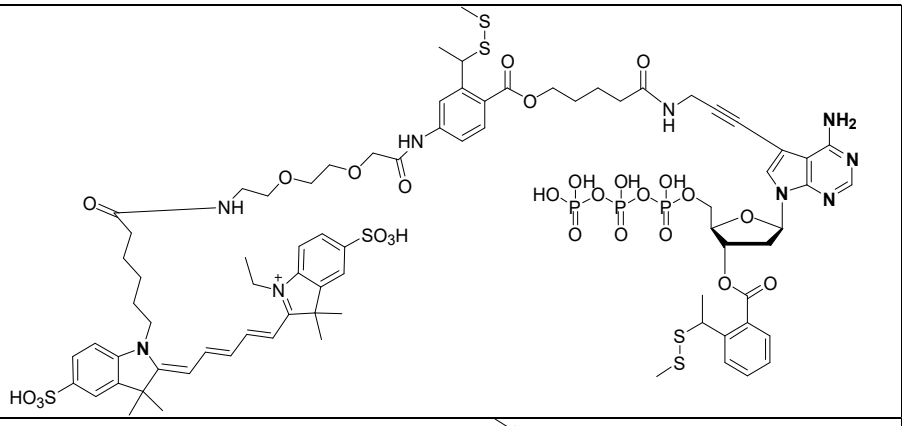
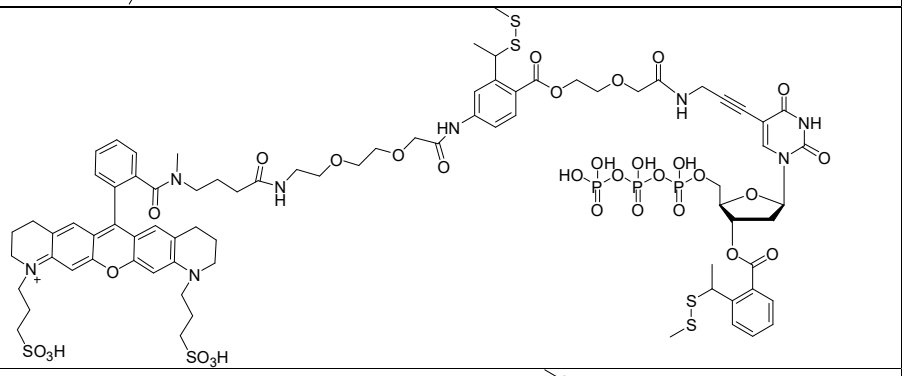
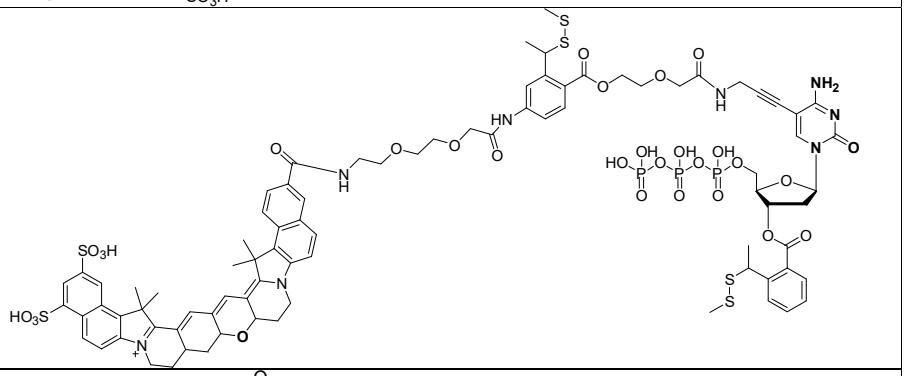
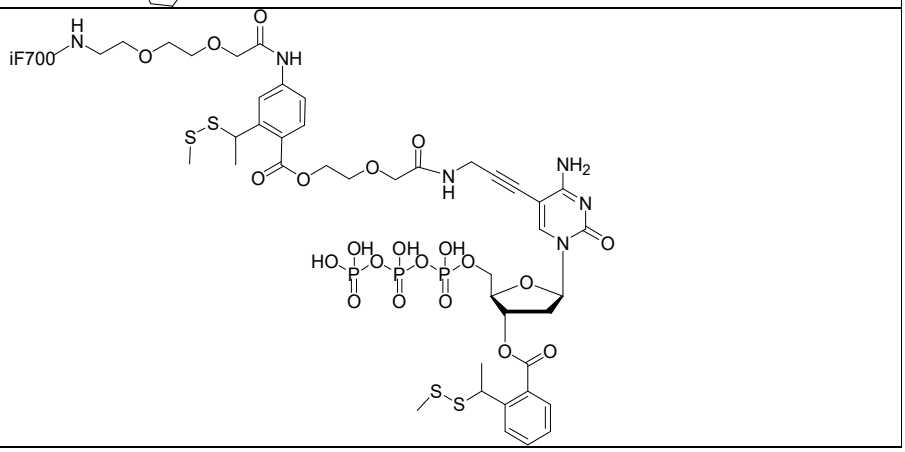
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2A'	
2B'	
2C'	

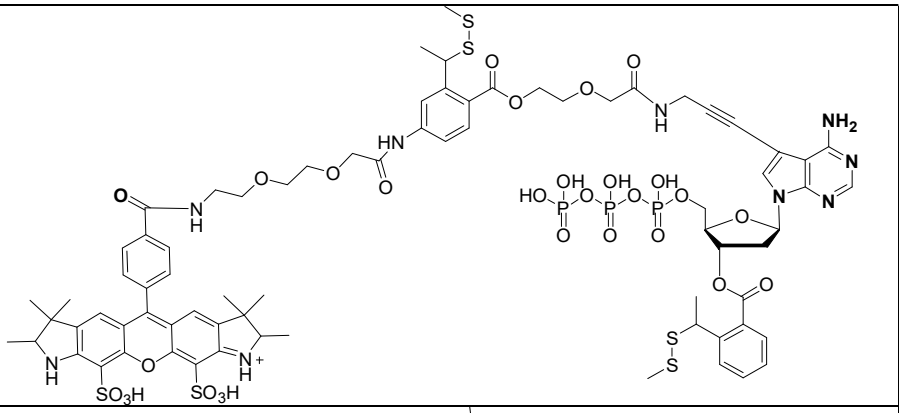
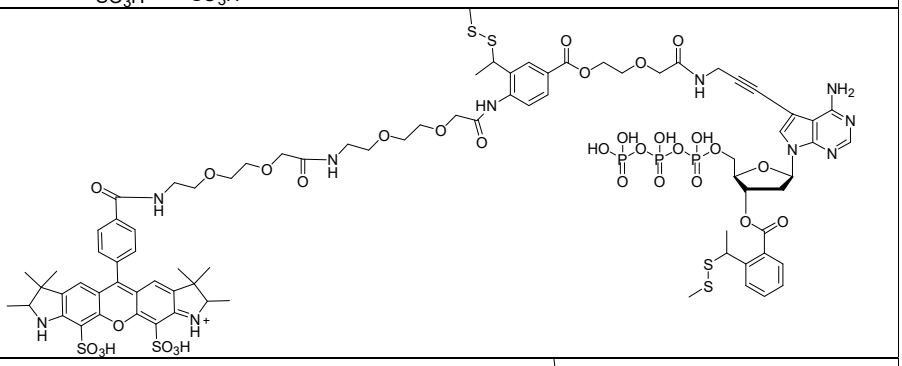
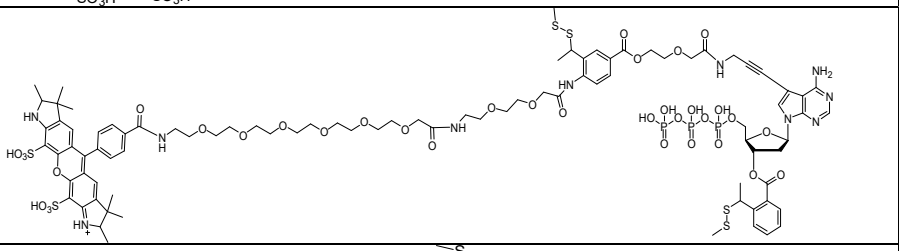
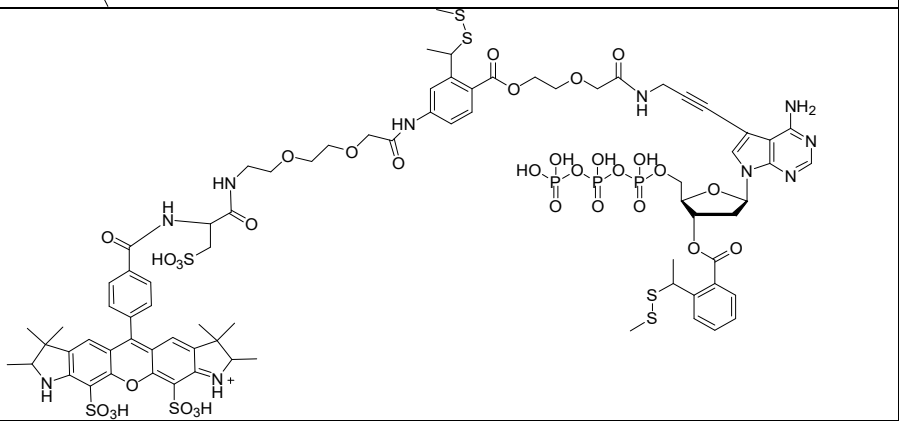
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3A'	
3B'	
3C'	

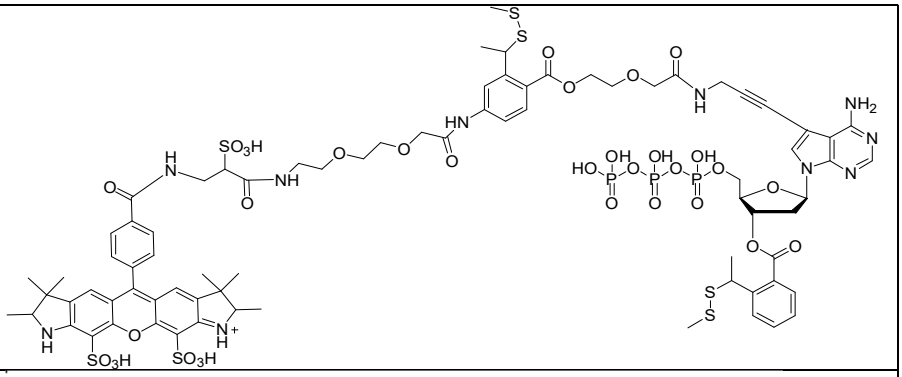
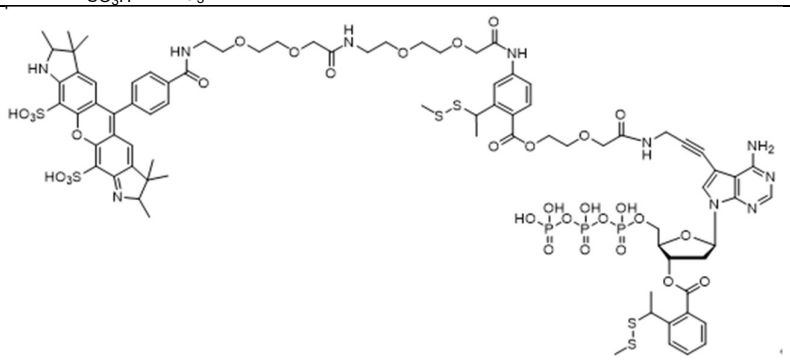
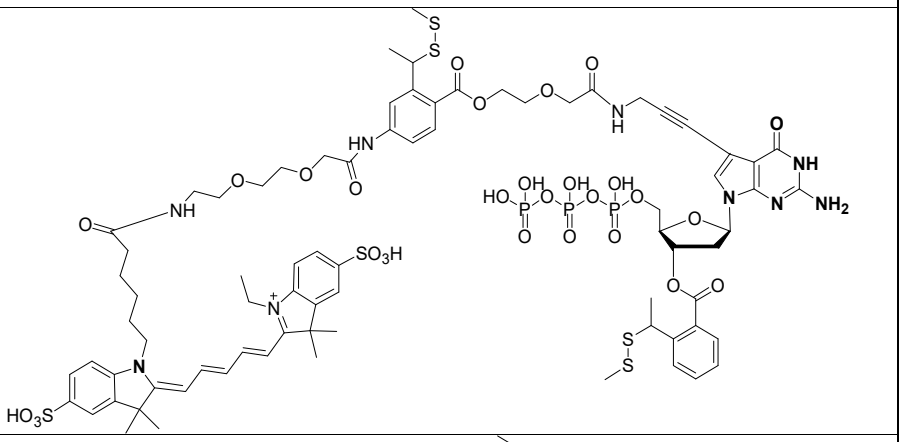
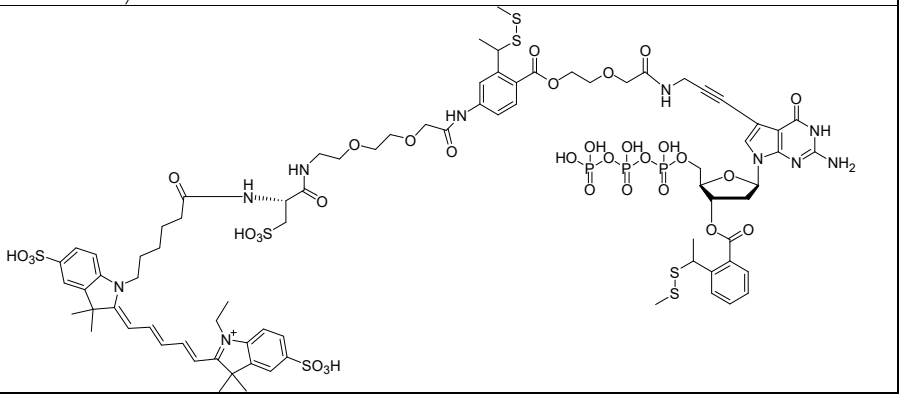
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4A'	
4B'	
4C'	

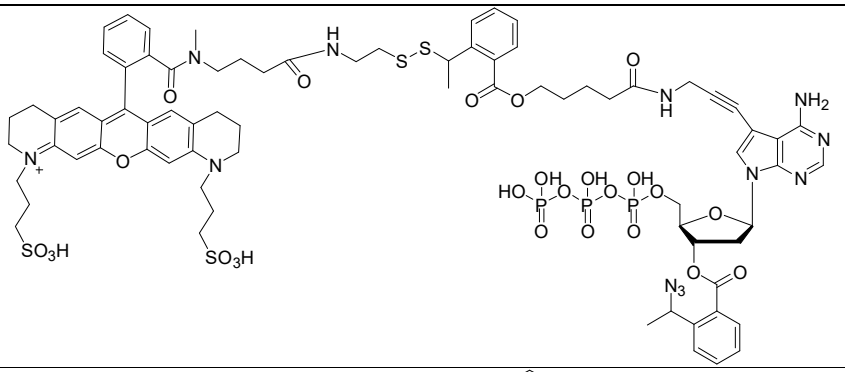
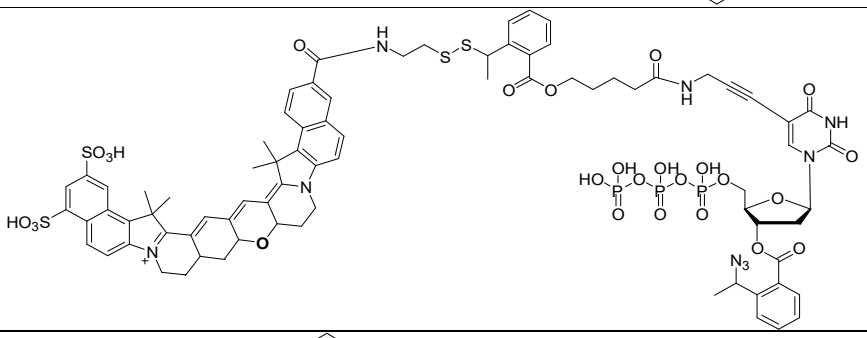
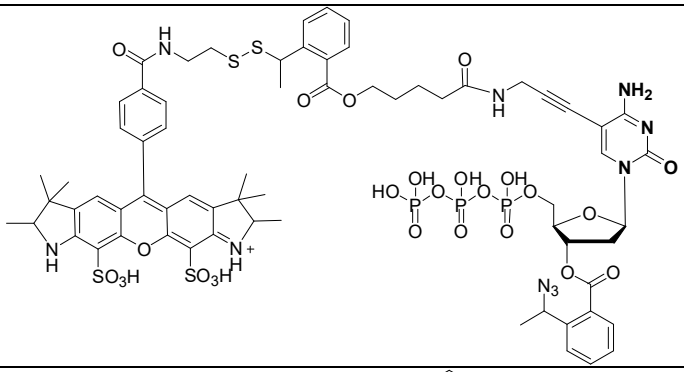
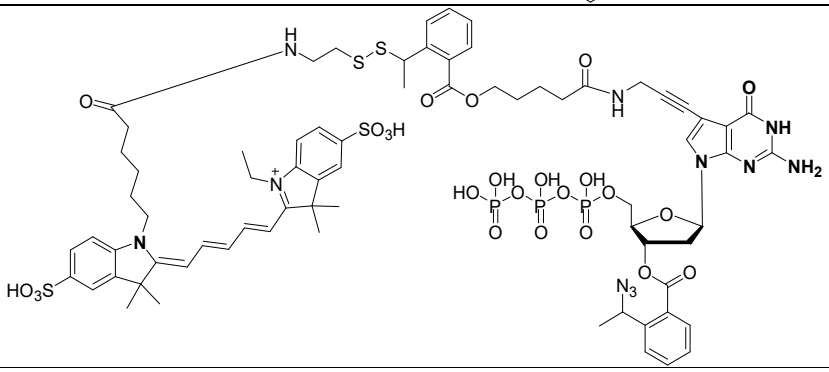
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5A'	
5B'	
5C'	

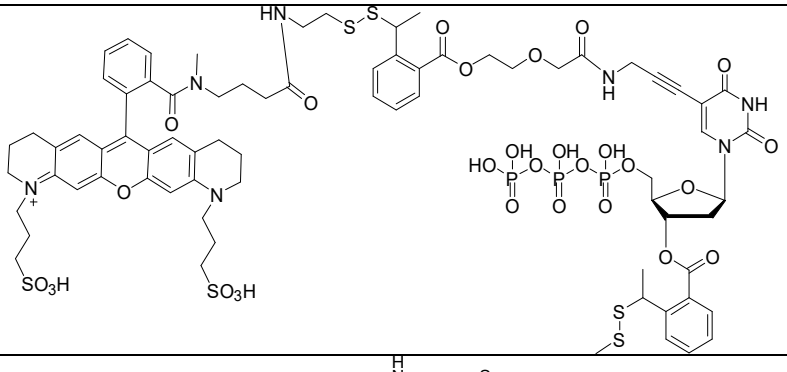
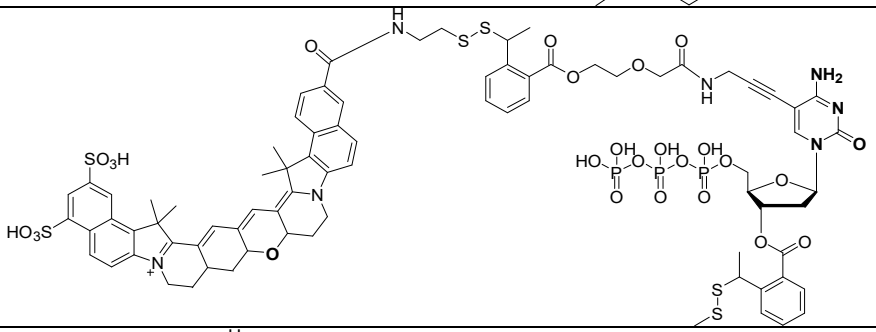
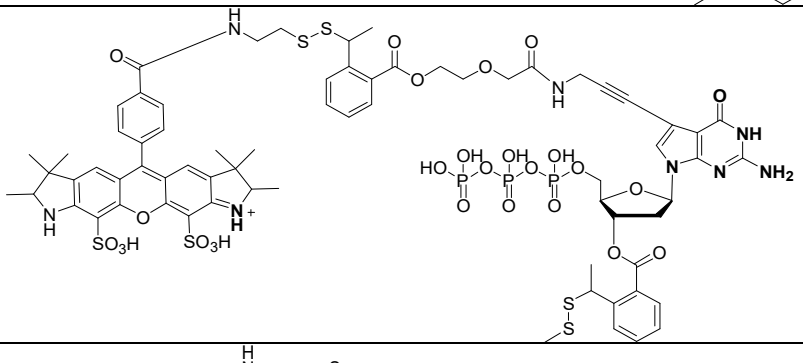
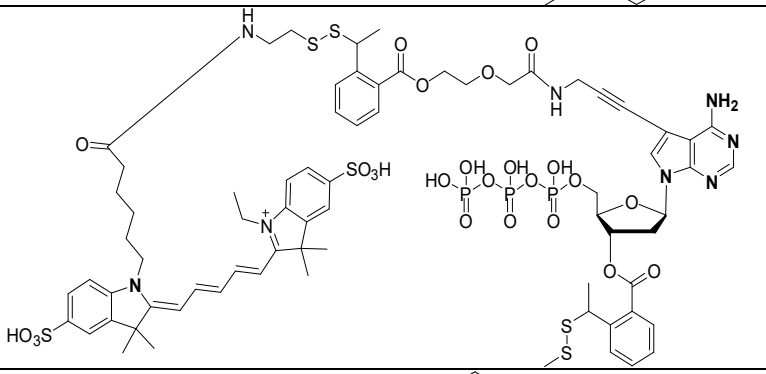
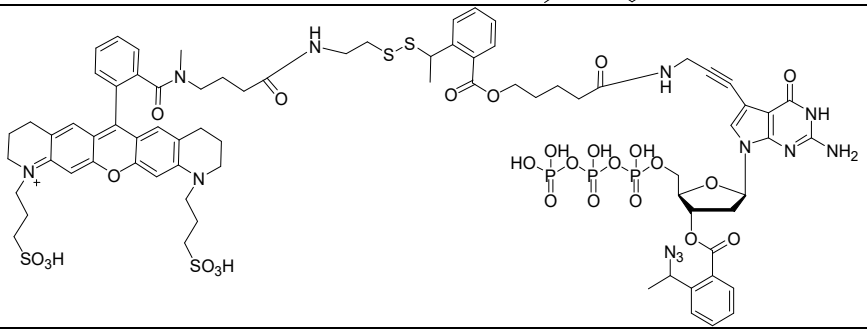
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6A'	
6B'	
6C'	

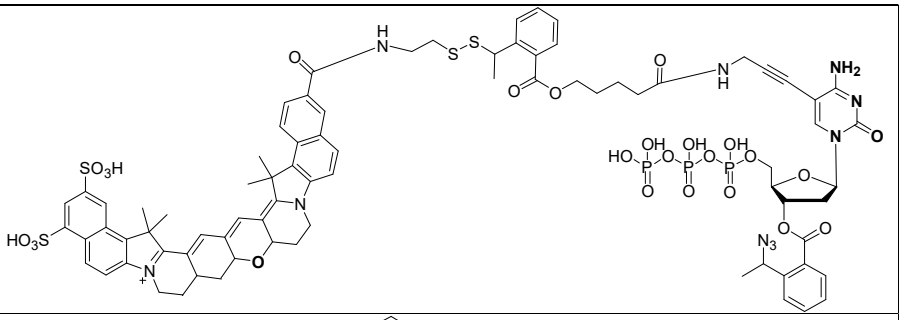
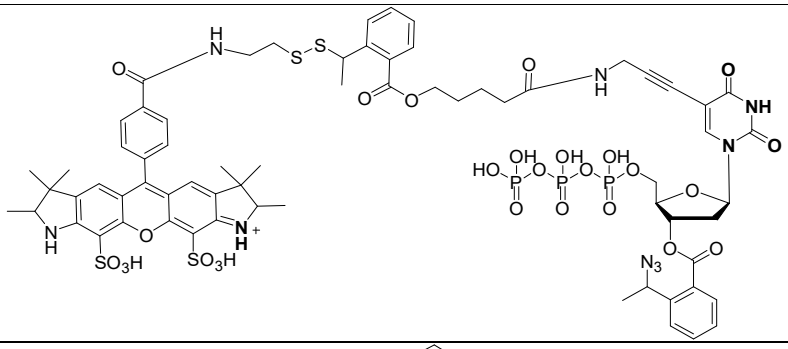
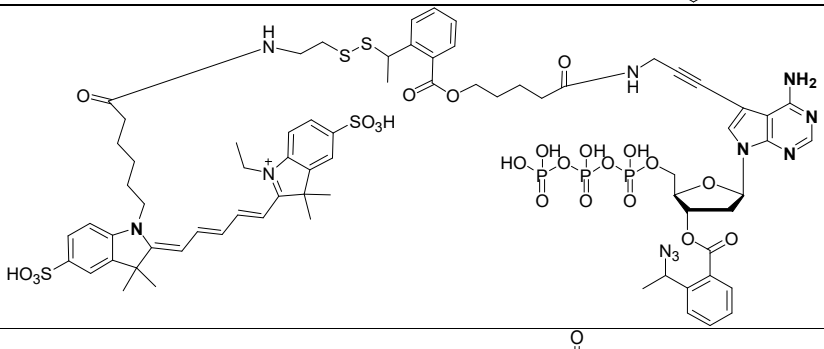
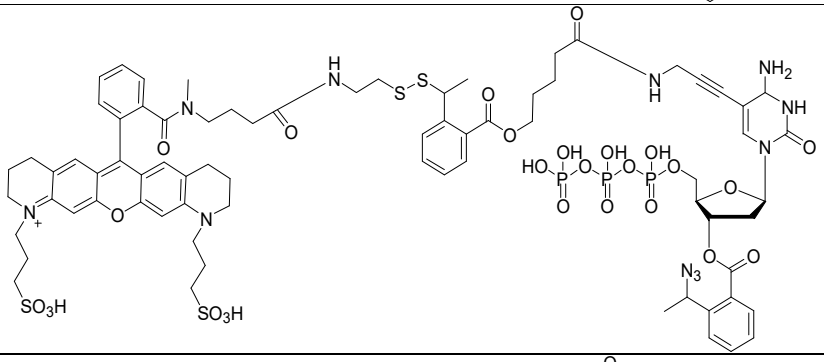
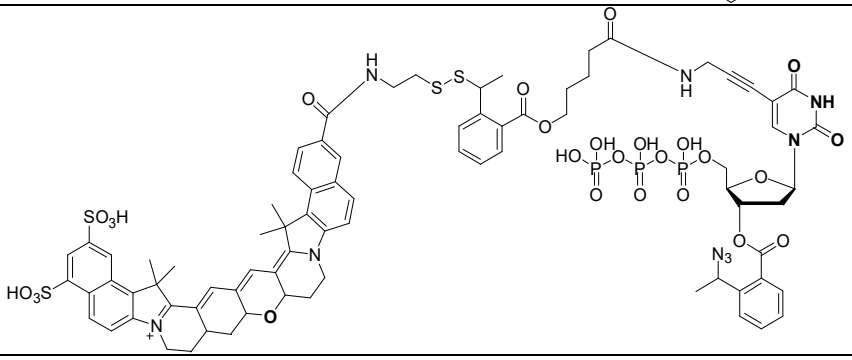
6D'	
7A'	
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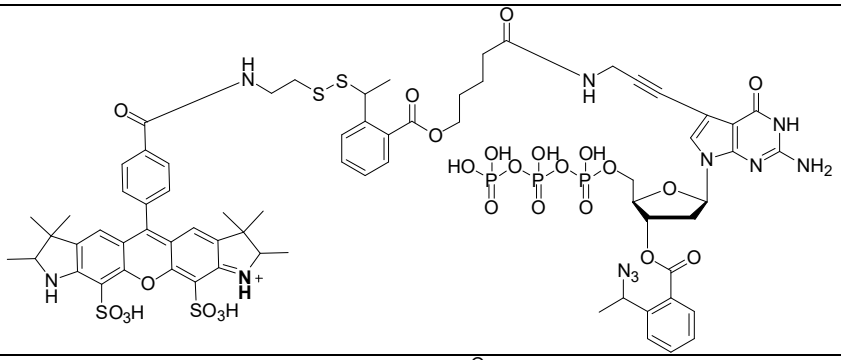
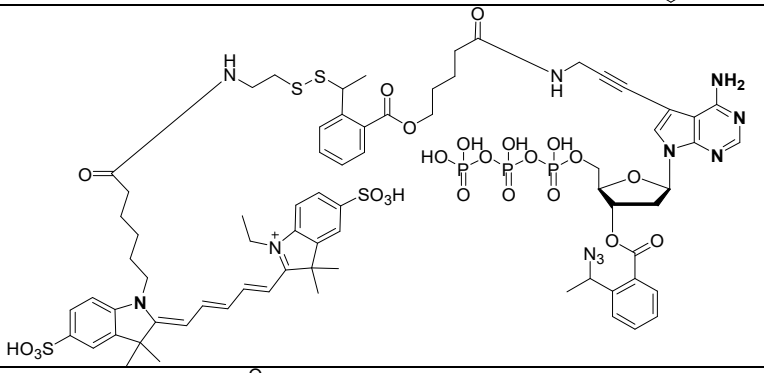
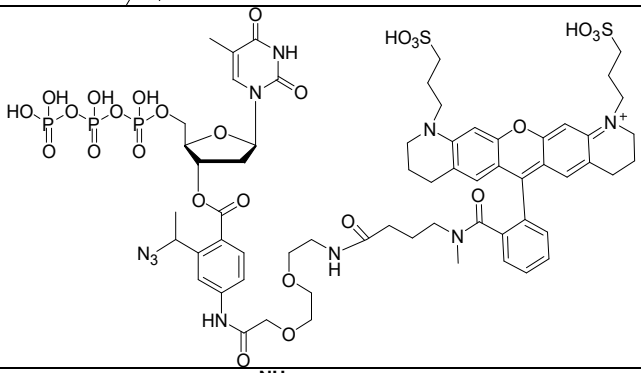
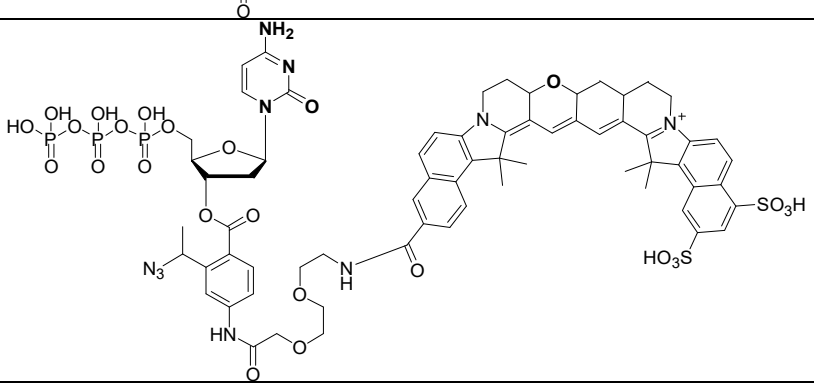
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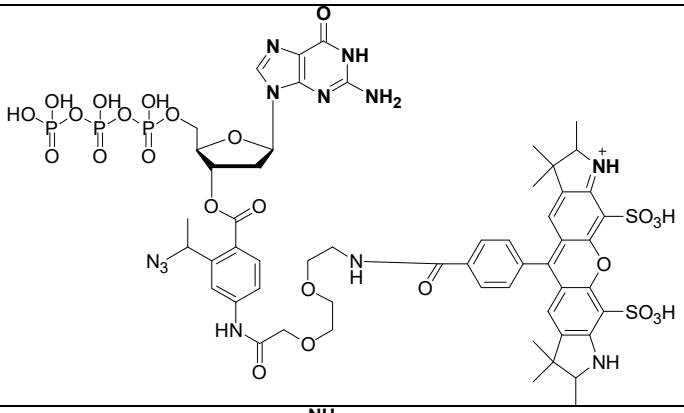
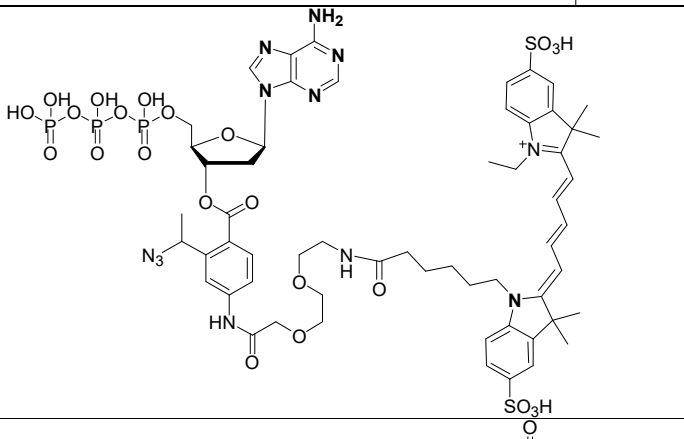
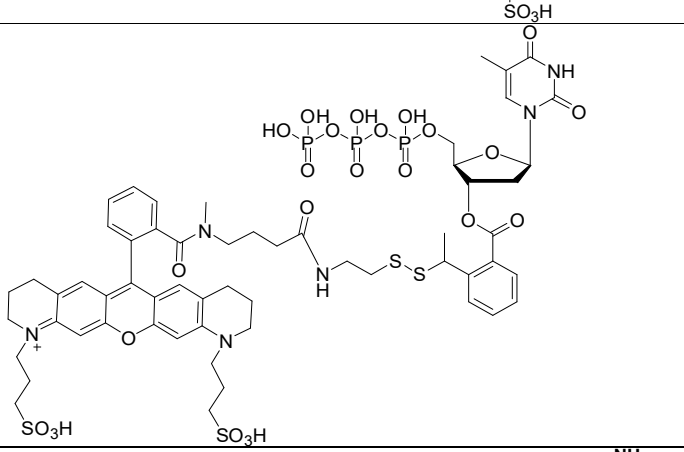
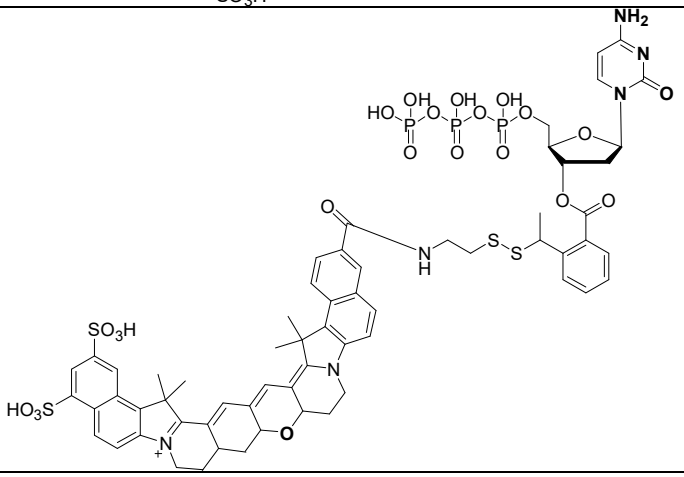
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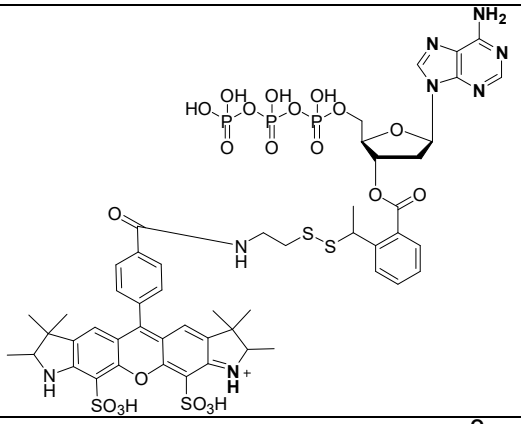
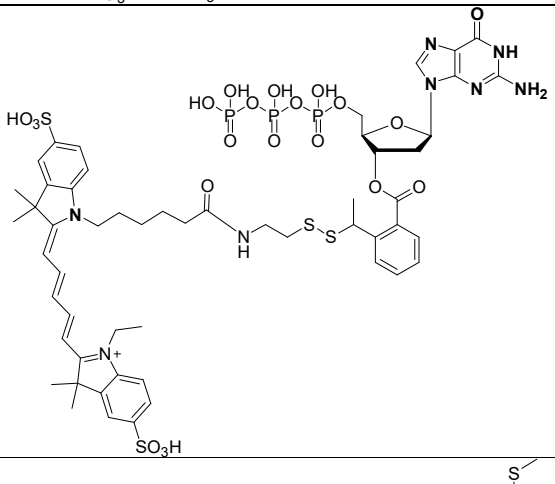
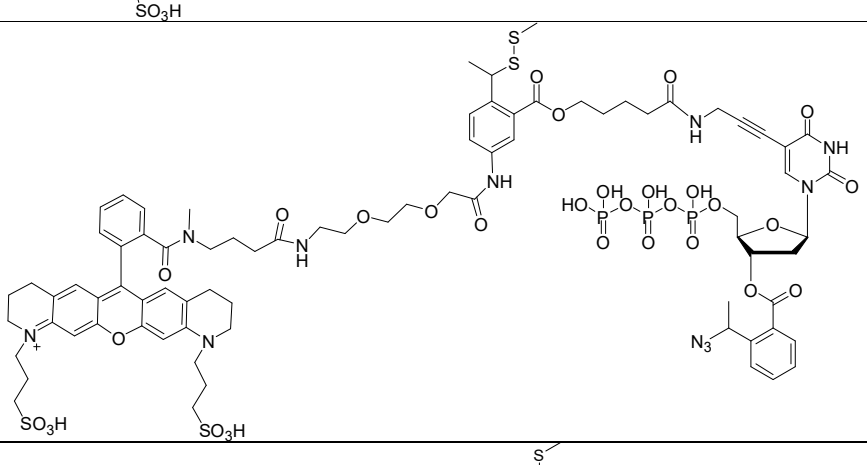
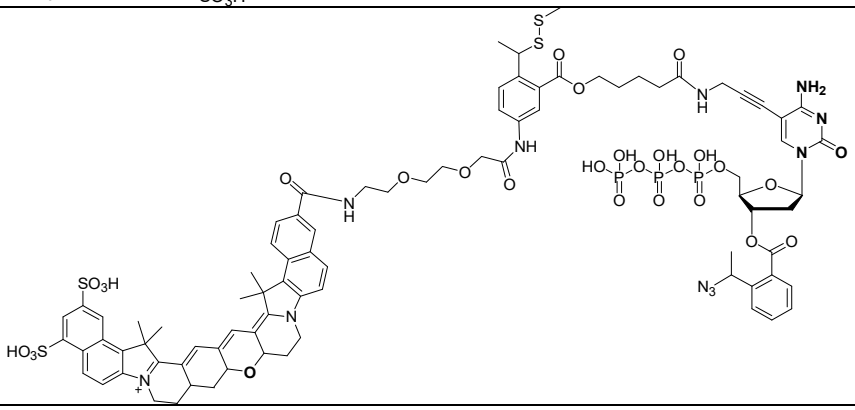
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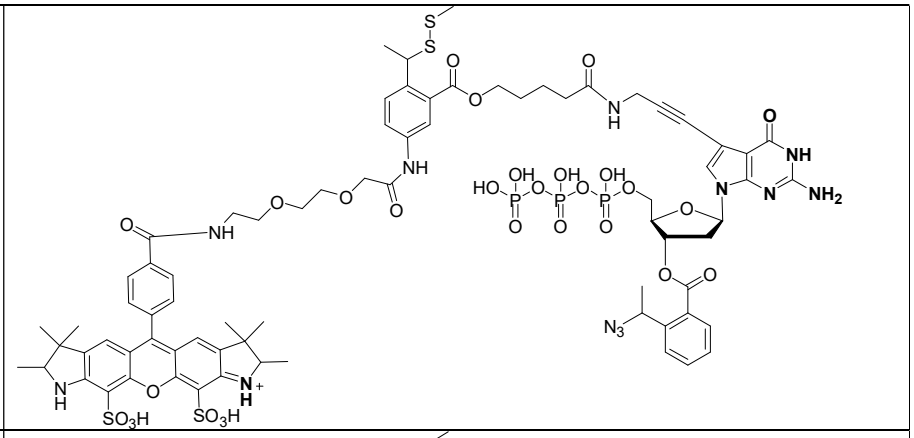
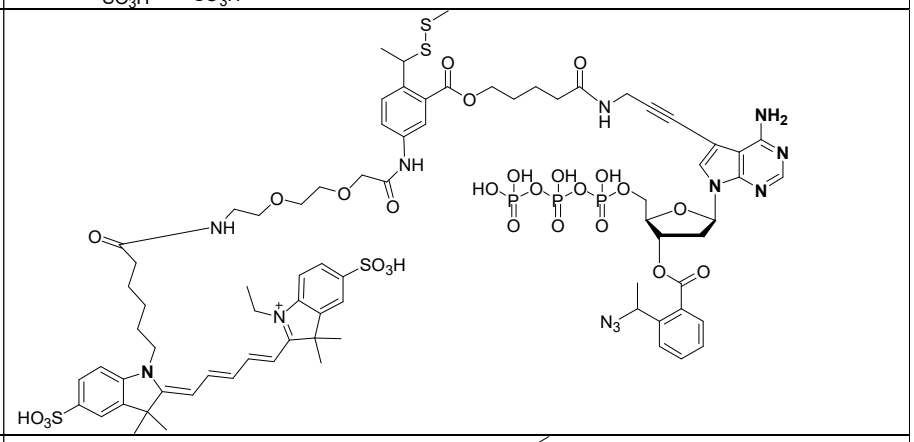
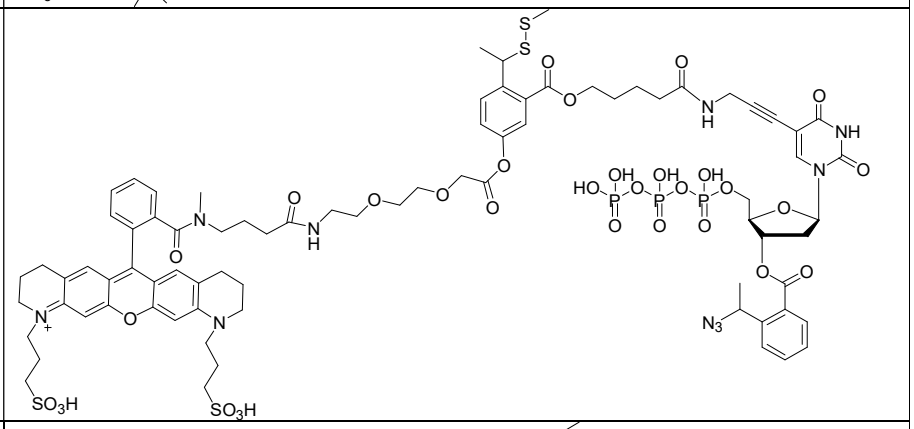
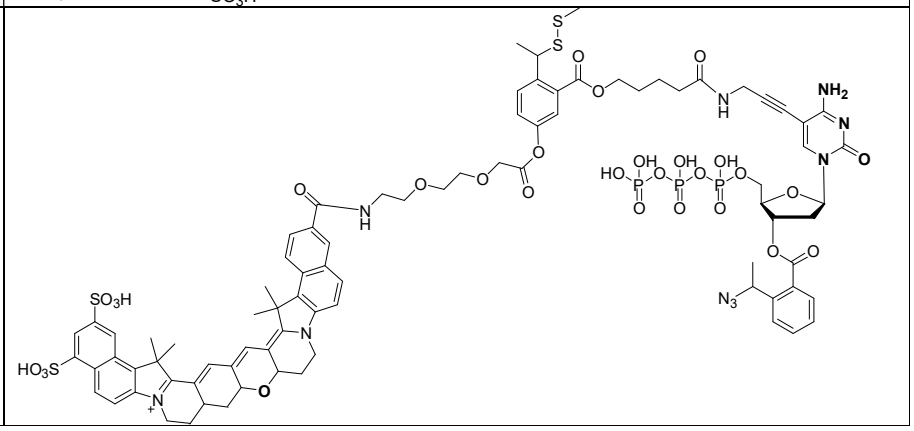
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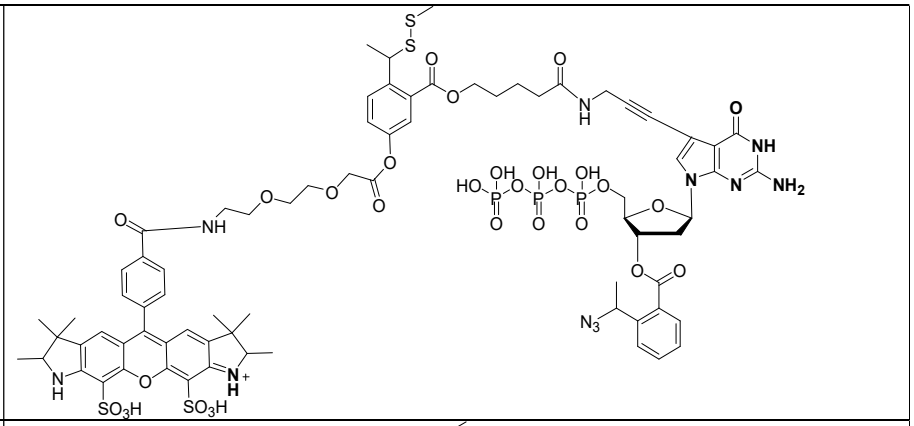
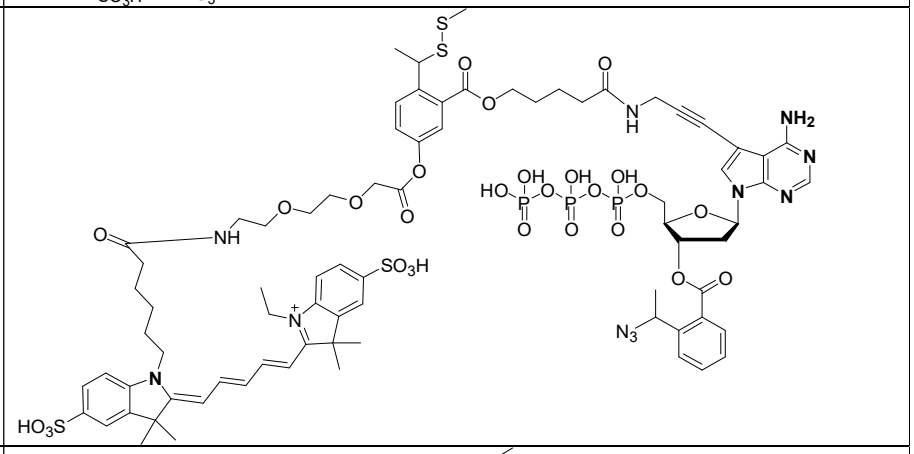
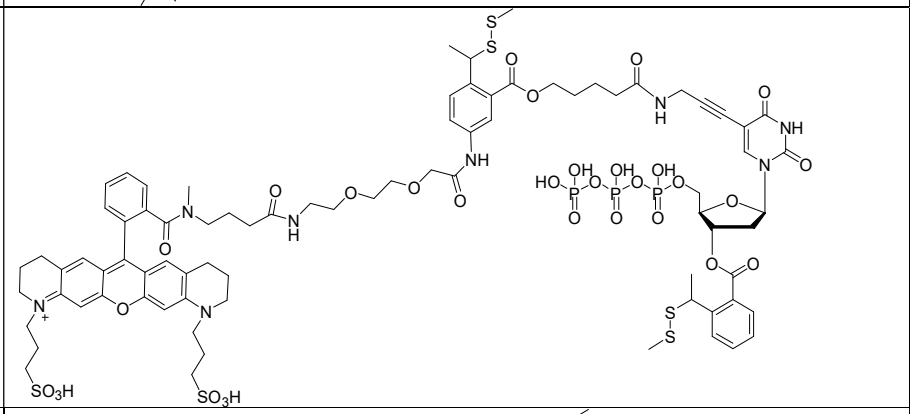
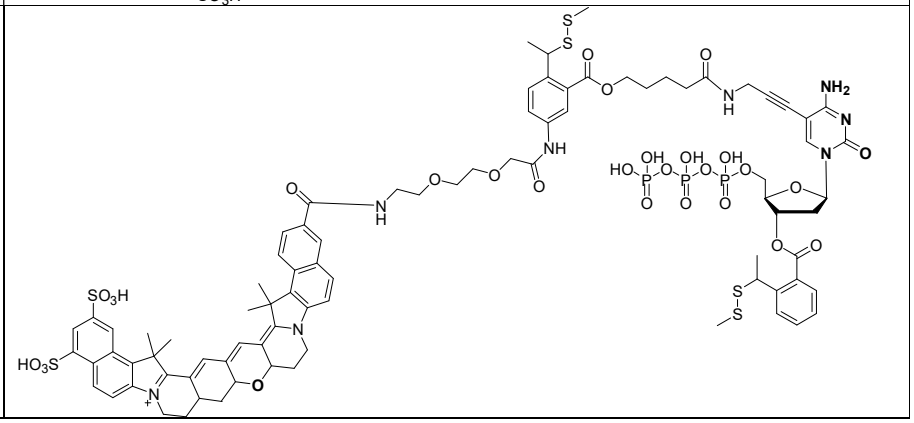
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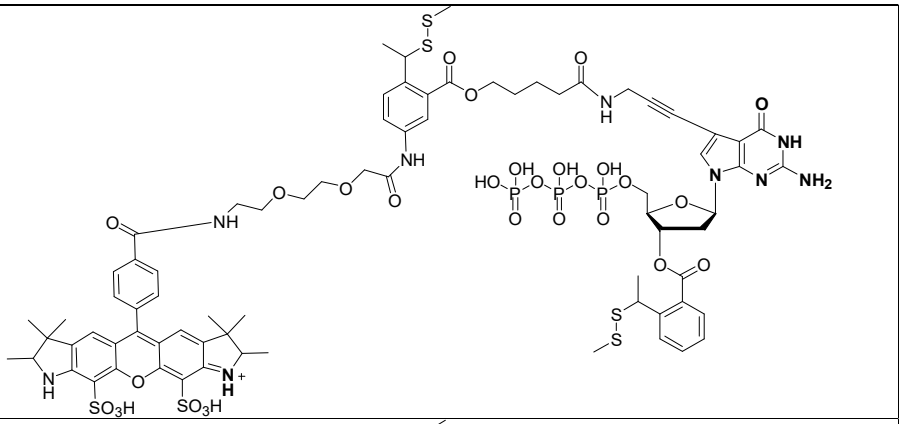
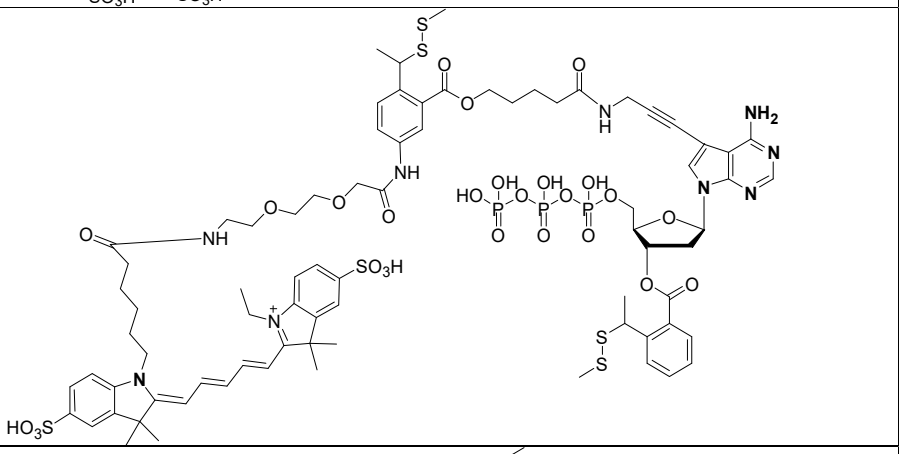
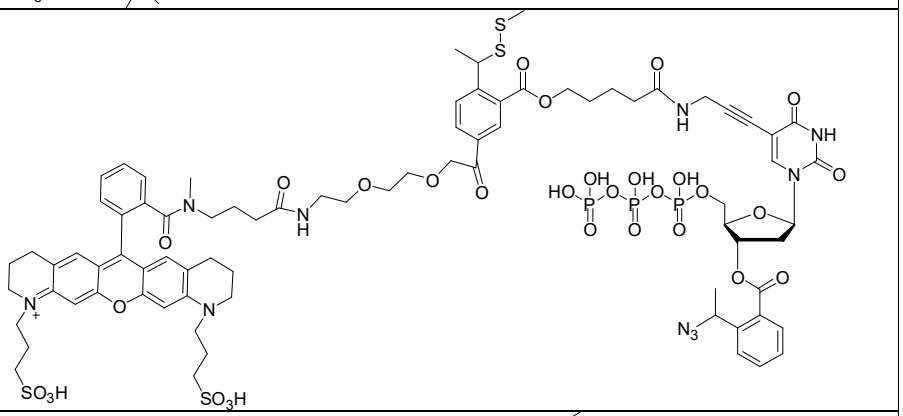
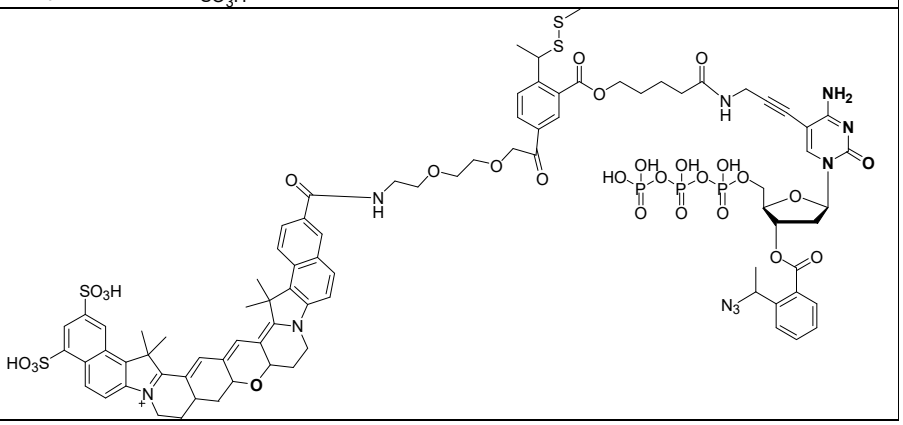
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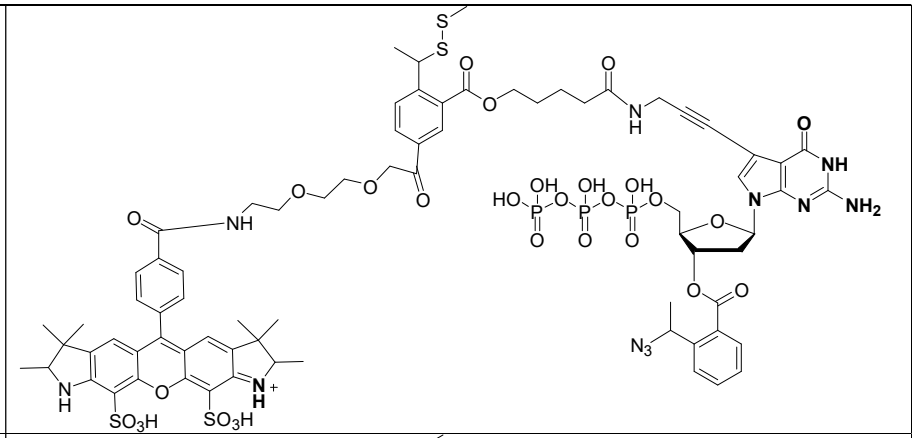
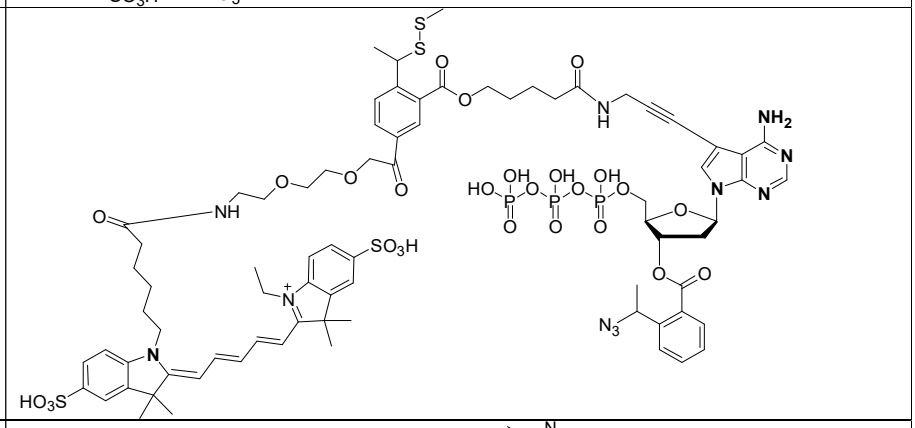
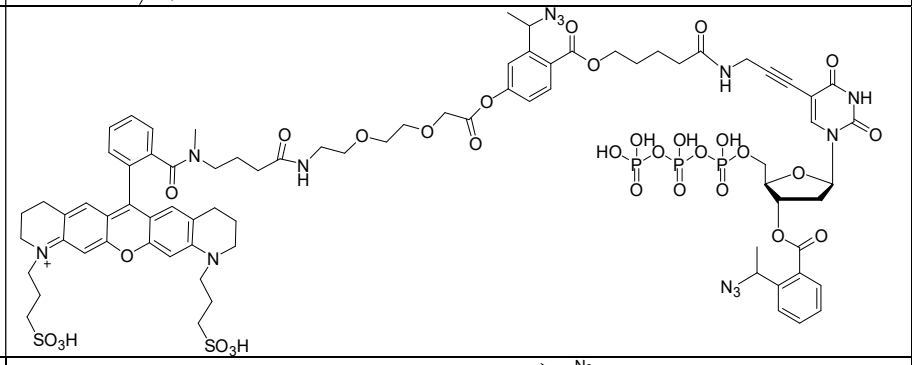
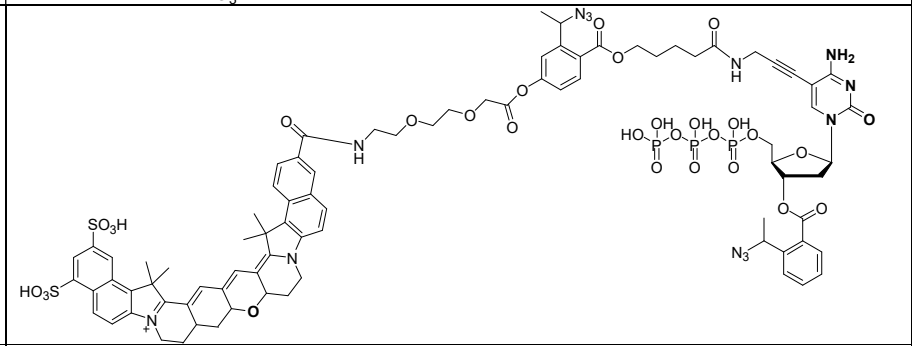
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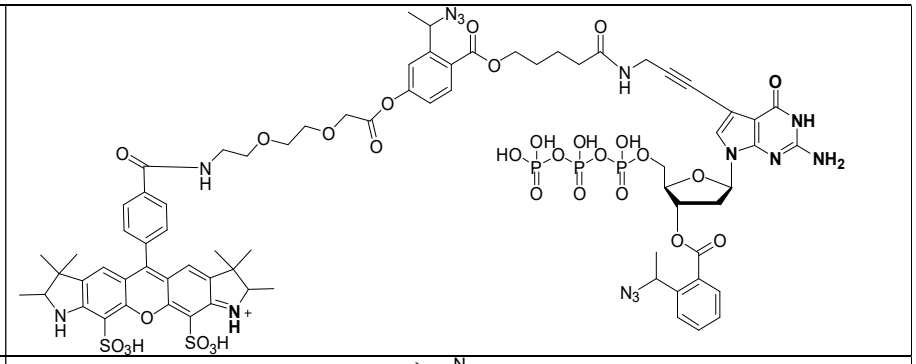
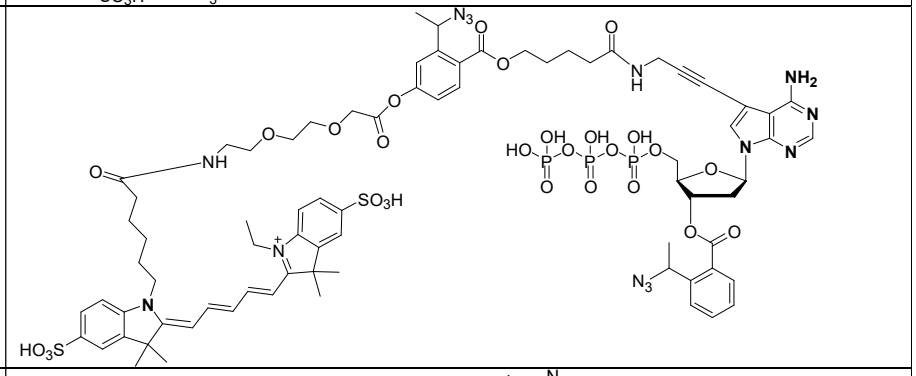
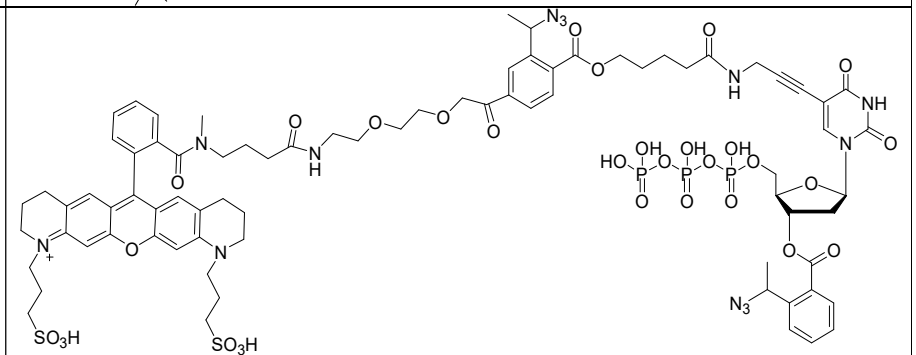
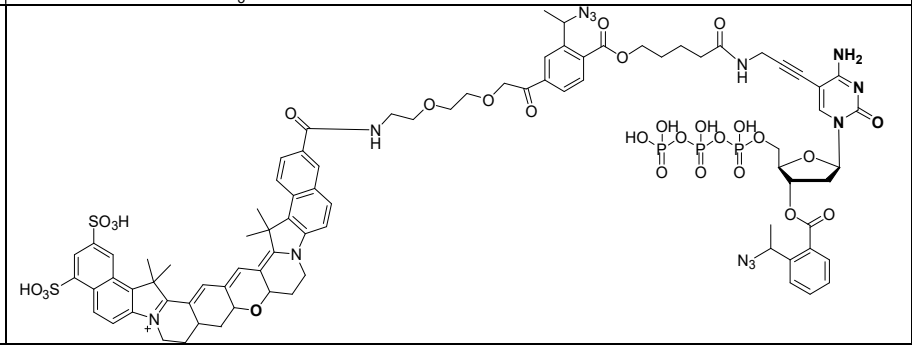
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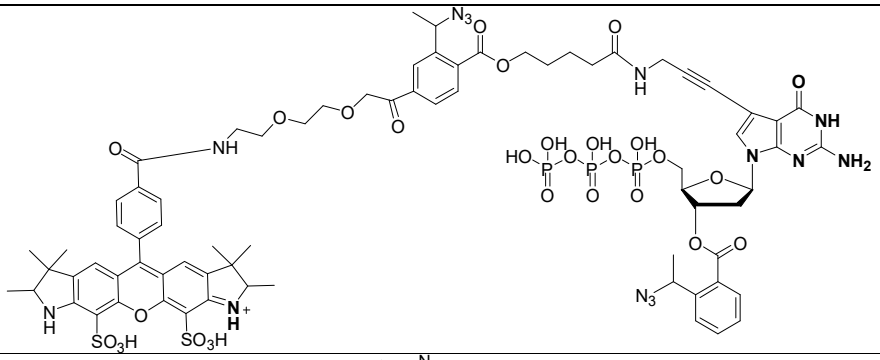
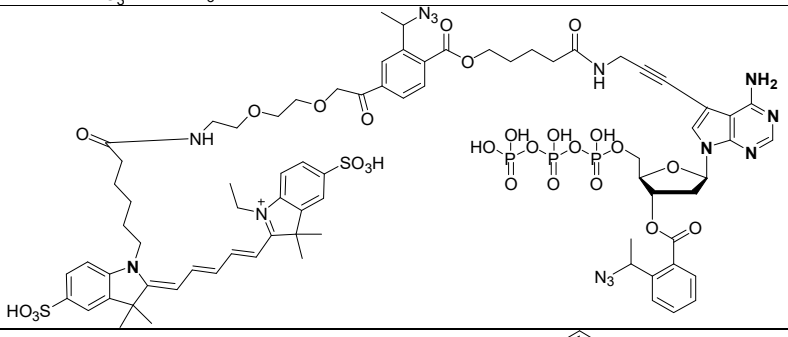
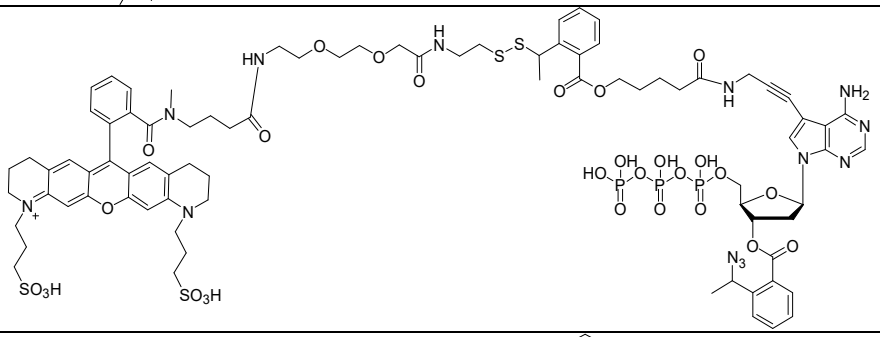
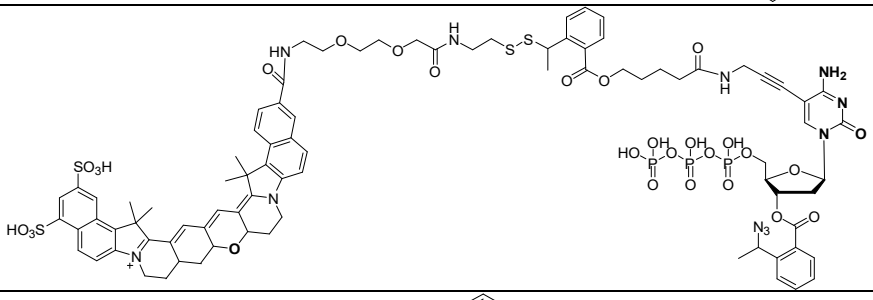
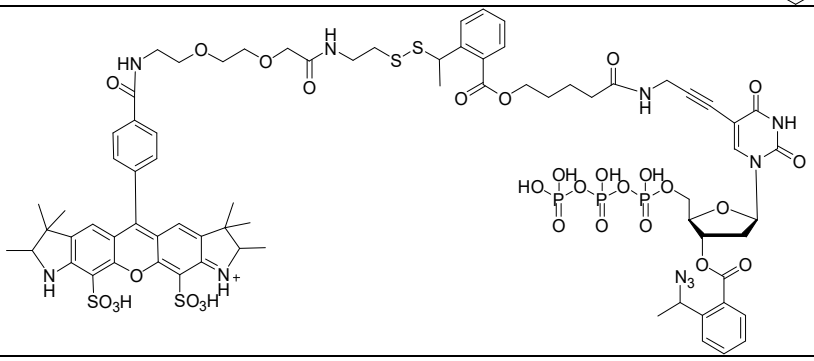
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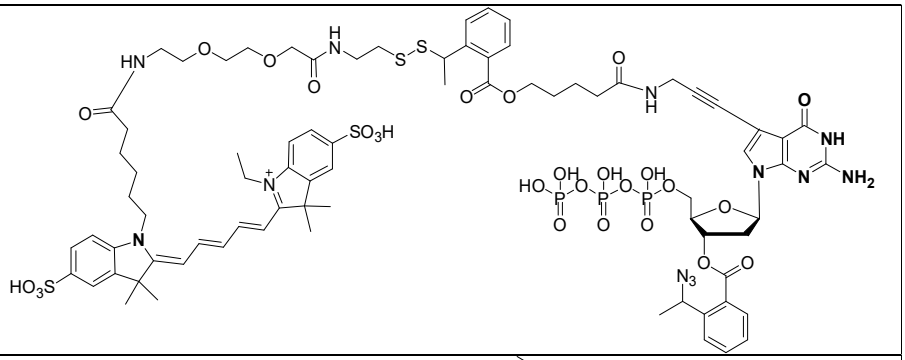
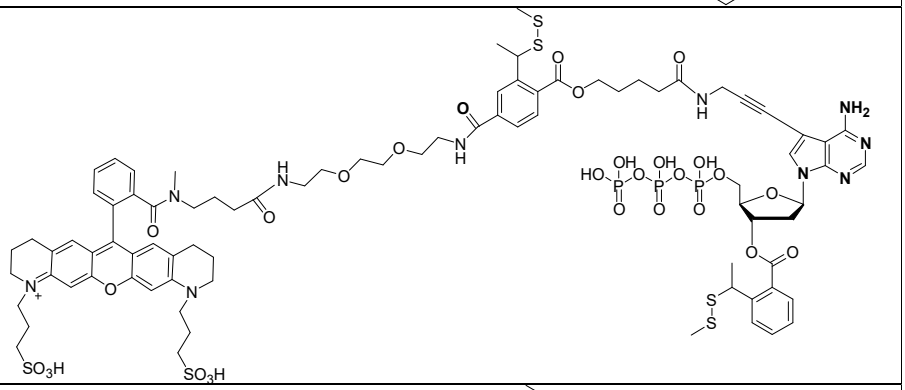
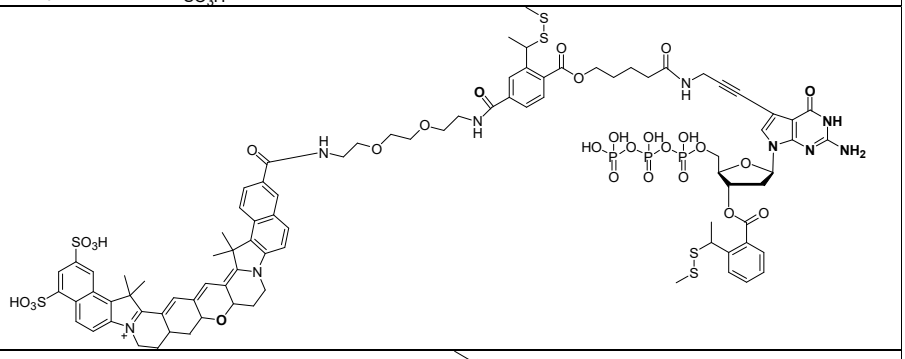
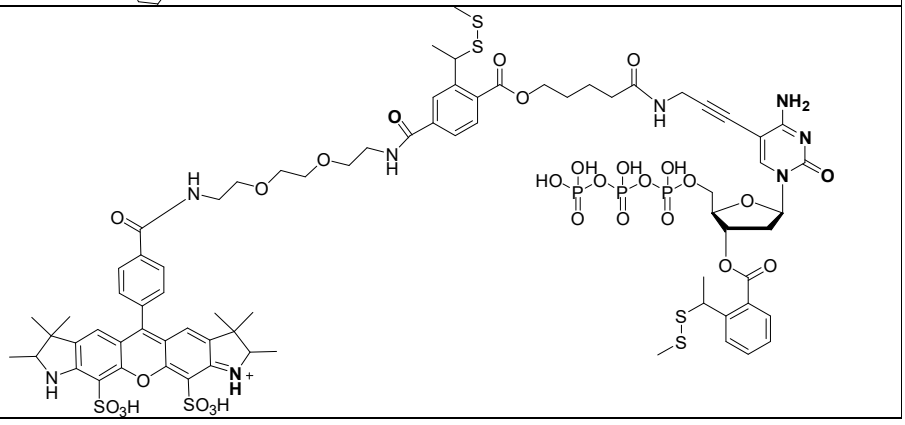
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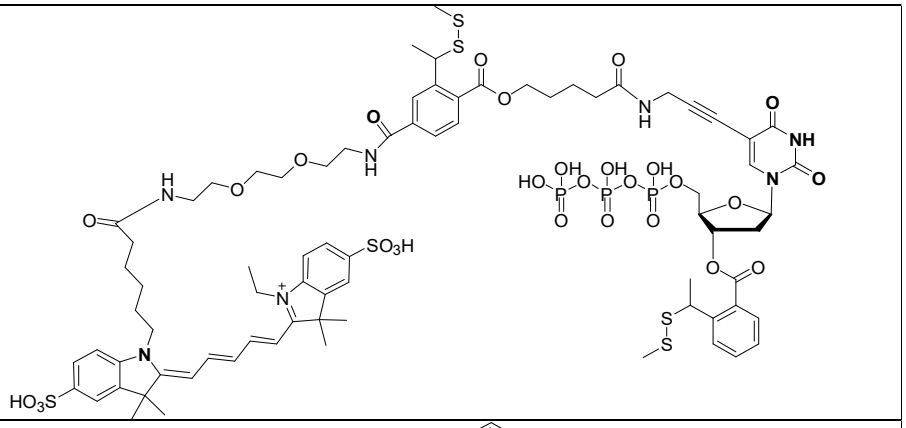
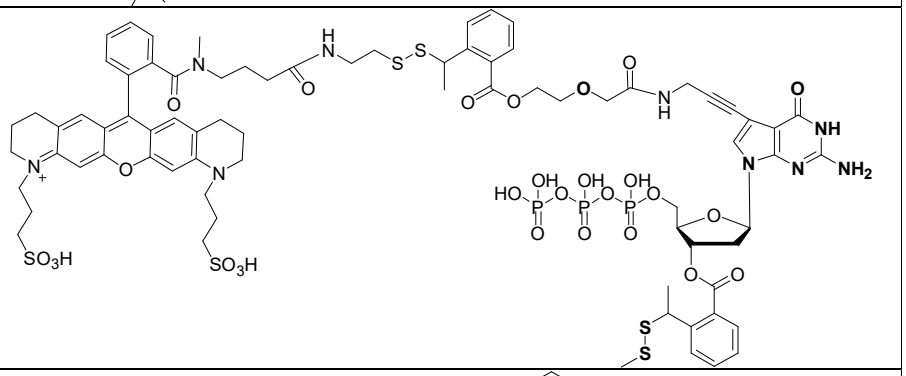
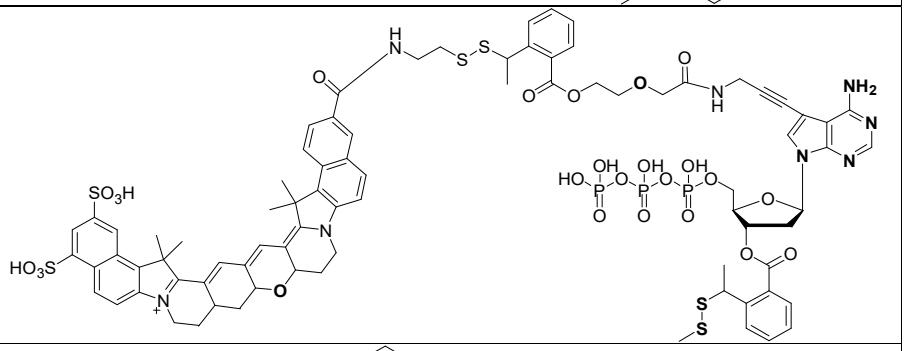
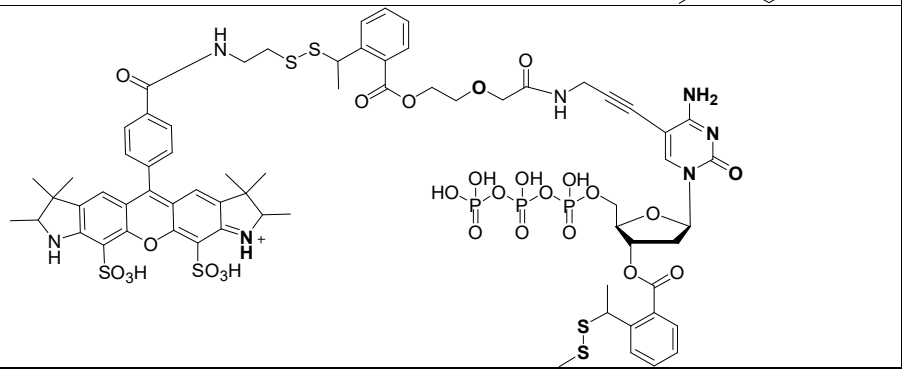
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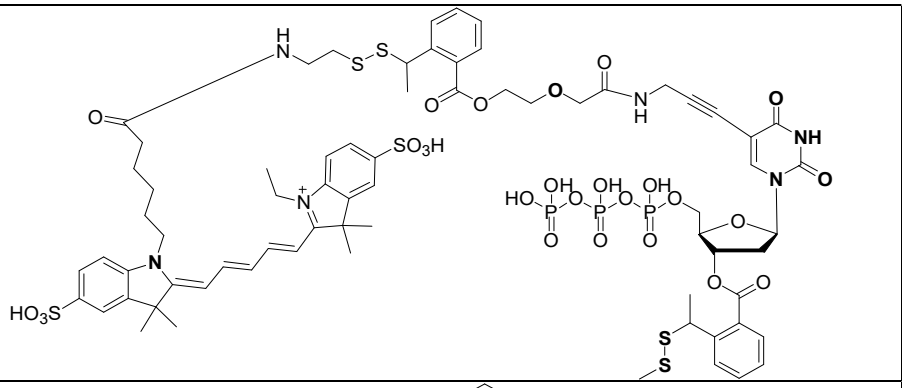
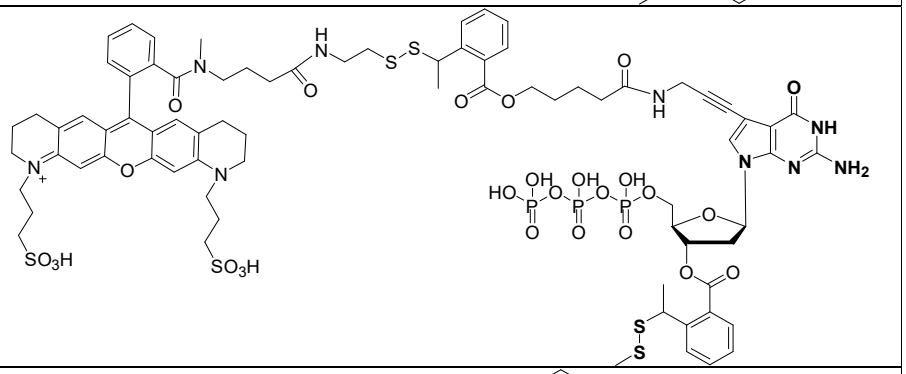
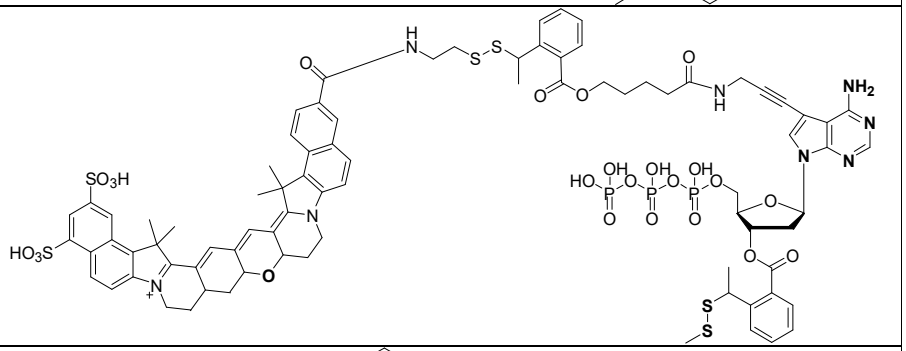
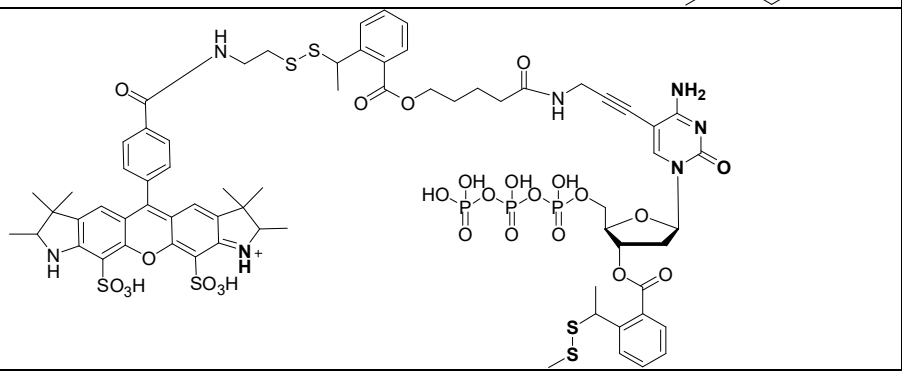
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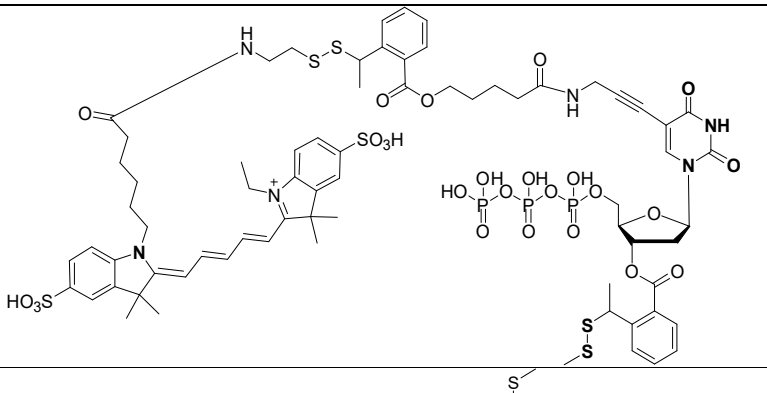
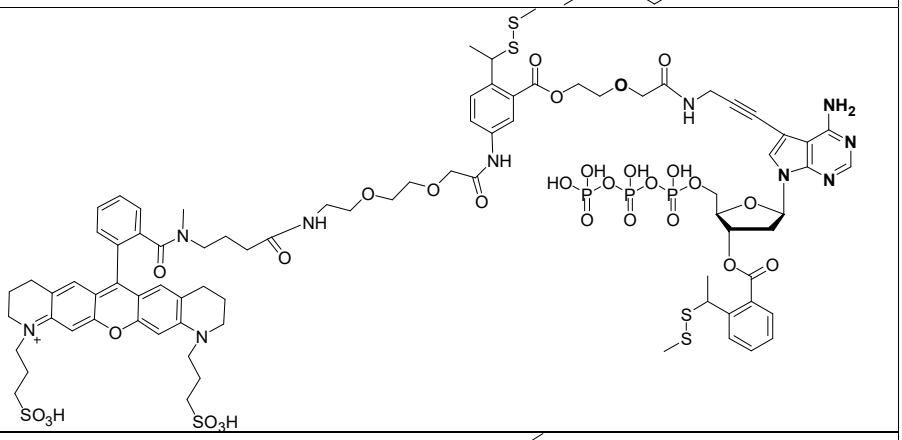
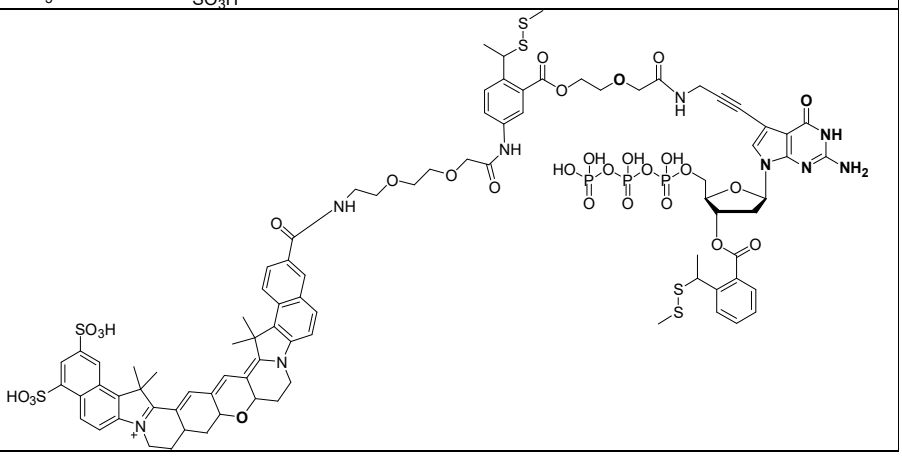
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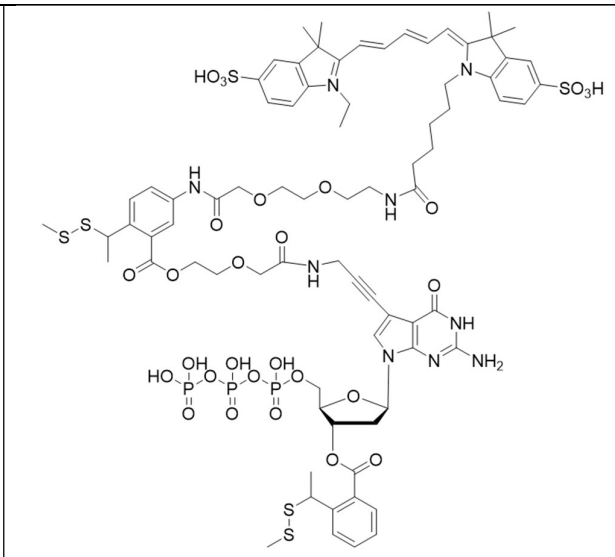
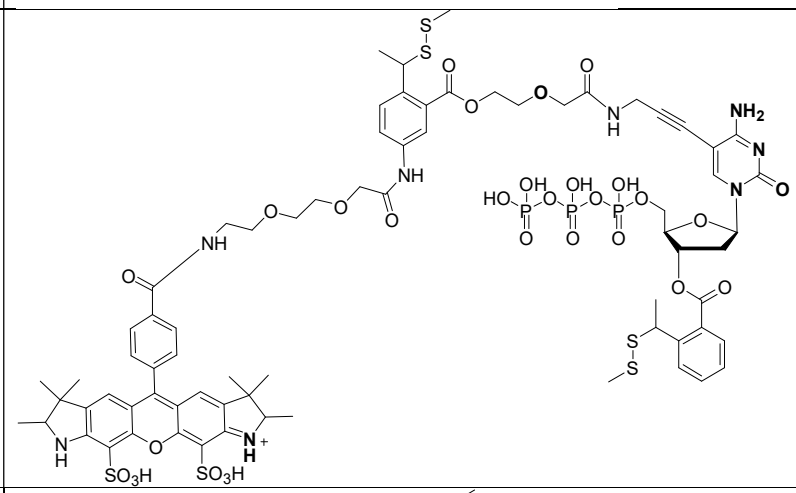
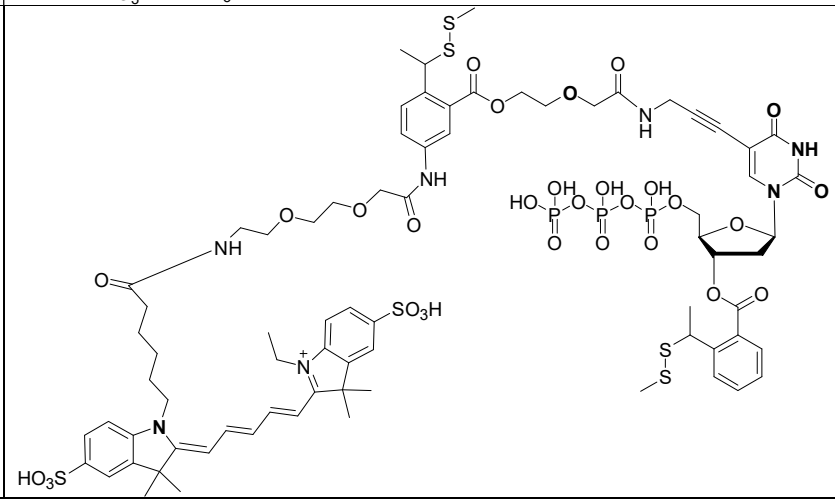
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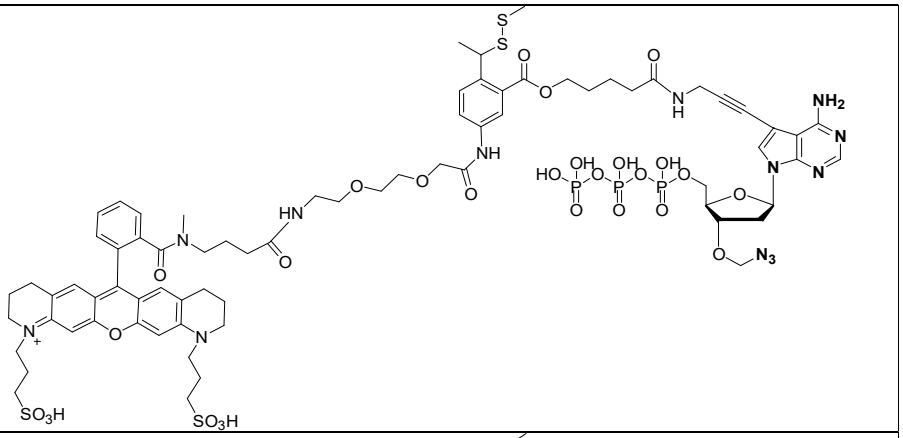
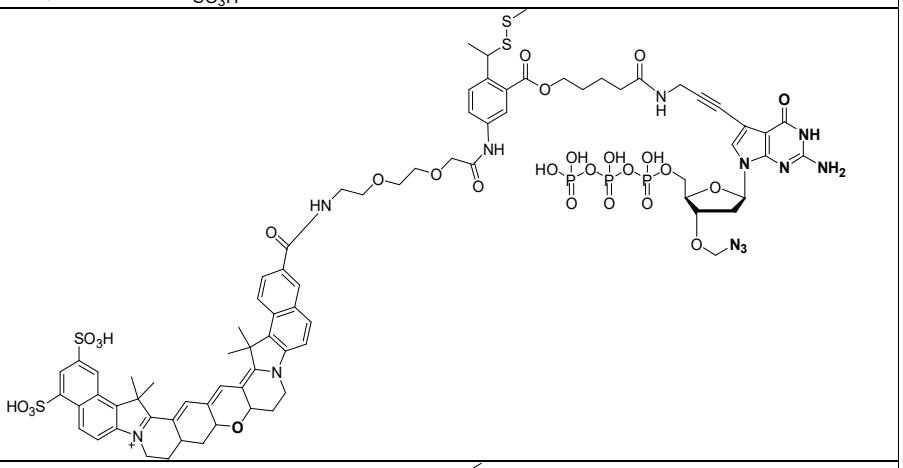
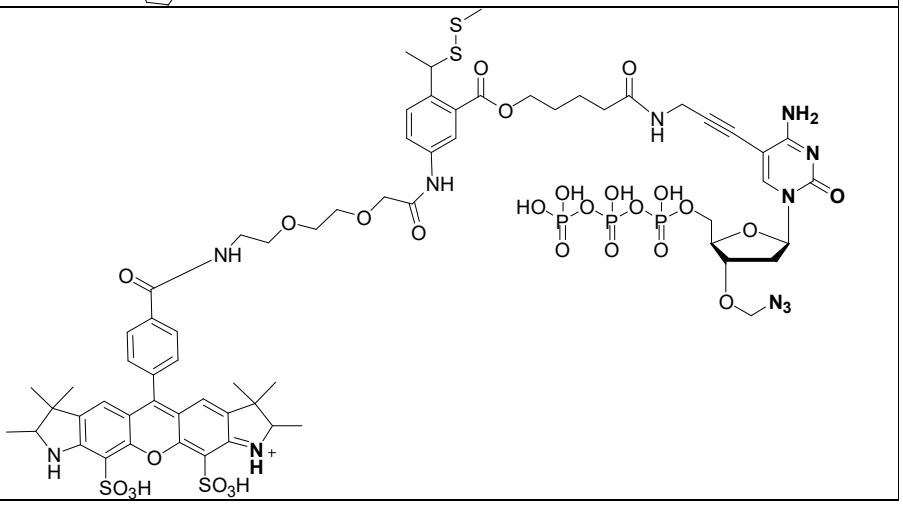
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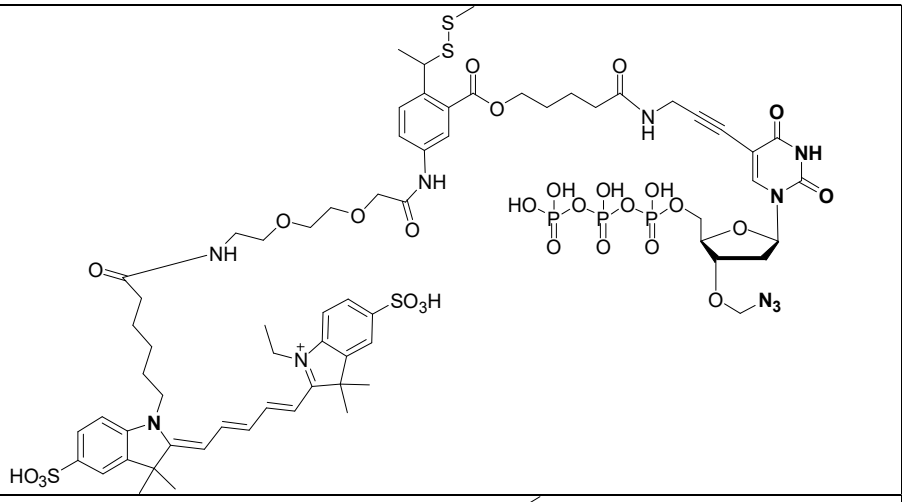
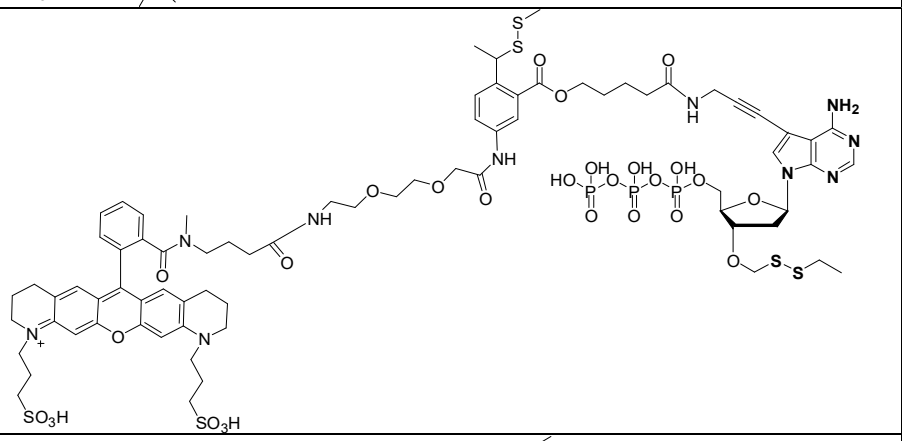
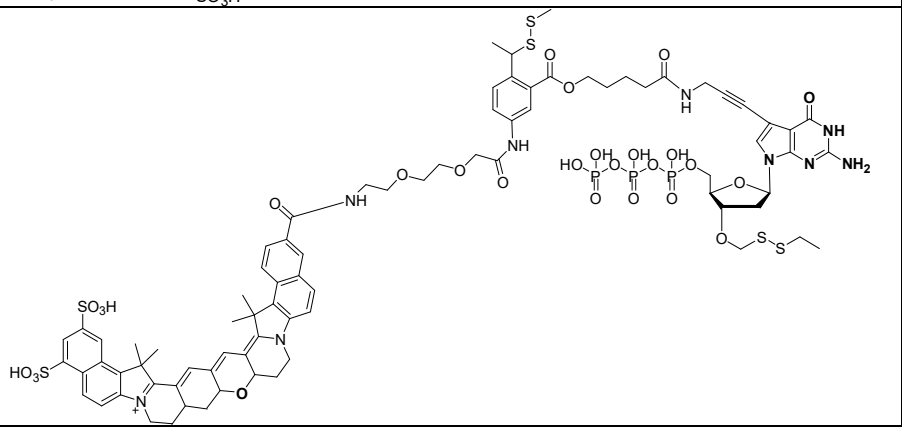
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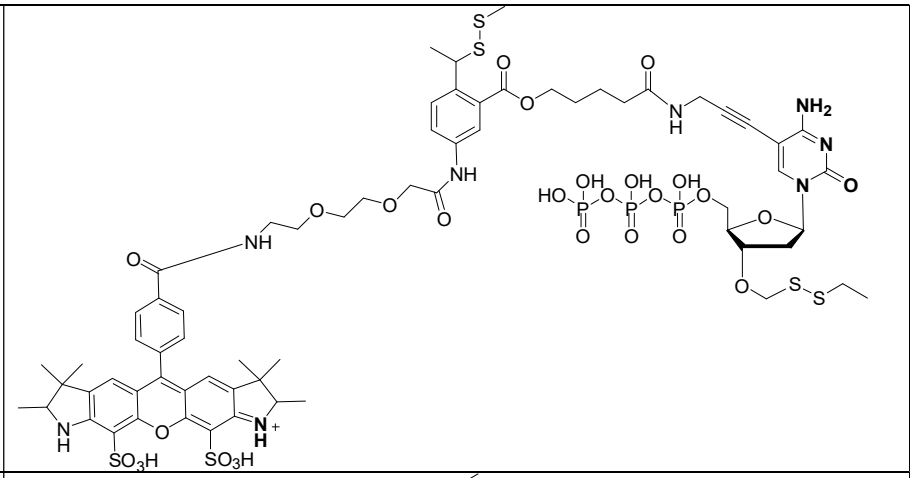
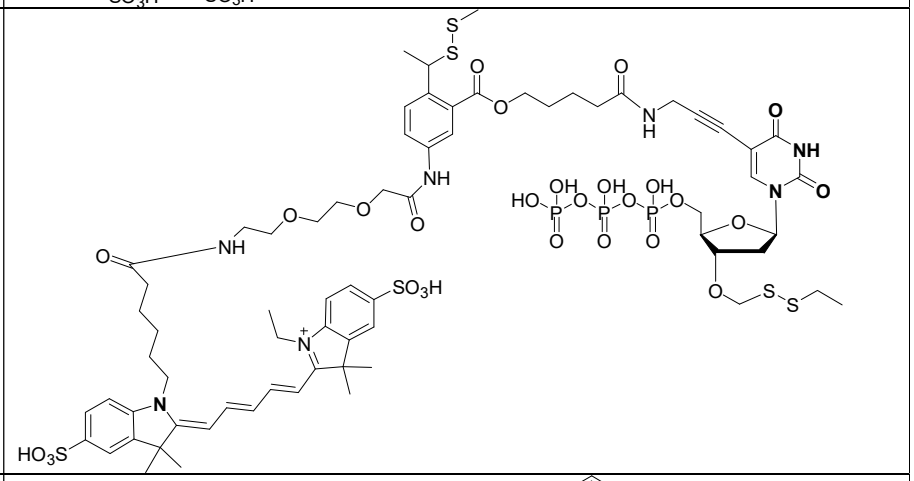
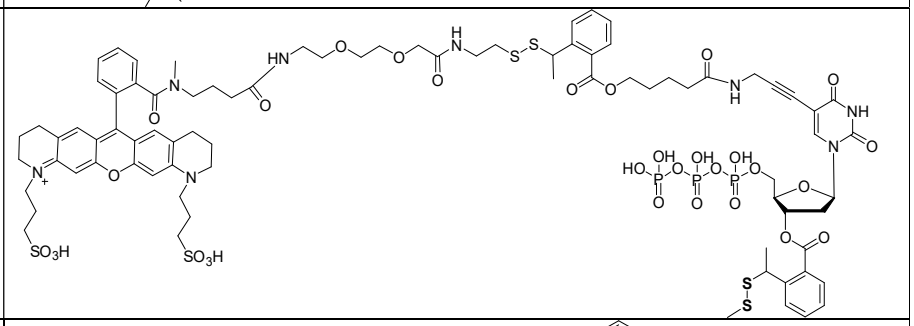
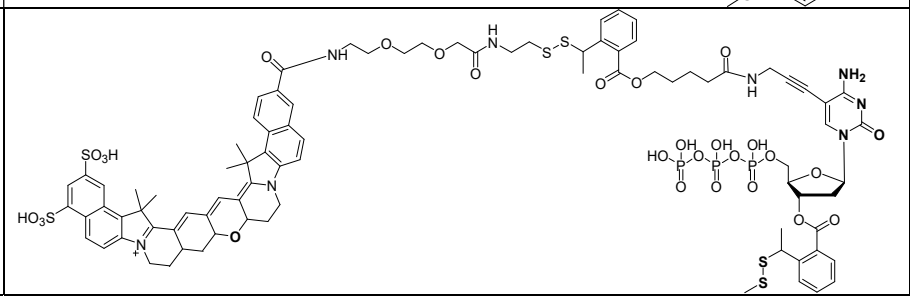
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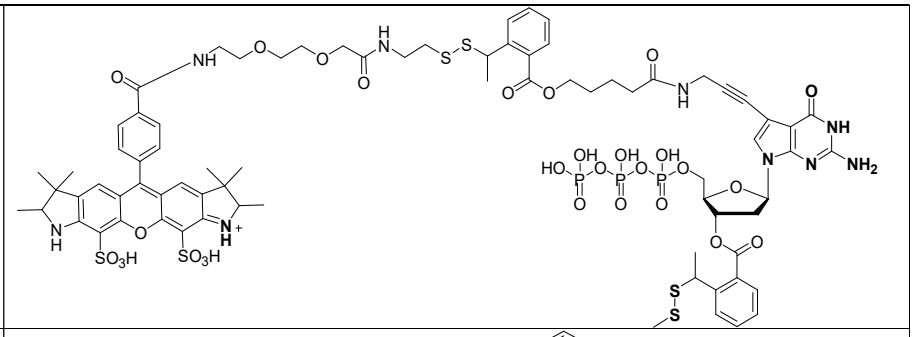
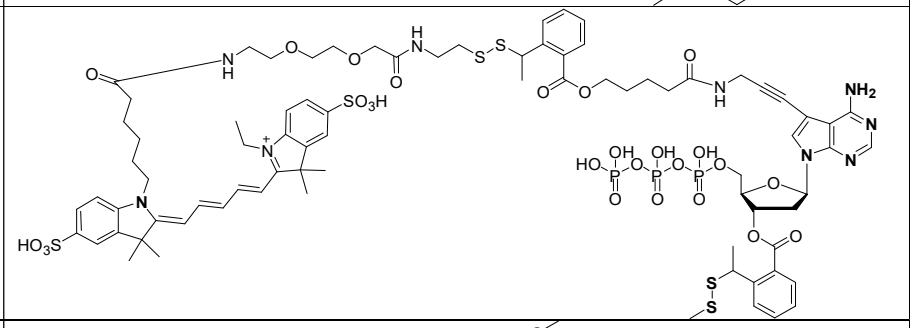
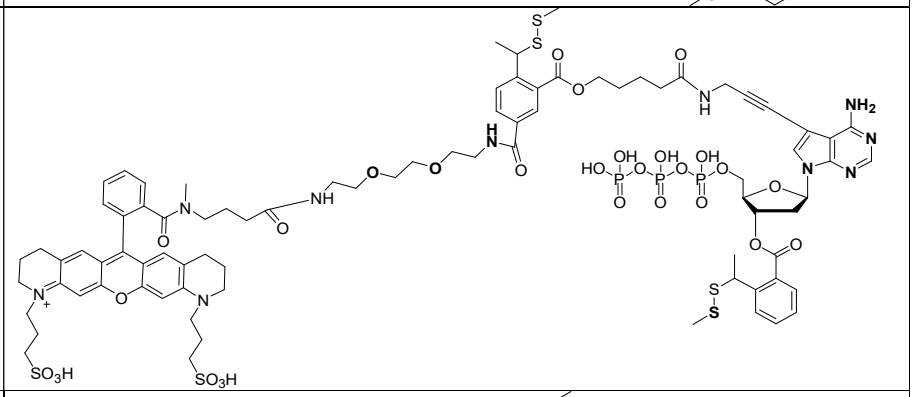
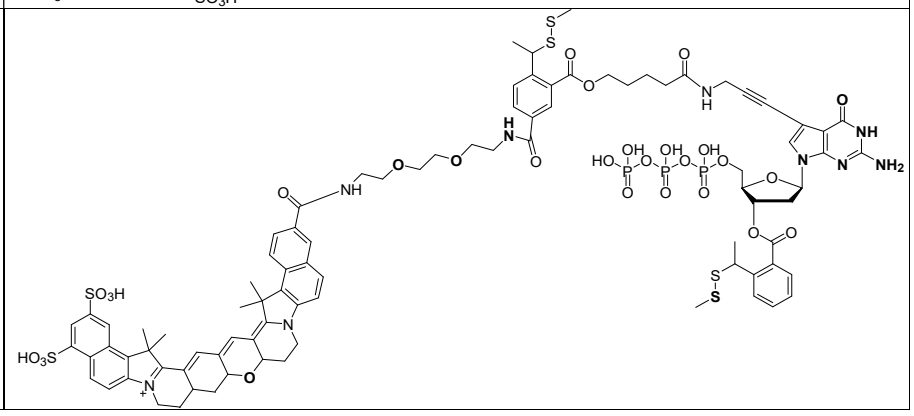
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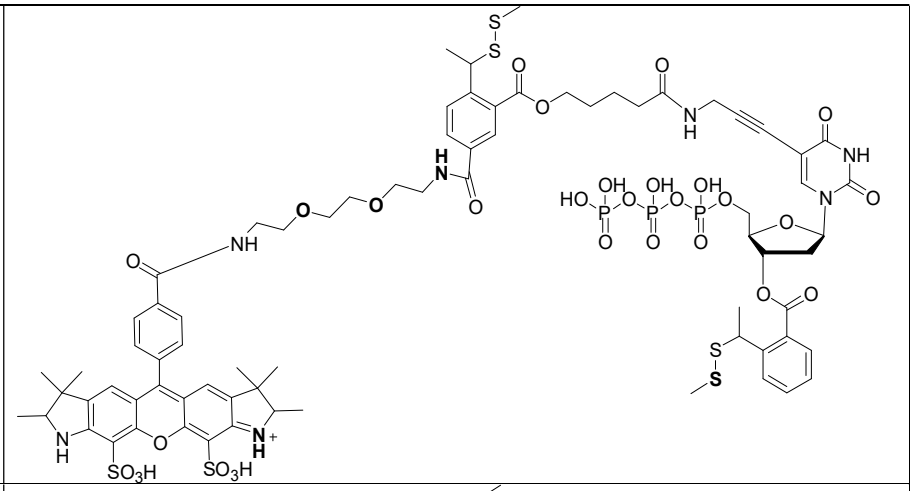
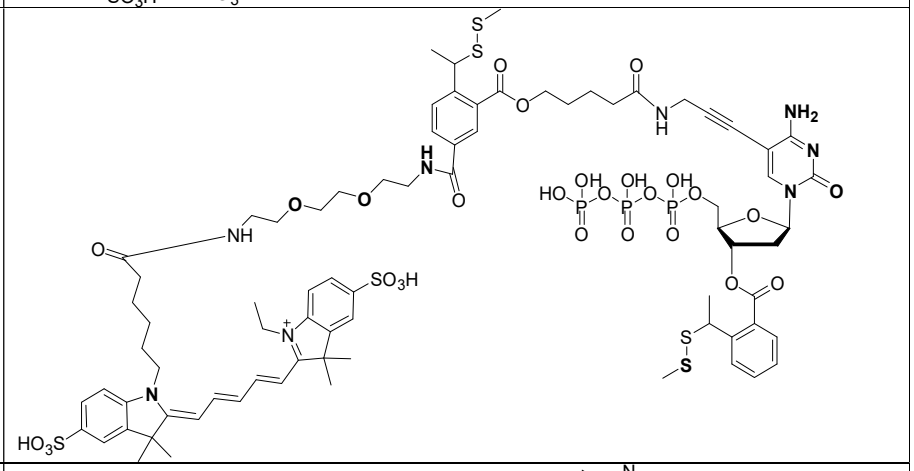
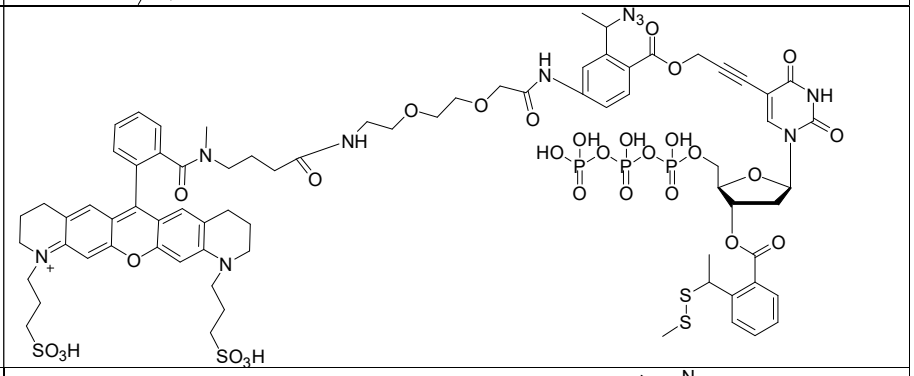
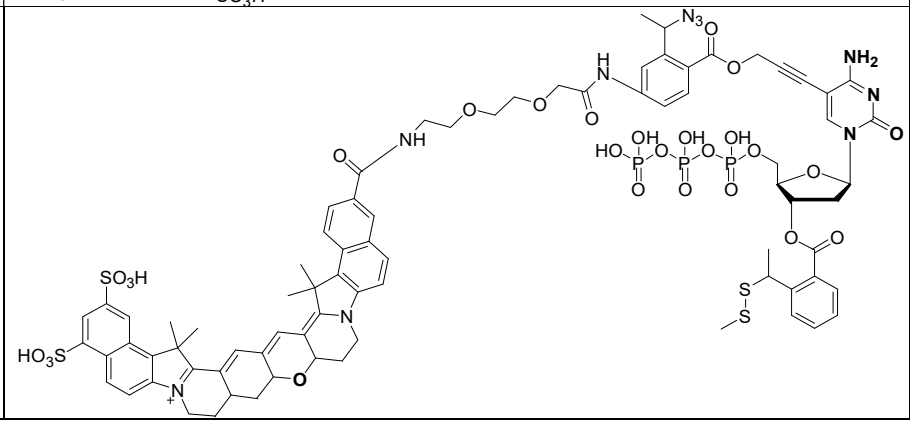
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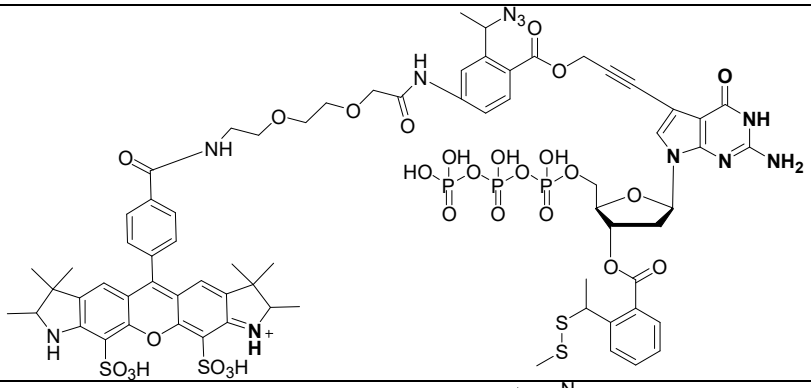
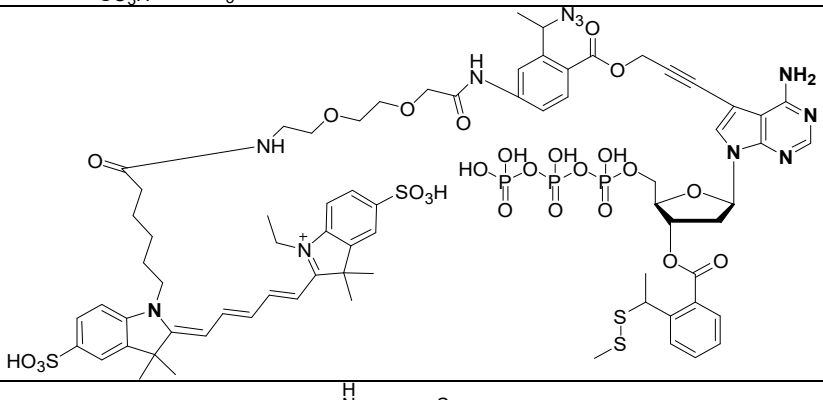
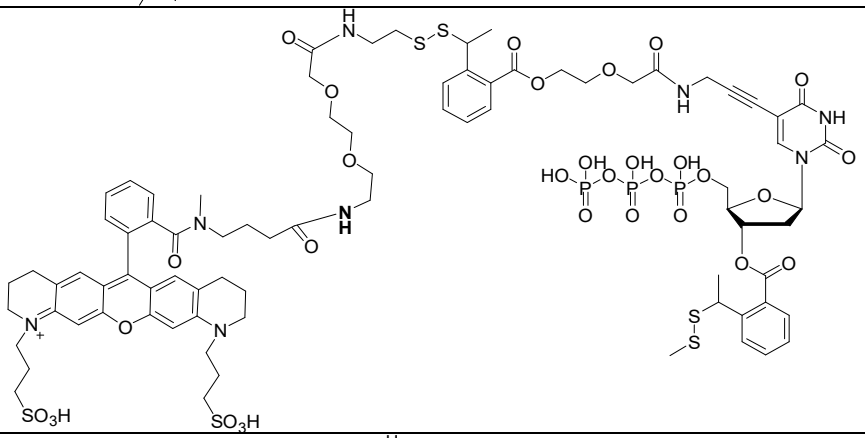
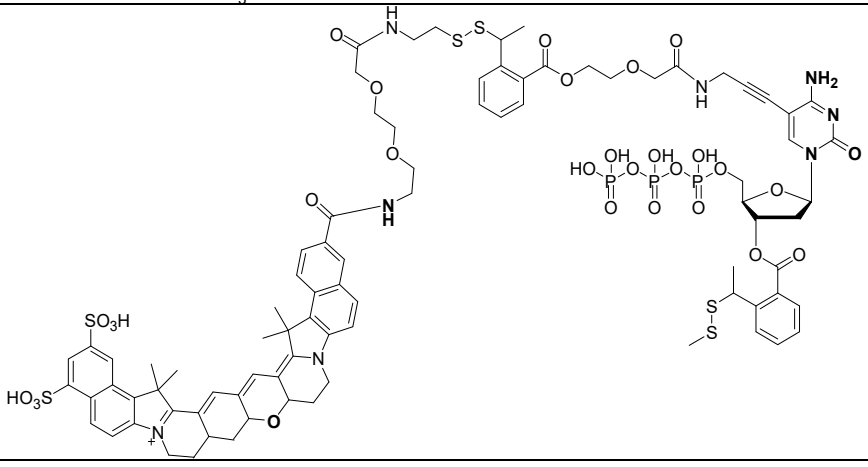
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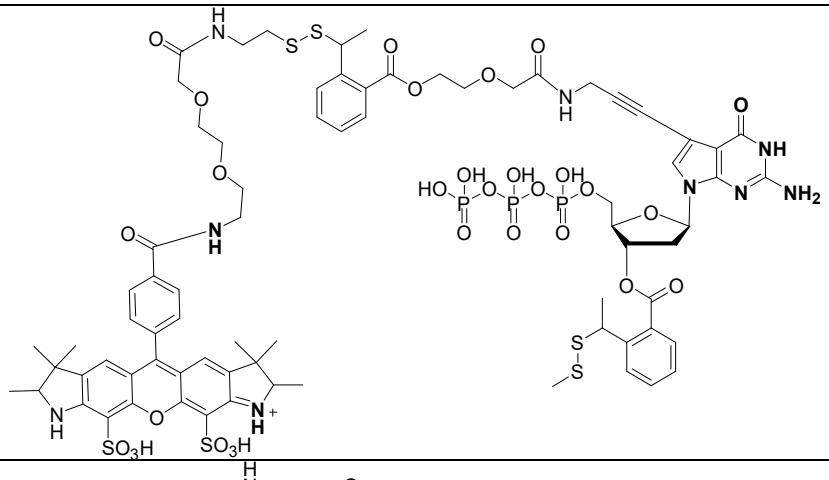
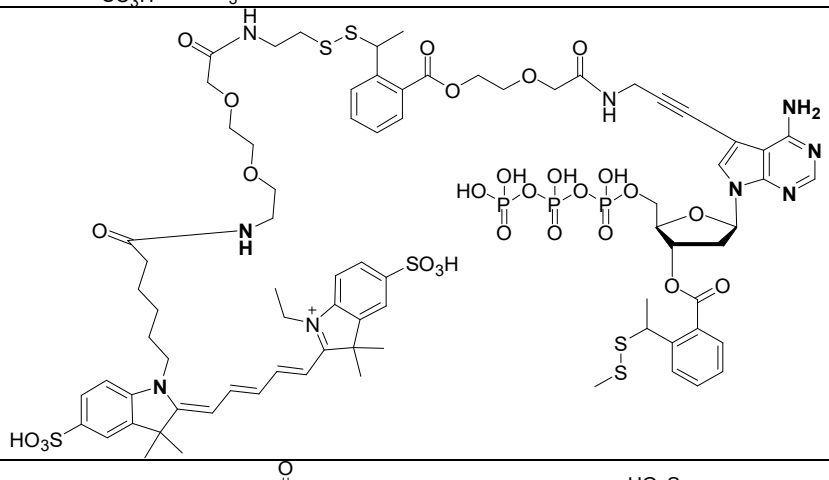
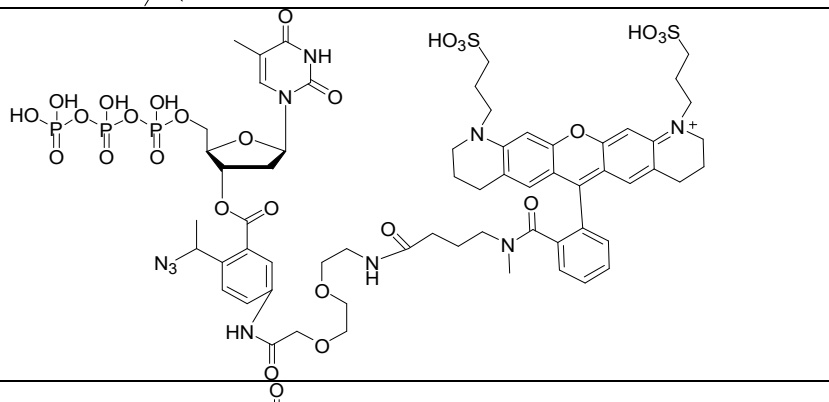
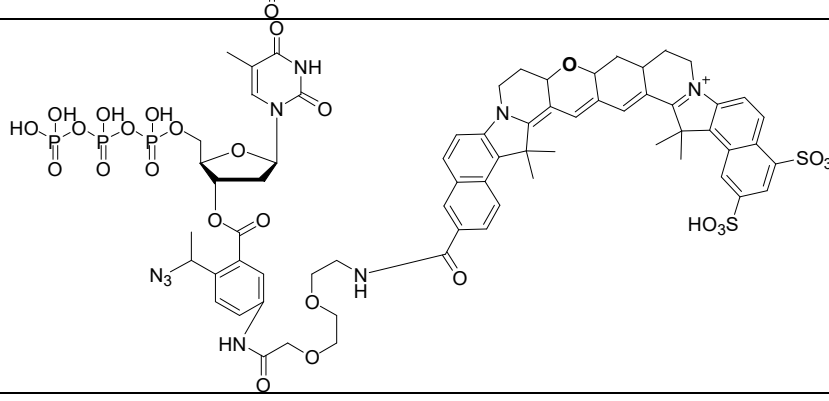
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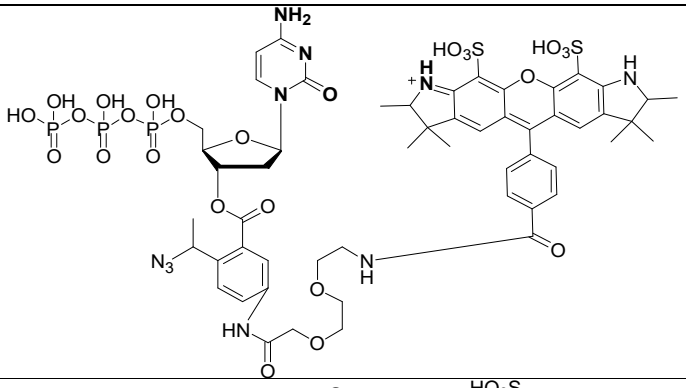
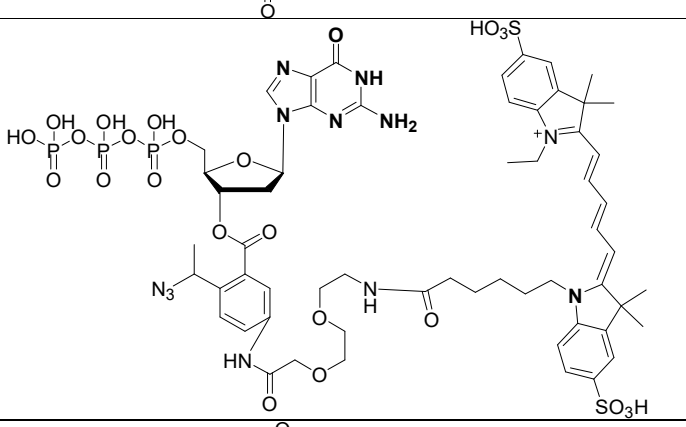
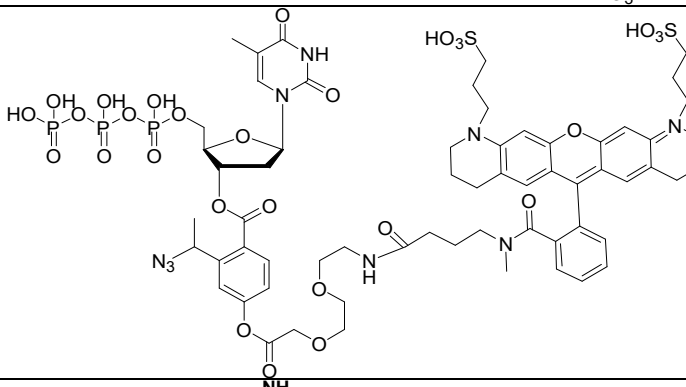
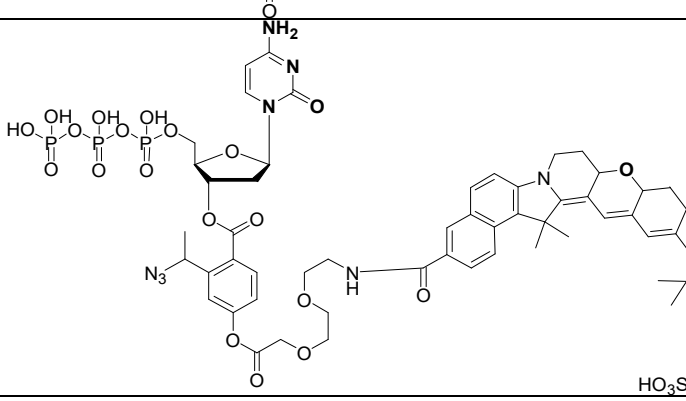
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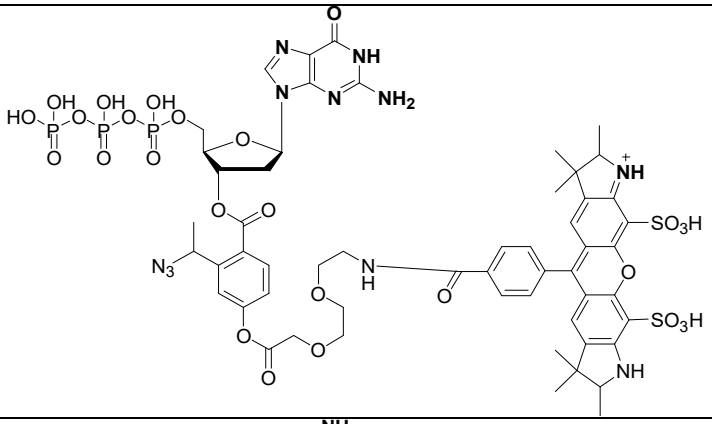
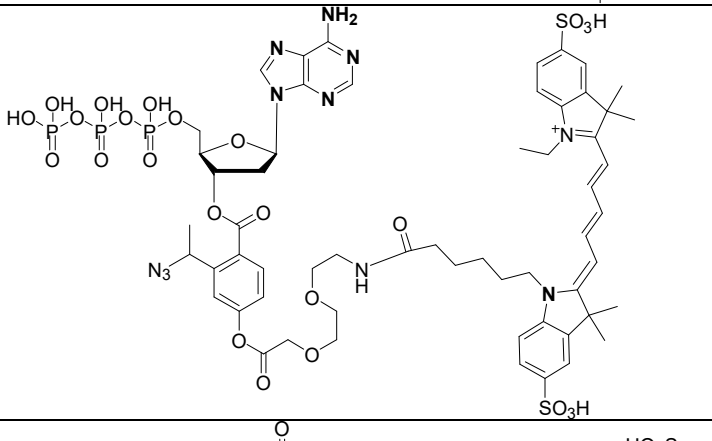
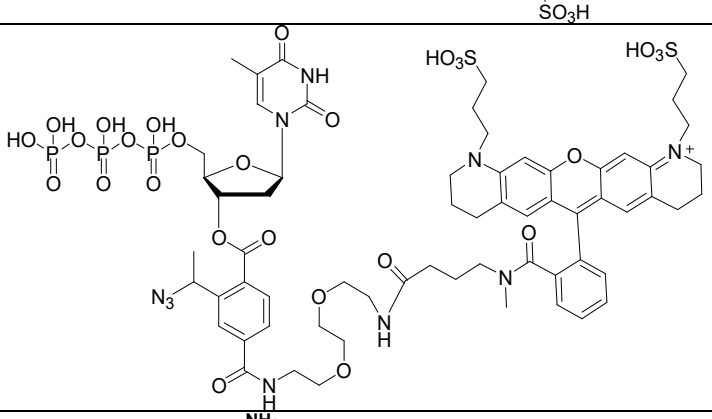
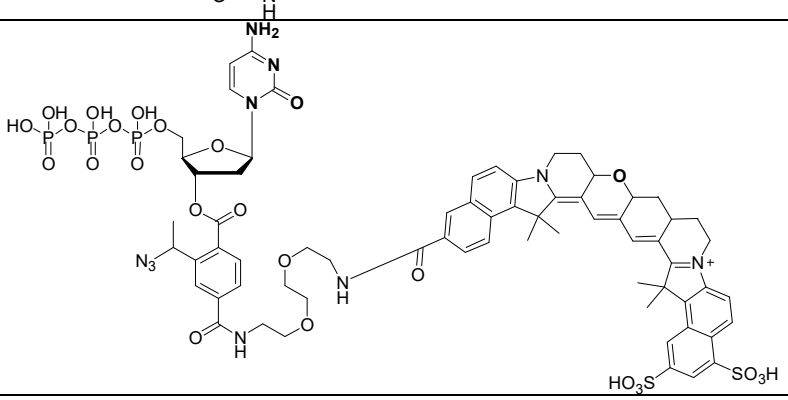
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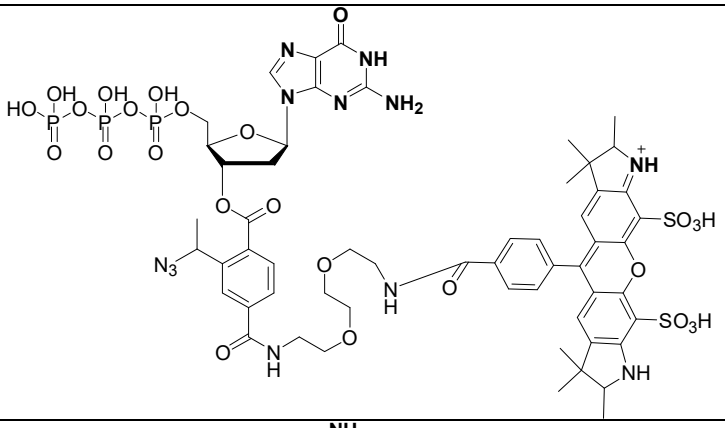
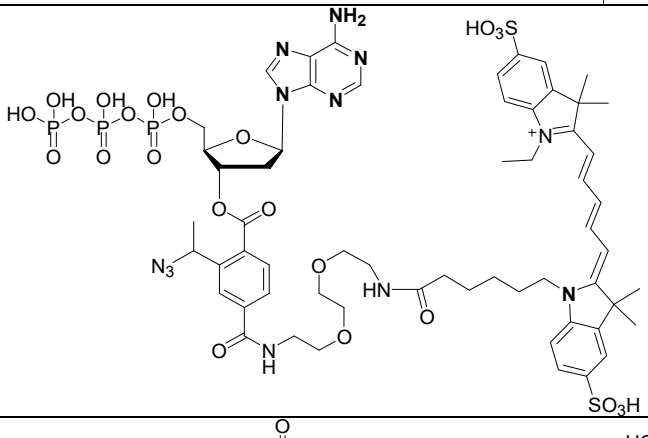
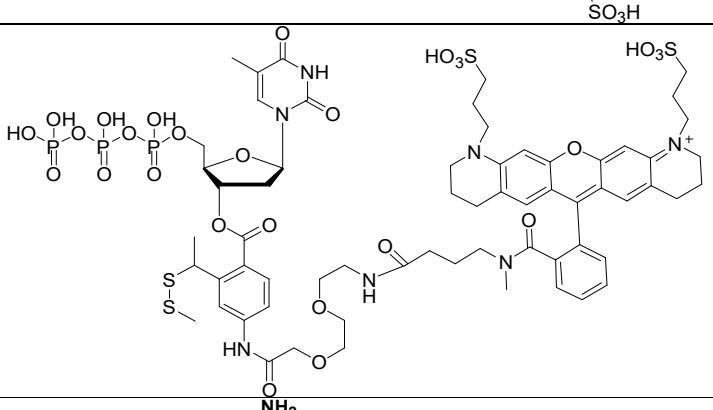
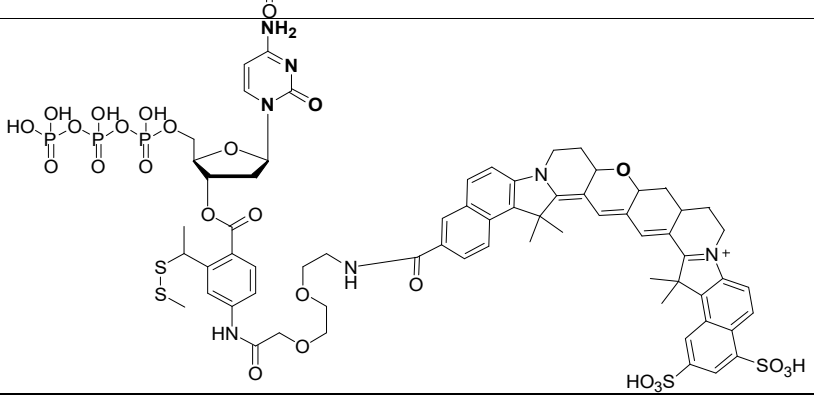
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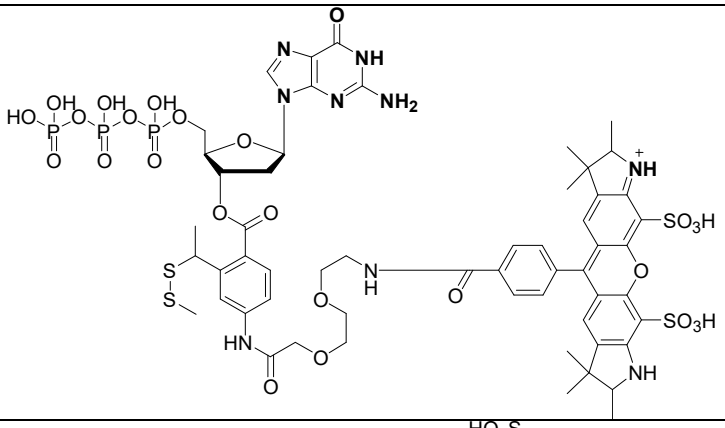
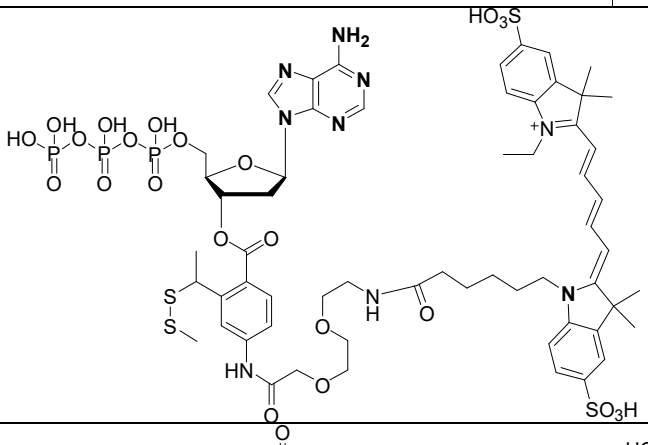
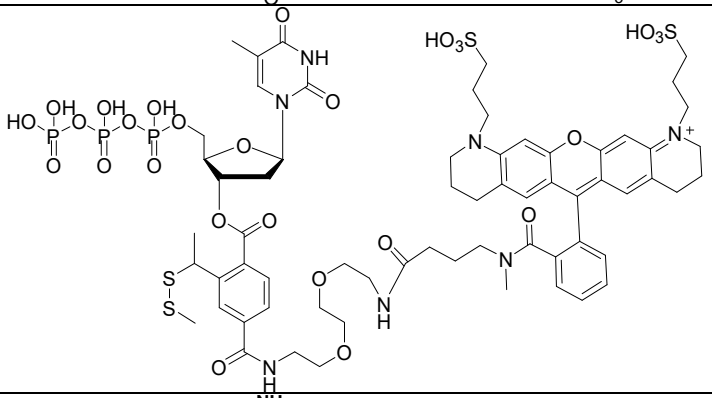
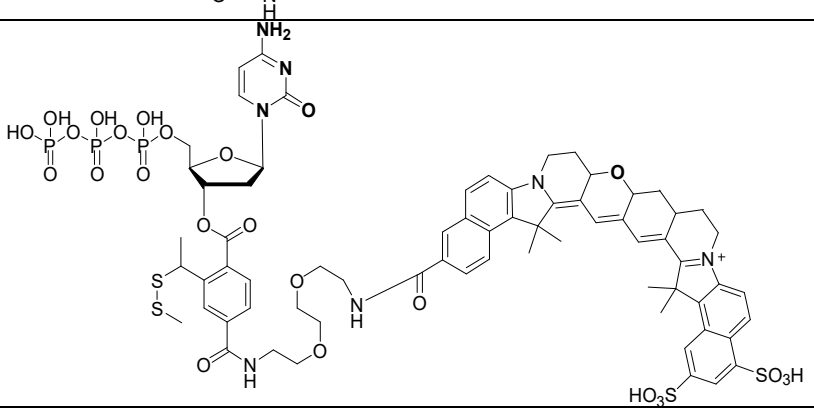
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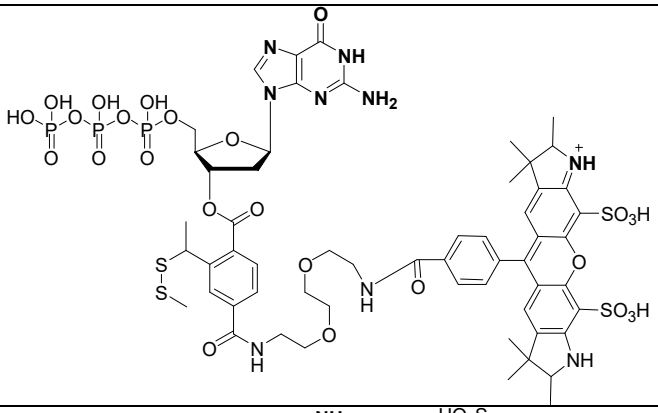
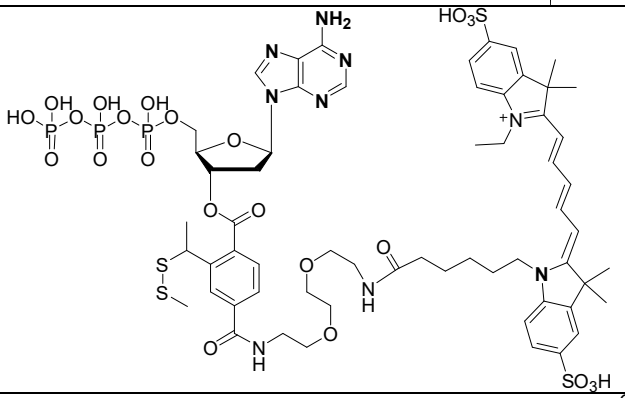
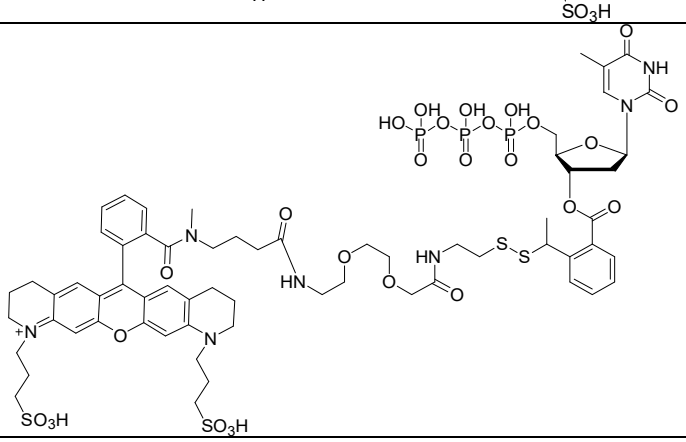
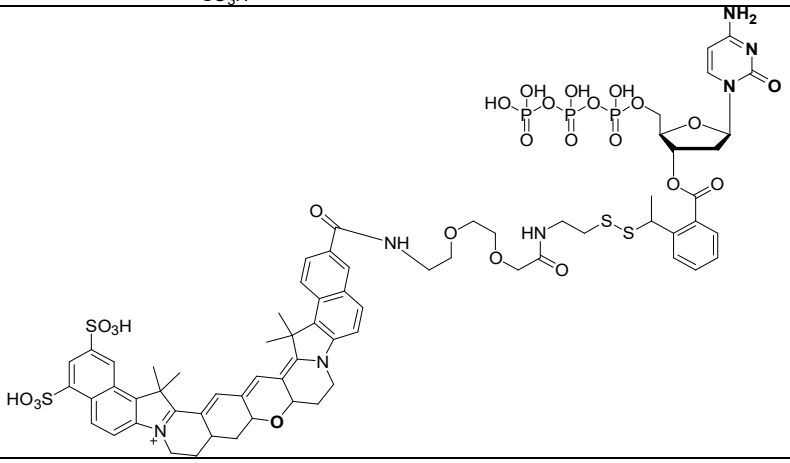
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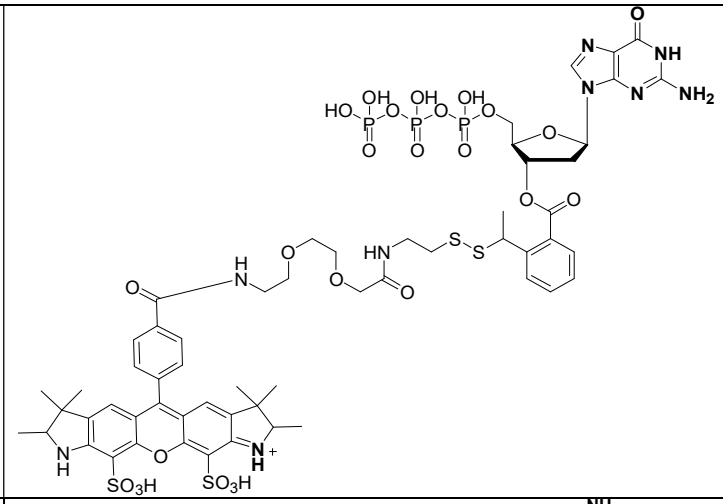
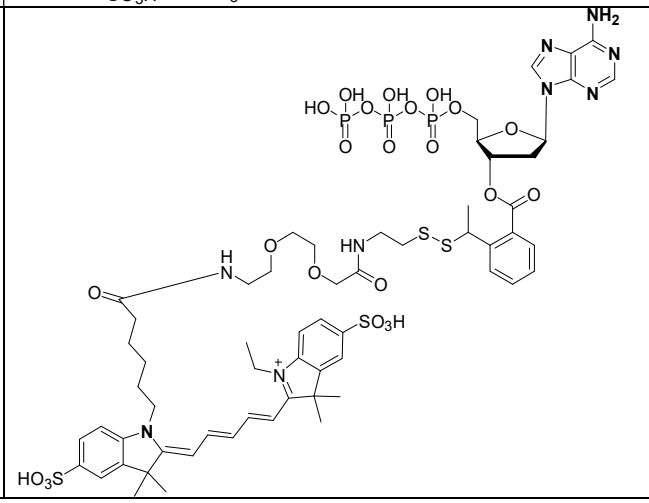
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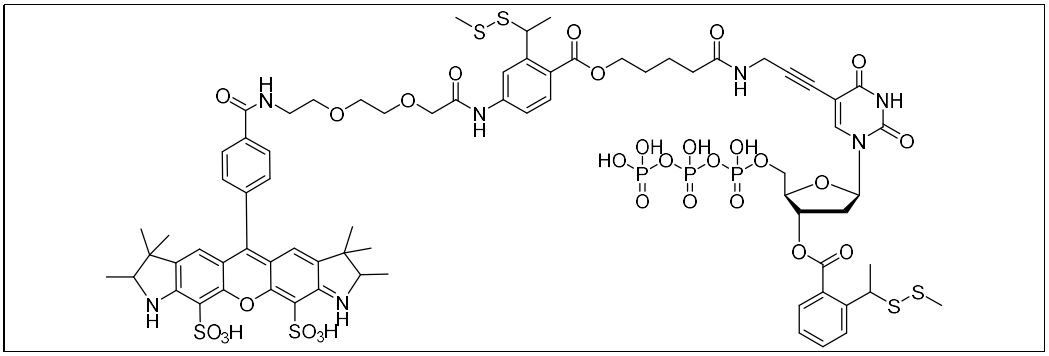
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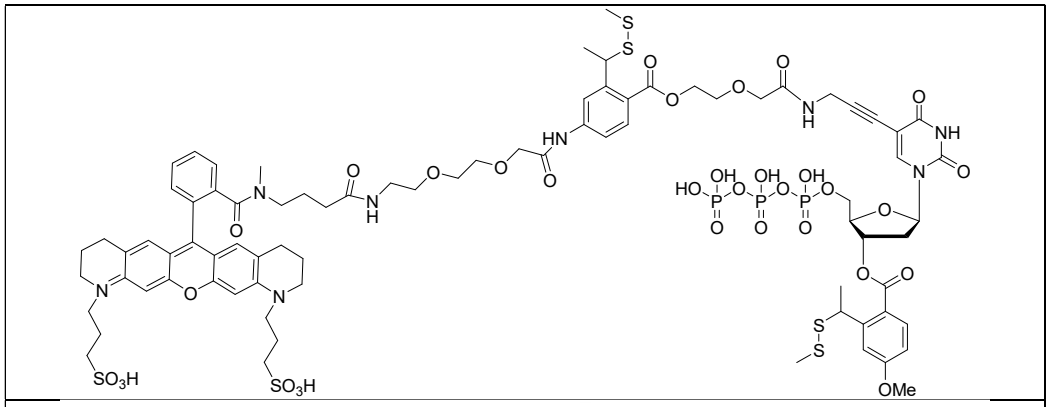
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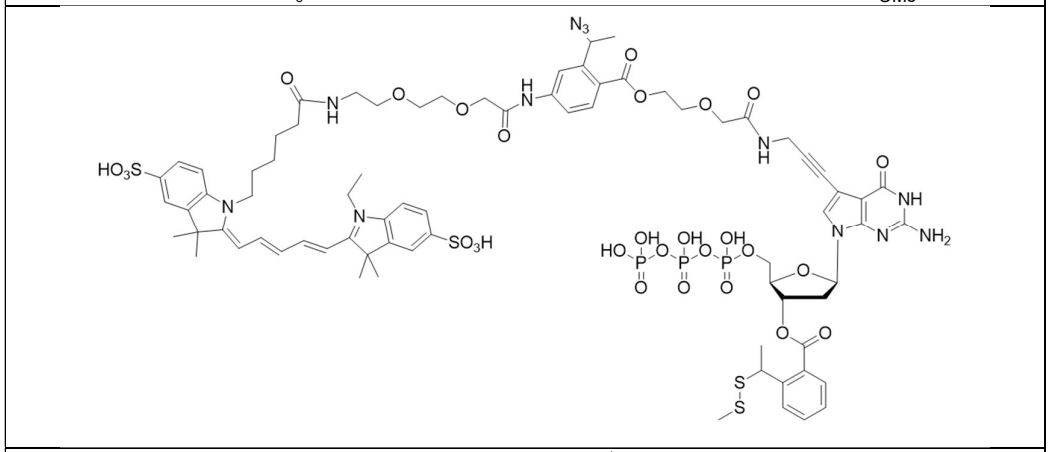
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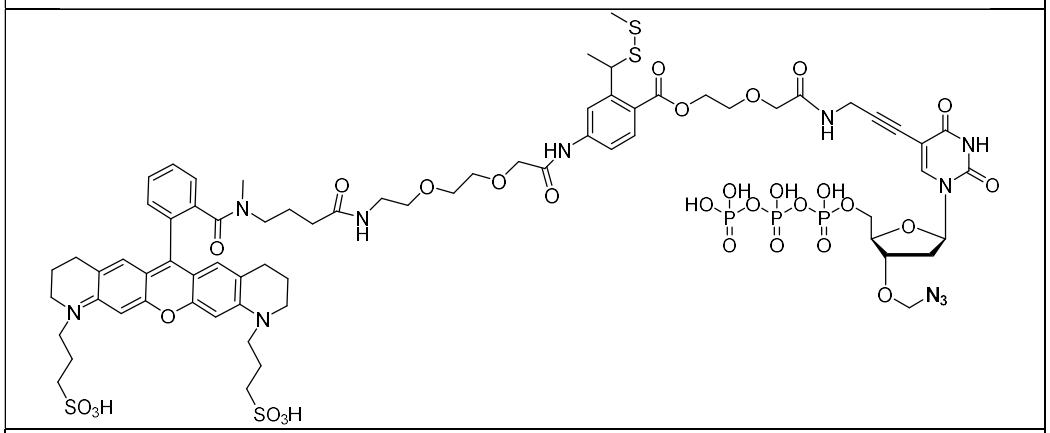
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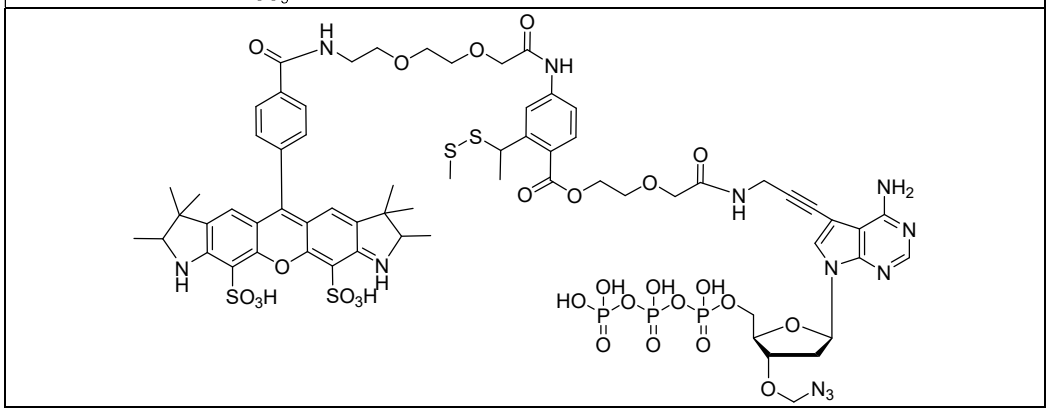
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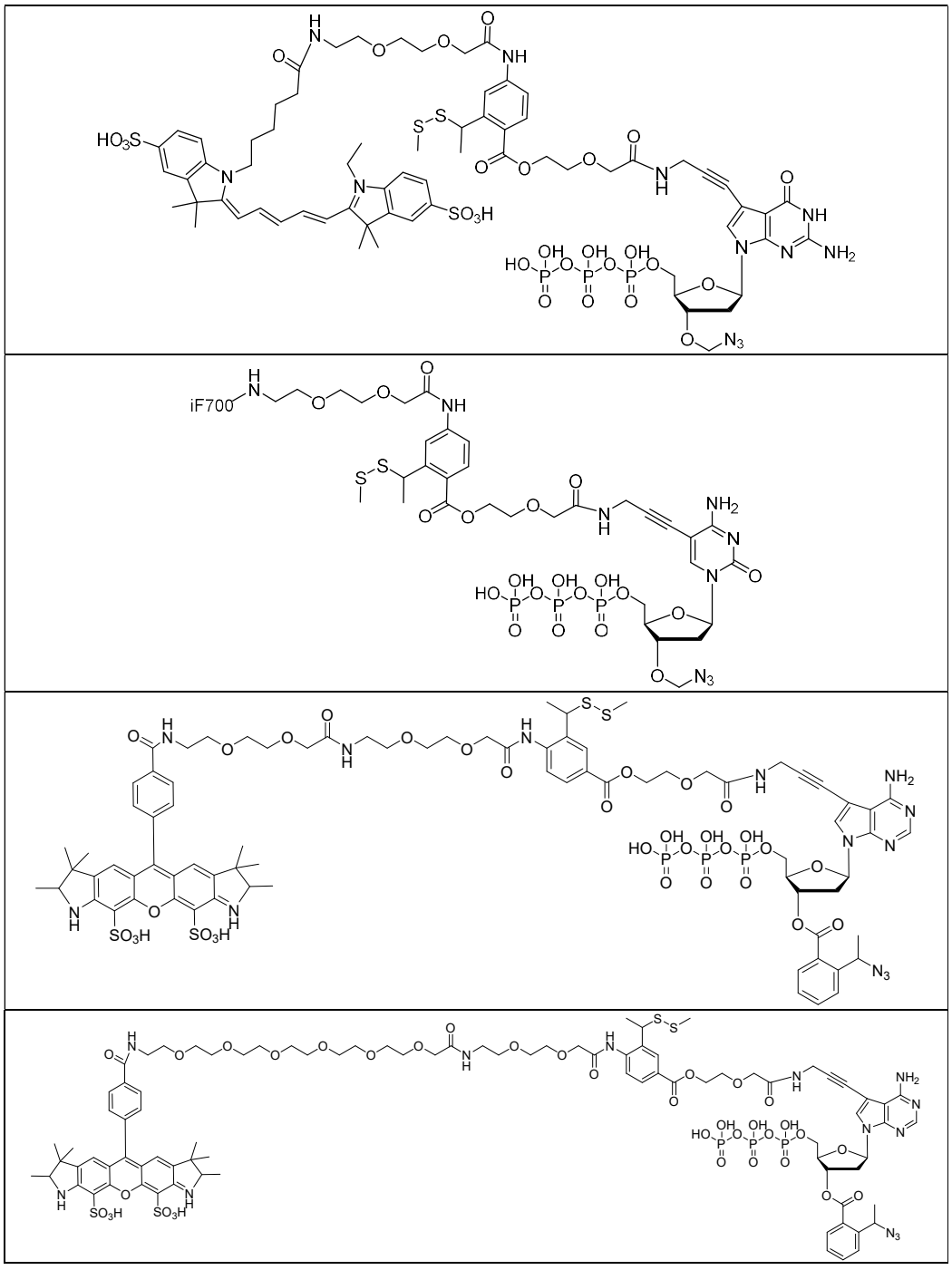


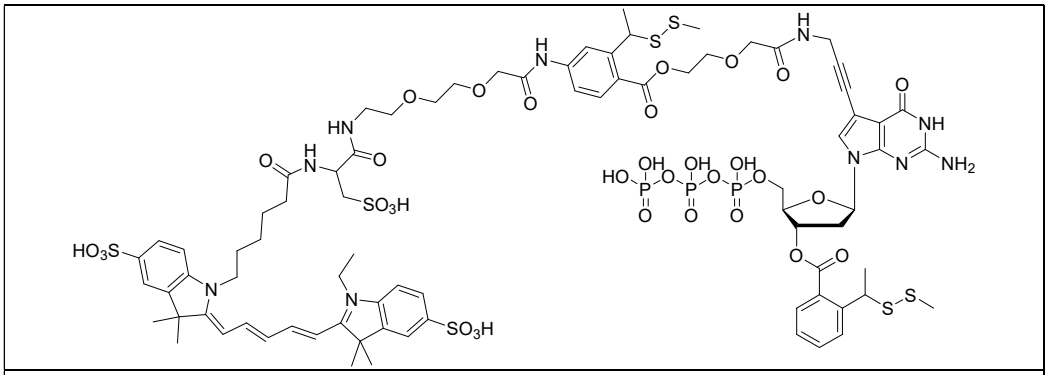


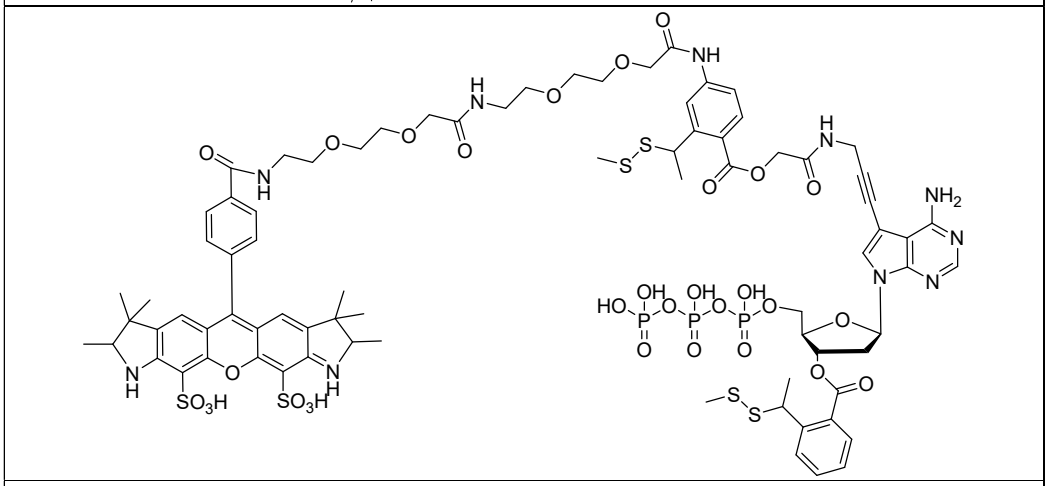


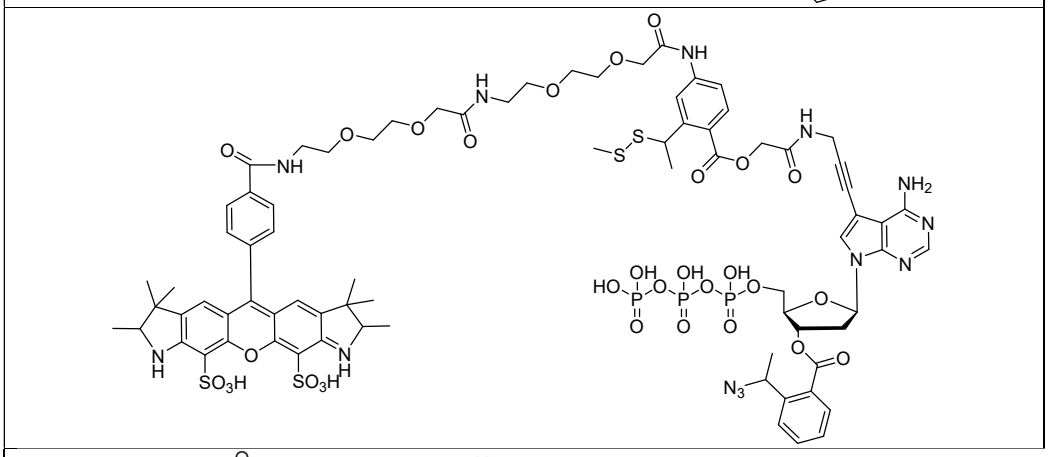


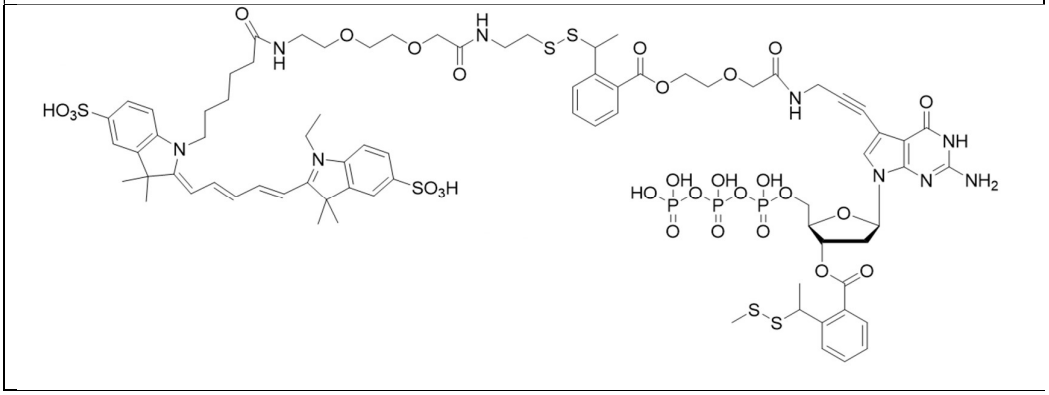


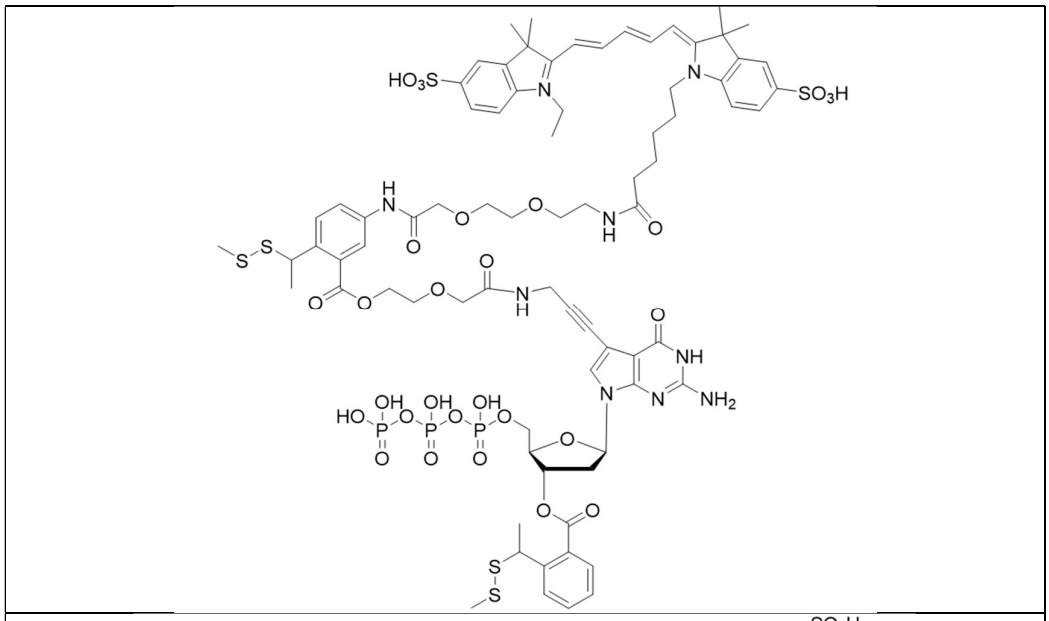


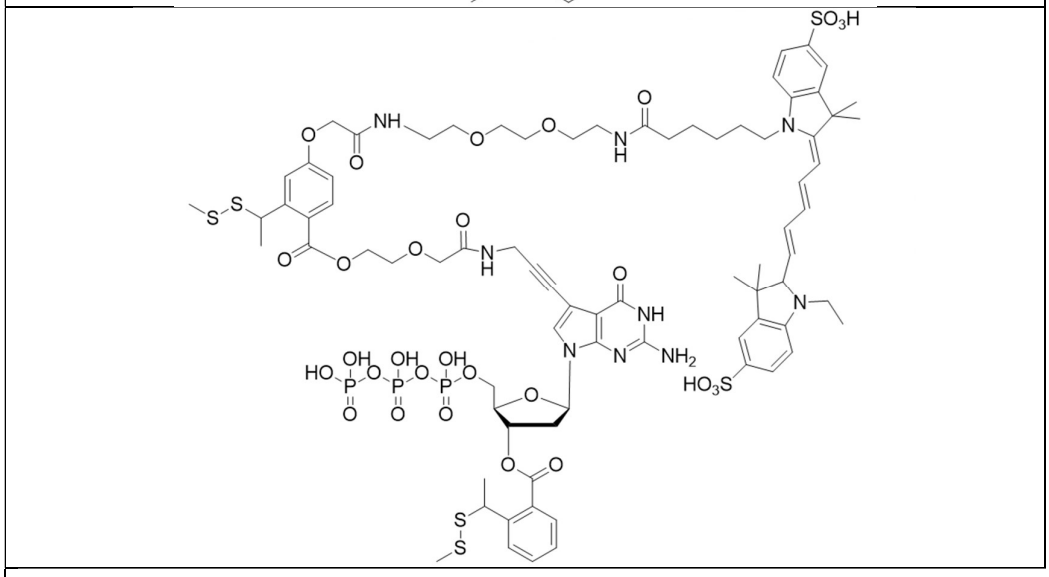


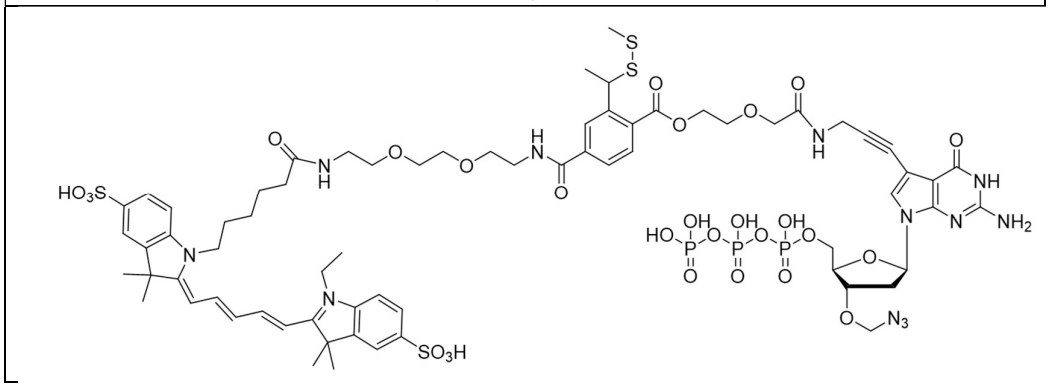












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12. A method for terminating a nucleic acid synthesis, which comprises incorporating the compound or a salt thereof according to any one of claims 1 to 11 into a nucleic acid molecule to be terminated;

preferably, the incorporation of the compound or a salt thereof is achieved by a terminal transferase, a terminal polymerase or a reverse transcriptase;

preferably, the method comprises incorporating the compound or a salt thereof into the nucleic acid molecule to be terminated by using a polymerase;

preferably, the method comprises performing a nucleotide polymerization reaction using a polymerase under conditions where the polymerase is allowed to carry out the nucleotide polymerization reaction, thereby incorporating the compound or a salt thereof into the 3' end of the nucleic acid molecule to be terminated

13. A method for preparing a growing polynucleotide complementary to a target single-stranded polynucleotide in a sequencing reaction, which comprises incorporating the compound or a salt thereof according to any one of claims 1 to 11 into the growing complementary polynucleotide, wherein the incorporation of the compound or a salt thereof prevents any subsequent nucleotides from being introduced into the growing complementary polynucleotide;

preferably, the incorporation of the compound or a salt thereof is achieved by a terminal transferase, a terminal polymerase or a reverse transcriptase;

preferably, the method comprises incorporating the compound or a salt thereof into the growing complementary polynucleotide by using a polymerase;

preferably, the method comprises performing a nucleotide polymerization reaction using a polymerase under conditions where the polymerase is allowed to carry out the nucleotide polymerization reaction, thereby incorporating the compound or a salt thereof into the 3' end of the growing complementary polynucleotide.

14. A nucleic acid intermediate, which is formed in determining the sequence of a target single-stranded polynucleotide, wherein,

the nucleic acid intermediate is formed according to the step:

incorporating a nucleotide complementary to the target single-stranded polynucleotide into a growing nucleic acid strand, to form the nucleic acid intermediate, wherein the incorporated complementary nucleotide is the compound or a salt thereof according to any one of claims 1 to 11;

or, the nucleic acid intermediate is formed according to the step:

incorporating a nucleotide complementary to the target single-stranded polynucleotide into a growing nucleic acid strand, to form the nucleic acid intermediate, wherein the incorporated complementary nucleotide is the compound or a salt thereof according to any one of claims 1 to 11, and the growing nucleic acid strand is pre-incorporated with at least one nucleotide complementary to the target single-stranded polynucleotide, the at least one pre-incorporated nucleotide complementary to the target single-stranded polynucleotide being the compound or a salt thereof according to any one of claims 1 to 11 in which the reversible blocking group and optional detectable label have been removed.

15. A method for determining the sequence of a target single-stranded

polynucleotide, which comprises:

1) monitoring the incorporation of nucleotides complementary to the target single-stranded polynucleotide in a growing nucleic acid strand, wherein at least one complementary nucleotide incorporated is the compound or a salt thereof according to any one of claims 1 to 11, and,

2) determining the types of the incorporated nucleotides;

preferably, the reversible blocking group and optional detectable label are removed before a next complementary nucleotide is introduced;

preferably, the reversible blocking group and the detectable label are removed simultaneously;

preferably, the reversible blocking group and the detectable label are removed sequentially; for example, after the detectable label is removed, the reversible blocking group is removed, or, after the reversible blocking group is removed, the detectable label is removed.

16. The method according to claim 15, which comprises the following steps of:

(a) providing a plurality of different nucleotides, wherein at least one nucleotide is the compound or a salt thereof according to any one of claims 10 to 11, optionally, the rest of nucleotides are the compound or a salt thereof according to any one of claims 1 to 11;

(b) incorporating the plurality of different nucleotides into a sequence complementary to a target single-stranded polynucleotide, wherein the plurality of different nucleotides can be distinguished from each other during the detection;

(c) detecting the nucleotides in step (b) to determine the types of nucleotides incorporated;

(d) removing the reversible blocking groups and optional detectable labels carried by the nucleotides in step (b); and

(e) optionally repeating steps (a)-(d) one or more times;

whereby the sequence of the target single-stranded polynucleotide is determined.

17. The method according to claim 15, which comprises the following steps of:

(1) providing a first nucleotide, a second nucleotide, a third nucleotide and a fourth nucleotide, wherein at least one of the four nucleotides is the compound or a salt thereof according to any one of claims 10 to 11, optionally, the rest of nucleotides are the compound or a salt thereof according to any one of claims 1 to 11;

(2) contacting the four nucleotides with a target single-stranded polynucleotide; removing the nucleotides not incorporated into the growing nucleic acid strand; detecting the nucleotides incorporated into the growing nucleic acid strand; removing the reversible blocking groups and optional detectable labels carried in the nucleotides that are incorporated into the growing nucleic acid strand;

optionally, it also includes (3): repeating the steps (1)-(2) one or more times.

18. The method according to claim 15, which comprises the following

steps of:

(a) providing a mixture comprising a duplex, nucleotides comprising at least one compound or a salt thereof according to any one of claims 10 to 11, a polymerase, and an excision reagent; wherein the duplex comprises a growing nucleic acid strand and a nucleic acid strand to be sequenced;

(b) carrying out a reaction comprising the following steps (i), (ii) and (iii), optionally, repeating the steps for one or more times:

step (i): incorporating the compound or a salt thereof into the growing nucleic acid strand by using a polymerase, to form a nucleic acid intermediate containing the reversible blocking group and optional detectable label;

step (ii): detecting the nucleic acid intermediate;

step (iii): removing the reversible blocking group and optional detectable label contained in the nucleic acid intermediate by using the excision reagent;

preferably, removal of the reversible blocking group and removal of the detectable label are performed simultaneously, or, removal of the reversible blocking group and removal of the detectable label are performed sequentially (for example, the reversible blocking group is removed first, or the detectable label is removed first);

preferably, the excision reagent used for removal of the reversible blocking group is the same as that used for removal of the detectable label;

preferably, the excision reagent used for removal of the reversible blocking group is different from that used for removal of the detectable label.

19. The method according to claim 18, wherein the duplex is linked to a support;

preferably, the growing nucleic acid strand is a primer;

preferably, the primer is annealed to the nucleic acid strand to be sequenced to form the duplex;

preferably, the duplex, the compound or a salt thereof, and the polymerase together form a reaction system containing a solution phase and a solid phase;

preferably, the compound or a salt thereof is incorporated into the growing nucleic acid strand by using a polymerase under conditions where the polymerase is allowed to carry out a nucleotide polymerization reaction, thereby forming a nucleic acid intermediate containing the reversible blocking group and optional detectable label;

preferably, the polymerase is selected from KOD polymerase or a mutant thereof (e.g., KOD POL151, KOD POL157, KOD POL171, KOD POL174, KOD POL376, KOD POL391);

preferably, before any step of detecting the nucleic acid intermediate, the solution phase of the reaction system in the previous step is removed, and the duplex linked to the support is retained;

preferably, the excision reagent is in contact with the duplex or the growing nucleic acid strand in the reaction system containing a solution phase and a solid phase;

preferably, the excision reagent can remove the reversible blocking group and optional detectable label carried by the compound that is incorporated into the growing nucleic acid strand, without affecting the

phosphodiester bond on the backbone of the duplex;

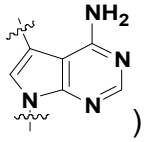
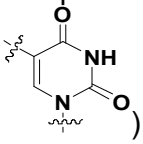
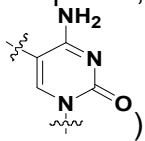
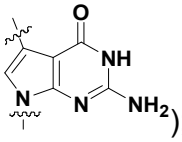
preferably, after any step of removing the reversible blocking group and optional detectable label contained in the nucleic acid intermediate, the solution phase of the reaction system in this step is removed;

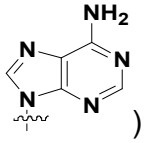
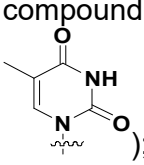
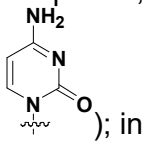
preferably, a washing operation is performed after any step comprising a removal operation;

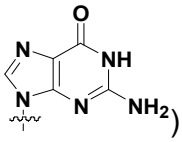
preferably, after step (ii), the method further comprises: determining the type of compound incorporated into the growing nucleic acid strand in step (i) according to the signal detected in step (ii), and determining the type of nucleotide at a corresponding position in the nucleic acid strand to be sequenced based on the principle of base complementary pairing.

20. A kit, which comprises at least one compound or a salt thereof according to any one of claims 1 to 11;

preferably, the kit comprises a first compound, a second compound, a third compound and a fourth compound, wherein the first, second, third and fourth compounds each are, independently, the compounds or salts thereof according to any one of claims 1 to 11;

preferably, in the first compound, base^1 is selected from adenine, 7-deazaadenine or a tautomer thereof (e.g., ); in the second compound, base^1 is selected from thymine, uracil or a tautomer thereof (e.g., ); in the third compound, base^1 is selected from cytosine or a tautomer thereof (e.g., ); in the fourth compound, base^1 is selected from guanine, 7-deazaguanine or a tautomer thereof (e.g., );

preferably, in the first compound, base^2 is selected from adenine, 7-deazaadenine or a tautomer thereof (e.g., ); in the second compound, base^2 is selected from thymine, uracil or a tautomer thereof (e.g., ); in the third compound, base^2 is selected from cytosine or a tautomer thereof (e.g., ); in the fourth compound, base^2 is selected

from guanine, 7-deazaguanine or a tautomer thereof (e.g., );

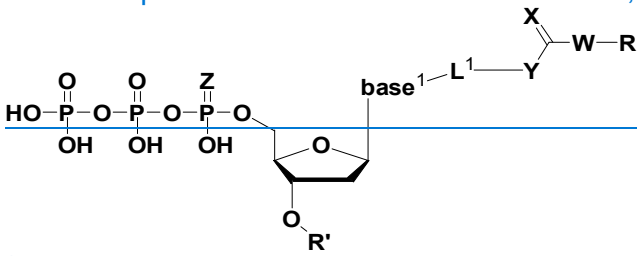
preferably, wherein the base[1] or base[2] contained in the first, second, third and fourth compounds are different from each other;

preferably, wherein the additional detectable labels carried by the first, second, third and fourth compounds are different from each other.

21. The kit according to claim 20, wherein the kit further comprises a reagent for pretreating the nucleic acid molecule; a support for linking nucleic acid molecule to be sequenced; a reagent for linking (for example, covalently or non-covalently linking) the nucleic acid molecule to be sequenced to the support; primers for initiating a nucleotide polymerization reaction; a polymerase for carrying out the nucleotide polymerization reaction; one or more buffer solutions; one or more washing solutions; or any combination thereof.

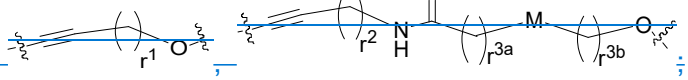
22. Use of the compound or a salt thereof according to any one of claims 1 to 11 or the kit according to any one of claims 20 to 21 for determining the sequence of a target single-stranded polynucleotide.

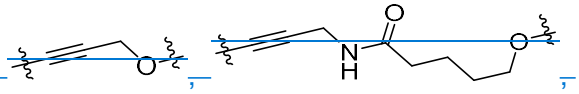
~~23. A compound of formula I-1 or a salt thereof,~~

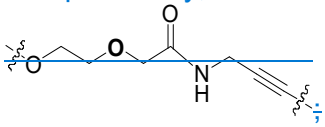


~~formula I-1~~

~~wherein:~~

~~L^1 is selected from~~ ;

~~preferably, L^1 is selected from~~ 

;

~~r^1, r^2, r^{3a}, r^{3b}, independently of each other, are selected from any integer between 1 and 6;~~

~~preferably, r^1 is selected from 1, 2, 3;~~

~~more preferably, r^1 is 1;~~

~~preferably, r^2 is selected from 1, 2, 3;~~

~~more preferably, r^2 is 1;~~

~~preferably, r^{3a}, r^{3b}, independently of each other, are selected from 1, 2, 3, 4, 5;~~

~~more preferably, r^{3a}, r^{3b}, independently of each other, are selected from 1,~~

2, 3;

most preferably, r^{3a} is 1;

most preferably, r^{3b} is 2;

M is selected from a direct bond, CH_2, NH, O, S;

preferably, M is selected from CH_2, O;

X is selected from O, S, NH;

preferably, X is selected from O, S;

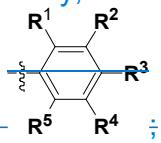
more preferably, X is O;

Y is selected from a direct bond, O, S, NH;

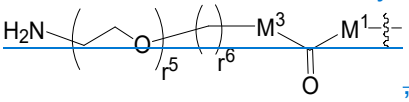
preferably, Y is a direct bond;

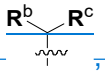
W is selected from a direct bond, O, S, NH;

preferably, W is a direct bond;

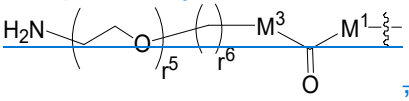
R is 

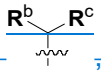
;

in R^1, R^2, R^3, R^4, R^5, any one (e.g., R^2, R^3 or R^4) is 

, another (e.g., R^1 or R^5) is 

, and the remaining three are H;

preferably, in R^1, R^2, R^3, R^4, R^5, R^3 or R^4 is 

, R^1 is 

, and the remaining three are H;

r^5, r^6, independently of each other, are selected from any integer between 1 and 6;

preferably, r^5 is selected from 1, 2, 3;

more preferably, r^5 is 2;

preferably, r^6 is selected from 1, 2, 3;

more preferably, r^6 is 1 or 2;

M^1, M^3, independently of each other, are selected from a direct bond, NH, O, S;

preferably, M^1 is selected from a direct bond, NH, O;

preferably, M^3 is selected from a direct bond, NH;

more preferably, when M^1 is NH, O or S, M^3 is a direct bond, and when M^3 is NH, O or S, M^1 is a direct bond;

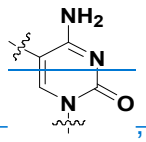
in R^b, R^c, any one is selected from $-N_3$, $-SS-C_1-C_6$ alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl;

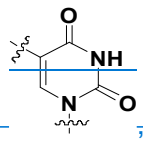
preferably, in R^b, R^c, any one is selected from $-N_3$, -SS-Me, and the other is methyl;

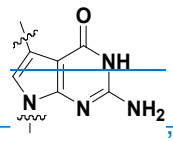
Z is selected from O, S, BH;

preferably, Z is O;

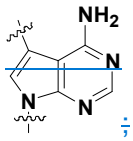
$base^1$ is selected from a base, a deaza base or a tautomer thereof, for example, adenine, 7-deazaadenine, thymine, uracil, cytosine, guanine, 7-deazaguanine or a tautomer thereof;

preferably, $base^1$ is selected from 

, 

, 

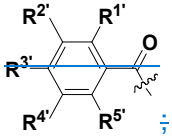
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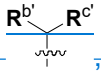
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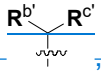
R' represents a reversible blocking group.

24. The compound or a salt thereof according to claim 23, wherein the reversible blocking group R' is selected from N_3-CH_2-, CH_3-CH_2-S-S-CH_2-,



;

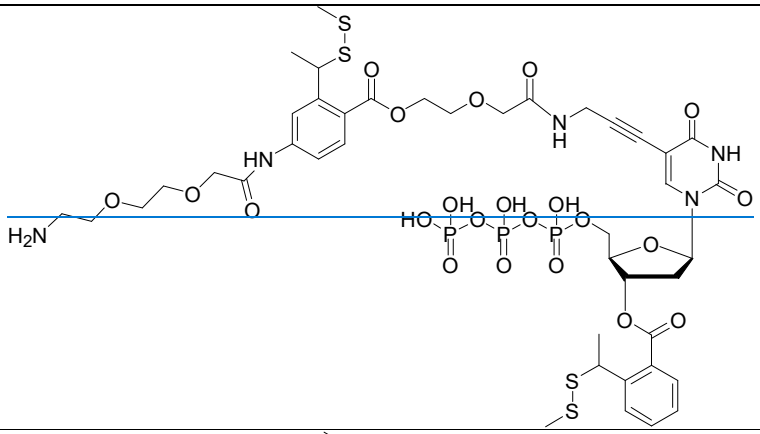
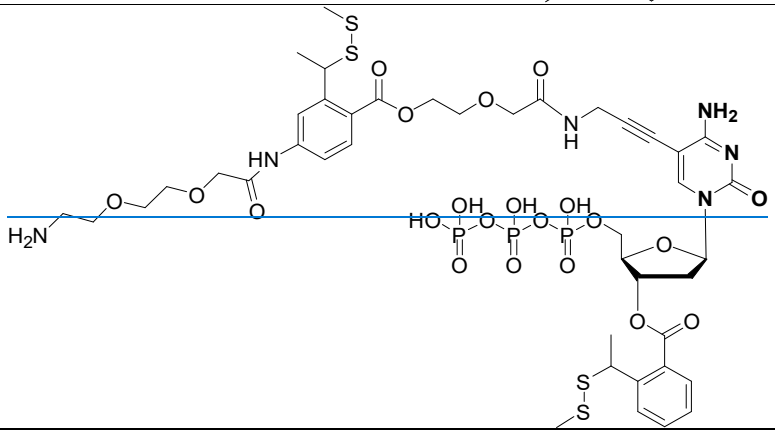
in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, any one (e.g., $R^{1'}$ or $R^{5'}$) is  , and the others are H,

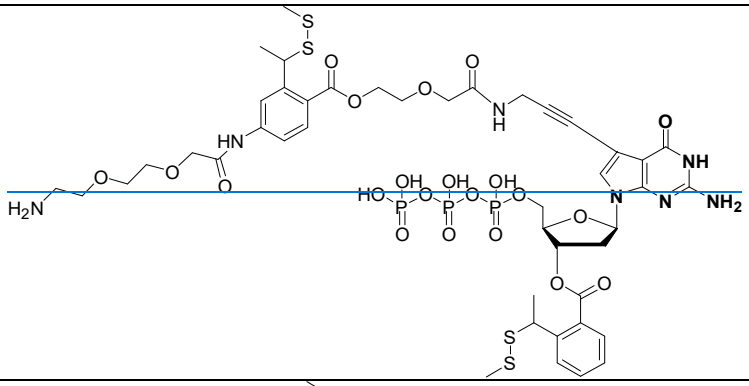
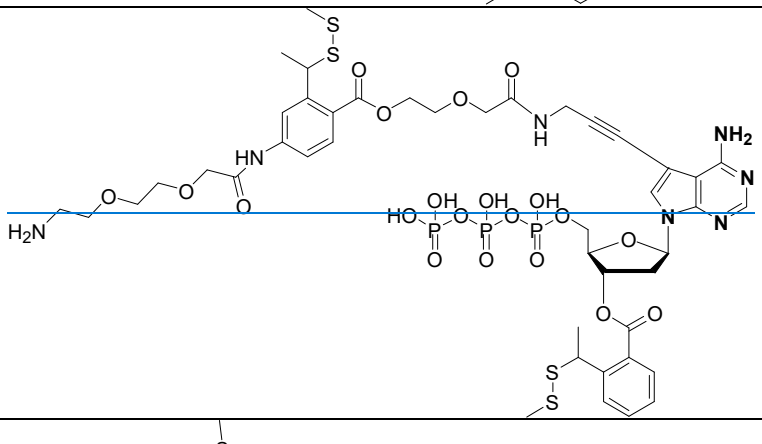
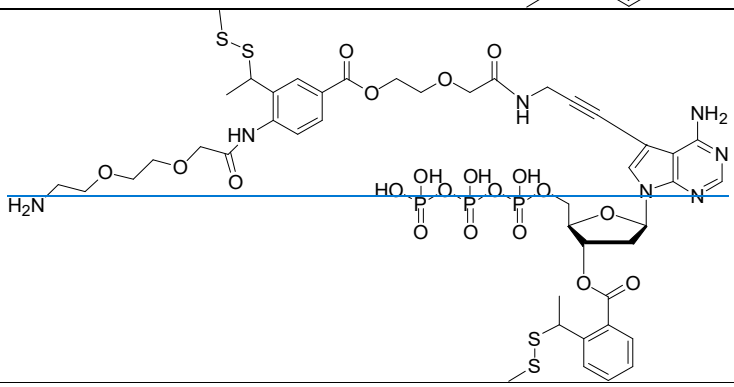
preferably, in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, $R^{1'}$ is  , and the others are H,

in $R^{b'}$, $R^{c'}$, any one is selected from $-N_3$, $-SS-C_1-C_6$ alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl,

preferably, in $R^{b'}$, $R^{c'}$, any one is selected from $-N_3$, -SS-Me, and the other is methyl.

25. The compound or a salt thereof according to any one of claims 23 to 24, wherein the compound is selected from:

Serial Number	Structural formulae
7A	
7B	

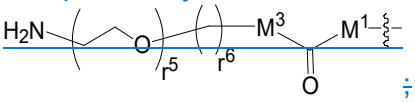
~~7C~~	
~~7D~~	
~~7D1~~	

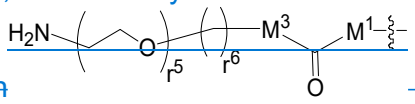
;

~~26. The compound or a salt thereof according to any one of claims 23 to 25, wherein the compound or a salt thereof carries an additional detectable label;~~

~~preferably, the additional detectable label carried by the compound or a salt thereof is introduced by an affinity reagent (e.g., antibody, aptamer, Affimer, Knottin), wherein the affinity reagent carries the detectable label, and the affinity reagent can specifically recognize and bind to an epitope of the compound or a salt thereof;~~

~~or preferably, the detectable label is linked to the R in the compound of formula I-1 according to any one of claims 23 to 24 or to a structural moiety corresponding to the R in the compound according to claim 25;~~

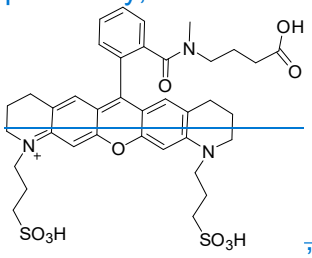
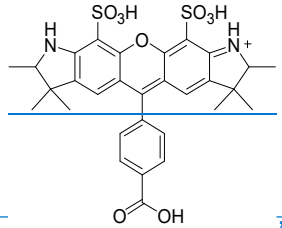
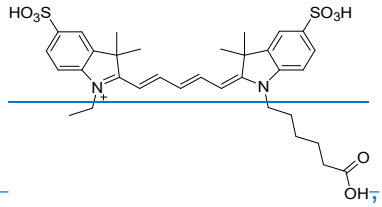
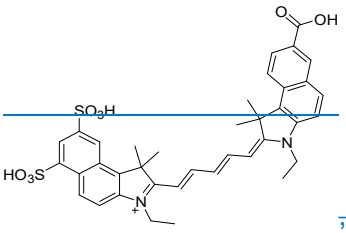
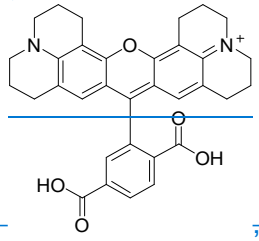
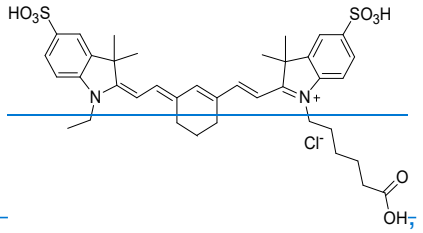
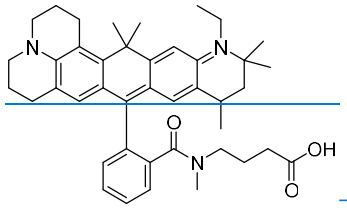
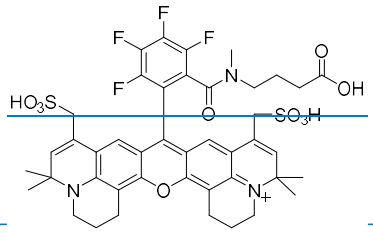
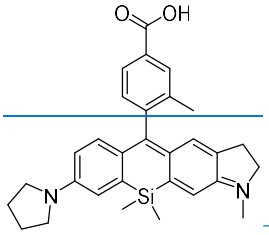
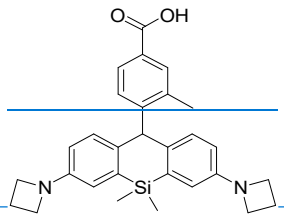
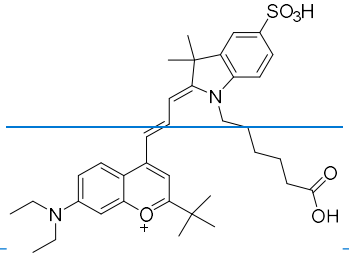
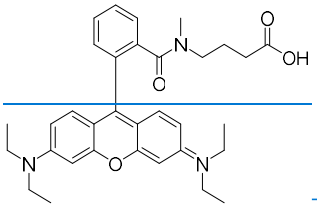
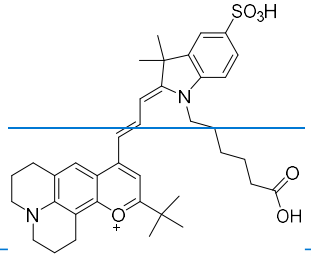
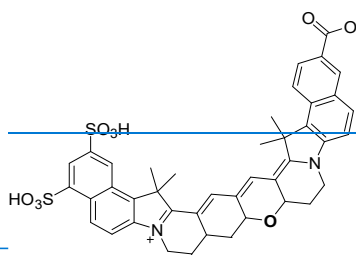
~~preferably, the detectable label is linked to the terminal amino group in~~  ;

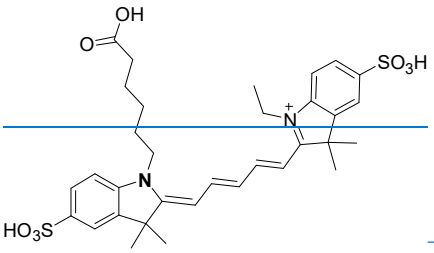
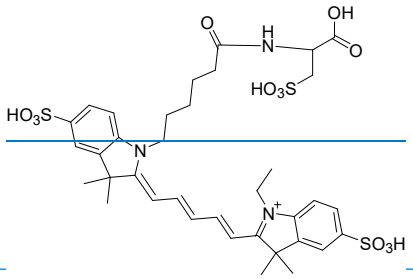
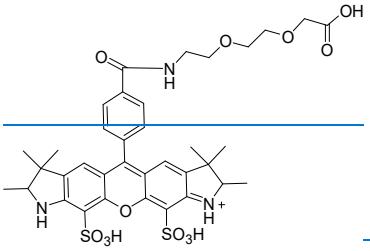
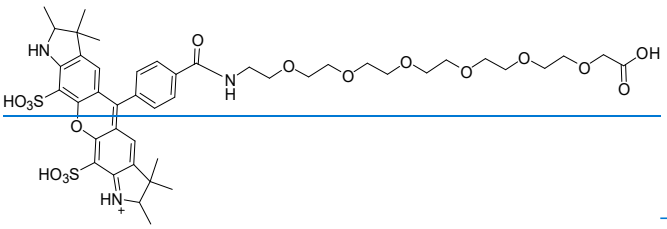
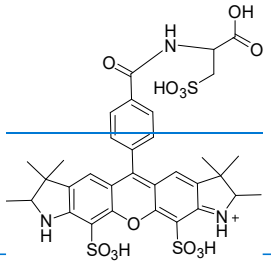
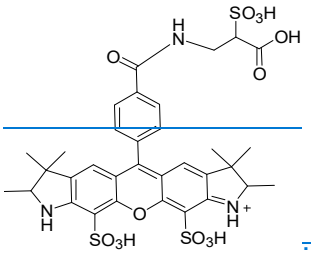
preferably, the carboxyl in the detectable label is linked to the terminal amino group in  via formation of an amide bond;

preferably, base[1] is different, and the additional detectable label carried by the compound of formula I-1 varies;

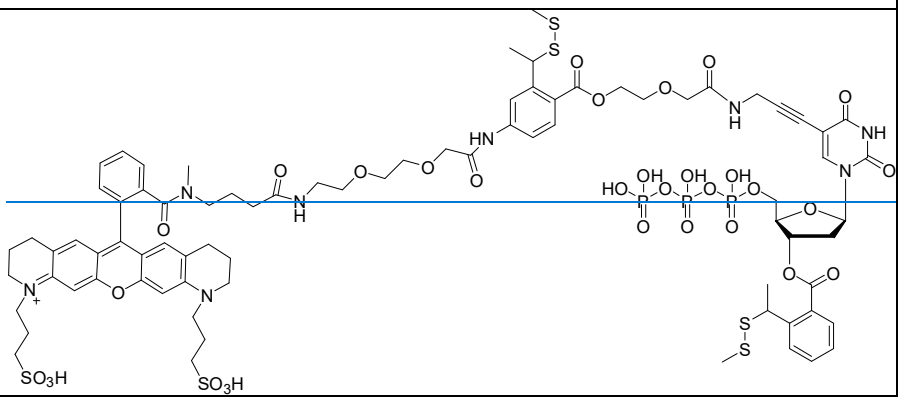
preferably, the detectable label is a fluorescent label;

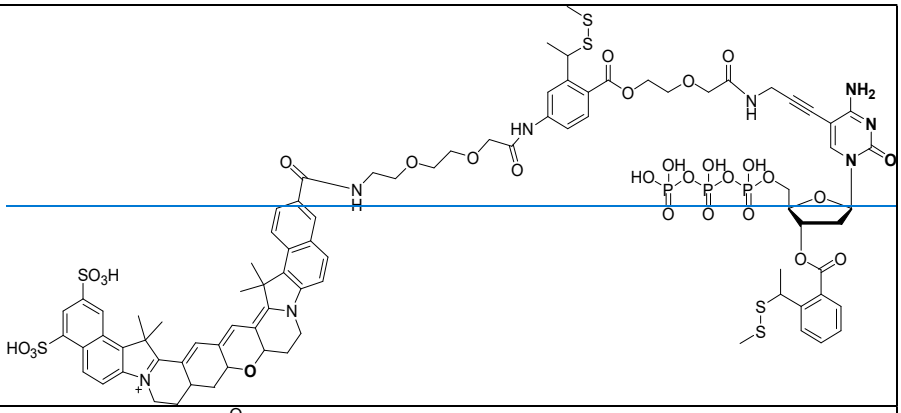
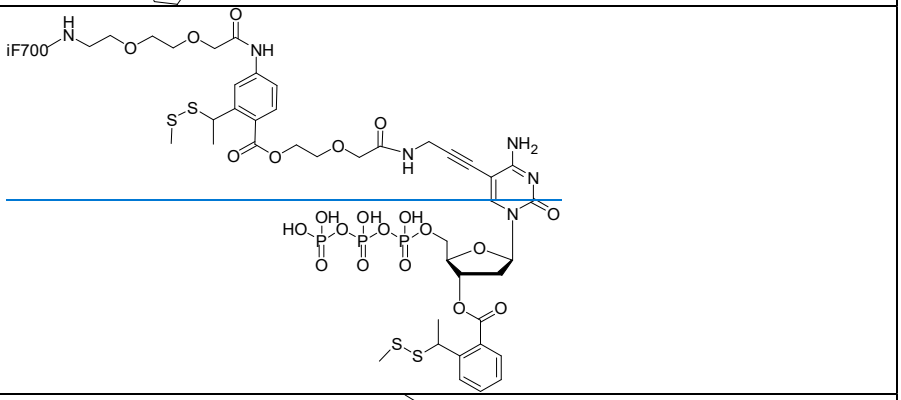
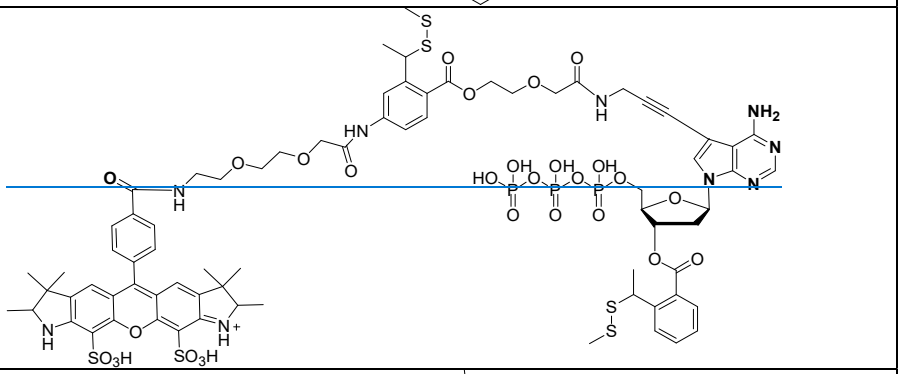
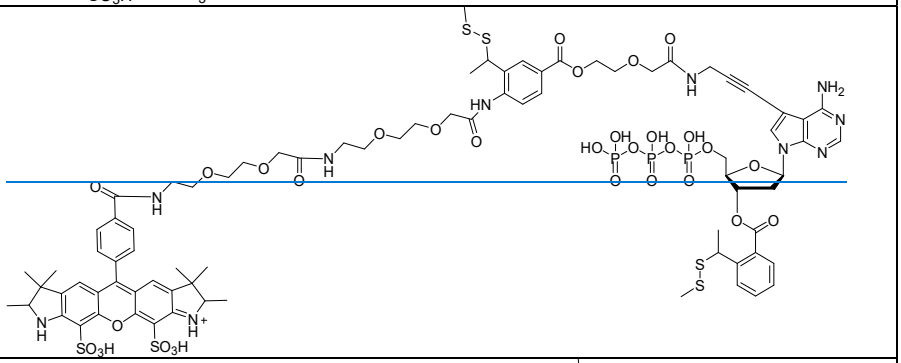
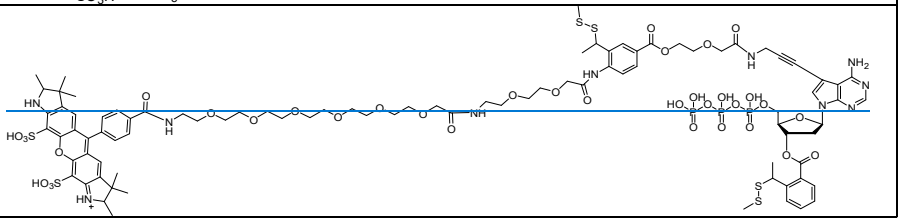
preferably, the detectable label is selected from: iF700,

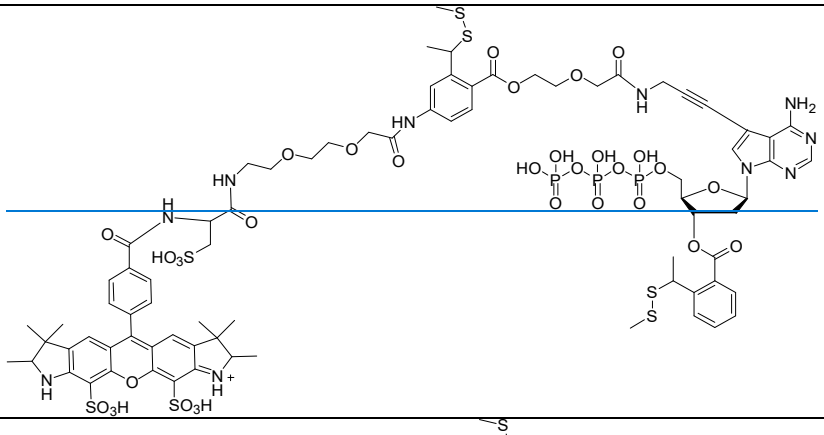
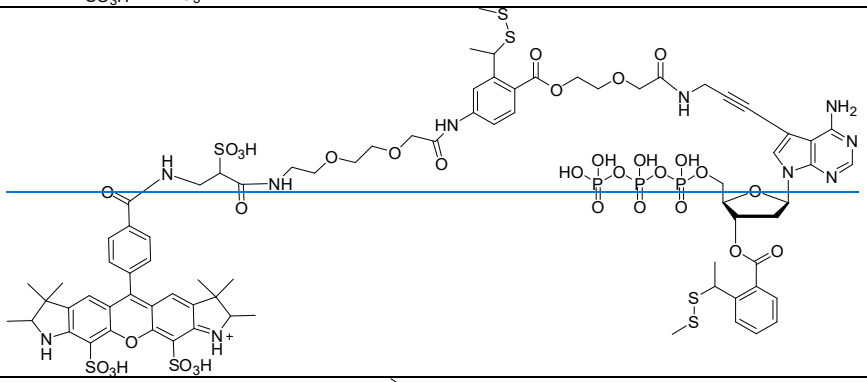
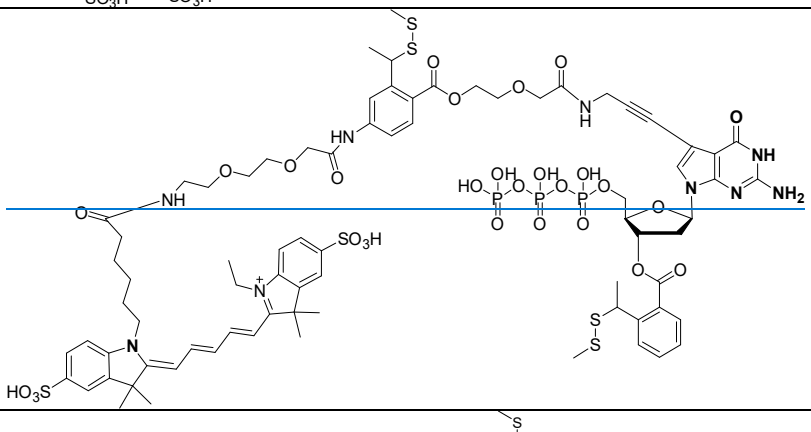
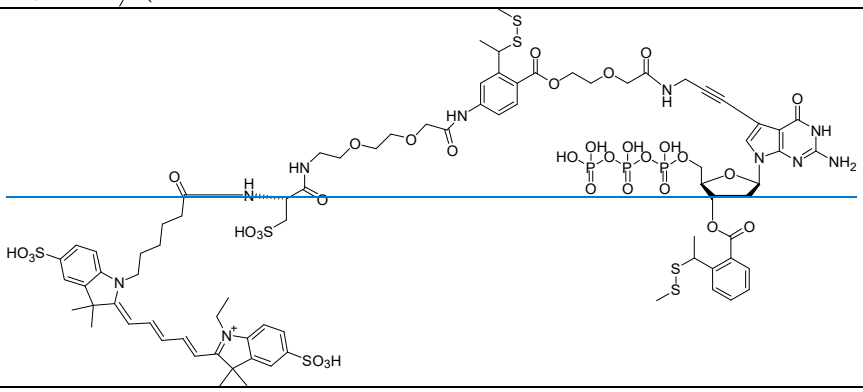
















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~~27. The compound or a salt thereof according to claim 26, wherein the compound is selected from:~~

~~Serial Number~~	~~Structural formulae~~
~~7A'~~	

~~7B'~~	
~~7B''~~	
~~7C'~~	
~~7C''~~	
~~7C'''~~	

7C””	
7C”””	
7D’	
7D”	

.

28. A method for terminating a nucleic acid synthesis, which comprises incorporating the compound or a salt thereof according to any one of claims 23 to 27 into a nucleic acid molecule to be terminated;

preferably, the incorporation of the compound or a salt thereof is achieved by a terminal transferase, a terminal polymerase or a reverse transcriptase;

preferably, the method comprises incorporating the compound or a salt thereof into the nucleic acid molecule to be terminated by using a polymerase;

preferably, the method comprises performing a nucleotide polymerization reaction using a polymerase under conditions where the polymerase is allowed to carry out the nucleotide polymerization reaction, thereby incorporating the compound or a salt thereof into the 3' end of the nucleic acid molecule to be terminated.

29. A method for preparing a growing polynucleotide complementary to a target single-stranded polynucleotide in a sequencing reaction, which comprises incorporating the compound or a salt thereof according to any one of 23 to 27 into the growing complementary polynucleotide, wherein the incorporation of the compound or a salt thereof prevents any subsequent nucleotides from being introduced into the growing complementary polynucleotide;

preferably, the incorporation of the compound or a salt thereof is achieved by a terminal transferase, a terminal polymerase or a reverse transcriptase;

preferably, the method comprises incorporating the compound or a salt thereof into the growing complementary polynucleotide by using a polymerase;

preferably, the method comprises performing a nucleotide polymerization reaction using a polymerase under conditions where the polymerase is allowed to carry out the nucleotide polymerization reaction, thereby incorporating the compound or a salt thereof into the 3' end of the growing complementary polynucleotide.

30. A nucleic acid intermediate, which is formed in determining the sequence of a target single-stranded polynucleotide, wherein,

the nucleic acid intermediate is formed according to the step:

incorporating a nucleotide complementary to the target single-stranded polynucleotide into a growing nucleic acid strand, to form the nucleic acid intermediate, wherein, the incorporated complementary nucleotide is the compound or a salt thereof according to any one of claims 23 to 27;

or, the nucleic acid intermediate is formed according to the step:

incorporating a nucleotide complementary to the target single-stranded polynucleotide into a growing nucleic acid strand, to form the nucleic acid intermediate, wherein, the incorporated complementary nucleotide is the compound or a salt thereof according to any one of claims 23 to 27, and the growing nucleic acid strand is pre-incorporated with at least one nucleotide complementary to the target single-stranded polynucleotide, the at least one pre-incorporated nucleotide complementary to the target single-stranded polynucleotide being the compound or a salt thereof according to any one of claims 23 to 27 in which the reversible blocking group and optional detectable label have been removed.

31. A method for determining the sequence of a target single-stranded

polynucleotide, which comprises:

1) monitoring the incorporation of nucleotides complementary to the target single-stranded polynucleotide in a growing nucleic acid strand, wherein at least one complementary nucleotide incorporated is the compound or a salt thereof according to any one of claims 23 to 27, and,

2) determining the types of the incorporated nucleotides;

preferably, the reversible blocking group and optional detectable label are removed before a next complementary nucleotide is introduced;

preferably, the reversible blocking group and the detectable label are removed simultaneously;

preferably, the reversible blocking group and the detectable label are removed sequentially; for example, after the detectable label is removed, the reversible blocking group is removed, or, after the reversible blocking group is removed, the detectable label is removed.

32. The method according to claim 31, which comprises the following steps of:

(a) providing a plurality of different nucleotides, wherein at least one nucleotide is the compound or a salt thereof according to any one of claims 26 to 27, optionally, the rest of nucleotides are the compound or a salt thereof according to any one of claims 23 to 27;

(b) incorporating the plurality of different nucleotides into a sequence complementary to a target single-stranded polynucleotide, wherein the plurality of different nucleotides can be distinguished from each other during the detection;

(c) detecting the nucleotides in step (b) to determine the types of nucleotides incorporated;

(d) removing the reversible blocking groups and optional detectable labels carried by the nucleotides in step (b); and

(e) optionally repeating steps (a)-(d) one or more times;

whereby the sequence of the target single-stranded polynucleotide is determined.

33. The method according to claim 31, which comprises the following steps of:

(1) providing a first nucleotide, a second nucleotide, a third nucleotide and a fourth nucleotide, wherein at least one of the four nucleotides is the compound or a salt thereof according to any one of claims 26 to 27, optionally, the rest of nucleotides are the compound or a salt thereof according to any one of claims 23 to 27;

(2) contacting the four nucleotides with a target single-stranded polynucleotide; removing the nucleotides not incorporated into the growing nucleic acid strand; detecting the nucleotides incorporated into the growing nucleic acid strand; removing the reversible blocking groups and optional detectable labels carried in the nucleotides that are incorporated into the growing nucleic acid strand;

optionally, it also includes (3): repeating the steps (1)-(2) one or more times.

34. The method according to claim 31, which comprises the following

steps of:

(a) providing a mixture comprising a duplex, nucleotides comprising at least one compound or a salt thereof according to any one of claims 26 to 27, a polymerase, and an excision reagent; wherein the duplex comprises a growing nucleic acid strand and a nucleic acid strand to be sequenced;

(b) carrying out a reaction comprising the following steps (i), (ii) and (iii), optionally, repeating the steps for one or more times:

step (i): incorporating the compound or a salt thereof into the growing nucleic acid strand by using a polymerase, to form a nucleic acid intermediate containing the reversible blocking group and optional detectable label;

step (ii): detecting the nucleic acid intermediate;

step (iii): removing the reversible blocking group and optional detectable label contained in the nucleic acid intermediate by using the excision reagent;

preferably, removal of the reversible blocking group and removal of the detectable label are performed simultaneously, or, removal of the reversible blocking group and removal of the detectable label are performed sequentially (for example, the reversible blocking group is removed first, or the detectable label is removed first);

preferably, the excision reagent used for removal of the reversible blocking group is the same as that used for removal of the detectable label;

preferably, the excision reagent used for removal of the reversible blocking group is different from that used for removal of the detectable label.

35. The method according to claim34, wherein the duplex is linked to a support;

preferably, the growing nucleic acid strand is a primer;

preferably, the primer is annealed to the nucleic acid strand to be sequenced to form the duplex;

preferably, the duplex, the compound or a salt thereof, and the polymerase together form a reaction system containing a solution phase and a solid phase;

preferably, the compound or a salt thereof is incorporated into the growing nucleic acid strand by using a polymerase under conditions where the polymerase is allowed to carry out a nucleotide polymerization reaction, thereby forming a nucleic acid intermediate containing the reversible blocking group and optional detectable label;

preferably, the polymerase is selected from KOD polymerase or a mutant thereof (e.g., KOD POL151, KOD POL157, KOD POL171, KOD POL174, KOD POL376, KOD POL391);

preferably, before any step of detecting the nucleic acid intermediate, the solution phase of the reaction system in the previous step is removed, and the duplex linked to the support is retained;

preferably, the excision reagent is in contact with the duplex or the growing nucleic acid strand in the reaction system containing a solution phase and a solid phase;

preferably, the excision reagent can remove the reversible blocking group and optional detectable label carried by the compound that is incorporated into the growing nucleic acid strand, without affecting the phosphodiester bond on the backbone of the duplex;

preferably, after any step of removing the reversible blocking group and

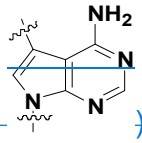
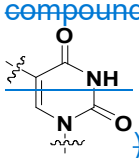
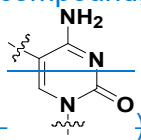
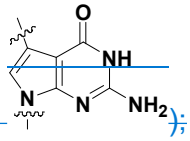
optional detectable label contained in the nucleic acid intermediate, the solution phase of the reaction system in this step is removed;

preferably, a washing operation is performed after any step comprising a removal operation;

preferably, after step (ii), the method further comprises: determining the type of compound incorporated into the growing nucleic acid strand in step (i) according to the signal detected in step (ii), and determining the type of nucleotide at a corresponding position in the nucleic acid strand to be sequenced based on the principle of base complementary pairing.

36. A kit, which comprises at least one compound or a salt thereof according to any one of claims 23 to 27;

preferably, the kit comprises a first compound, a second compound, a third compound and a fourth compound, wherein the first, second, third and fourth compounds each are, independently, the compound or a salt thereof according to any one of claims 23 to 27;

preferably, in the first compound, base[1] is selected from adenine, 7-deazaadenine or a tautomer thereof (e.g., ); in the second compound, base[1] is selected from thymine, uracil or a tautomer thereof (e.g., ); in the third compound, base[1] is selected from cytosine or a tautomer thereof (e.g., ); in the fourth compound, base[1] is selected from guanine, 7-deazaguanine or a tautomer thereof (e.g., );

preferably, wherein the base[1] contained in the first, second, third and fourth compounds are different from each other;

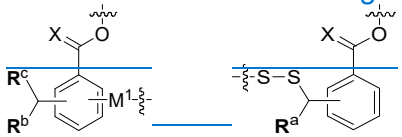
preferably, wherein the additional detectable labels carried by the first, second, third and fourth compounds are different from each other.

37. The kit according to claim 36, wherein the kit further comprises a reagent for pretreating the nucleic acid molecule; a support for linking nucleic acid molecule to be sequenced; a reagent for linking (for example, covalently or non-covalently linking) the nucleic acid molecule to be sequenced to the support; primers for initiating a nucleotide polymerization reaction; a polymerase for carrying out the nucleotide polymerization reaction; one or more buffer solutions; one or more washing solutions; or any combination thereof.

38. Use of the compound or a salt thereof according to any one of claims 23 to 27 or the kit according to any one of claims 36 to 37 for determining the

~~sequence of a target single-stranded polynucleotide.~~

~~39. A nucleotide analogue, which is formed by a ribose or deoxyribose, a reversible blocking group, base or deaza base or a tautomer thereof, a linker for linking to a detectable label, and an optional phosphate group, wherein the linker comprises the structure shown in the following formula A or formula A':~~



~~formula A formula A'~~

~~wherein:~~

~~in R^b, R^c, any one is selected from -N_3, -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), -ONH_2, -$OCOR_x$, -$OCONHR_x$, -S-SO_2R_x, and the other is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), wherein each R_x, independently, is selected from aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl) or aromatic alkyl (e.g., phenyl C_1-C_6 alkyl);~~

~~preferably, in R^b, R^c, any one is selected from -N_3, -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl;~~

~~more preferably, in R^b, R^c, any one is selected from -N_3, -SS-Me, -SS-Et, and the other is methyl;~~

~~most preferably, in R^b, R^c, any one is selected from -N_3, -SS-Me, and the other is methyl;~~

~~R^a is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl -C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl);~~

~~preferably, R^a is selected from H, C_1-C_6 alkyl;~~

~~more preferably, R^a is methyl;~~

~~X is selected from O, S, NH;~~

~~preferably, X is selected from O, S;~~

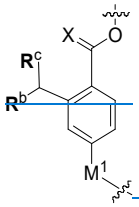
~~more preferably, X is O;~~

~~M^1 is selected from a direct bond, NH, O, S, CH_2;~~

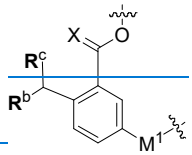
~~preferably, M^1 is selected from a direct bond, NH, O;~~

~~preferably, the reversible blocking group is linked to the 3'-OH of the ribose or deoxyribose, the base or deaza base or a tautomer thereof is linked to the 1'-C of the ribose or deoxyribose, the optional phosphate group is linked to the 5'-OH of the ribose or deoxyribose, and the linker is linked to the base or deaza base or a tautomer thereof.~~

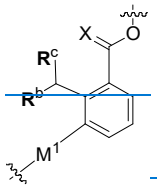
~~40. The nucleotide analogue according to claim 39, wherein, the structure of formula A is selected from formula A-1, formula A-2, formula A-3, formula A-4 or formula A-5, preferably the structure of formula A is formula A-1, formula A-2 or formula A-5; or, the structure of formula A' is selected from formula A'-1, formula A'-2 or formula A'-3, preferably the structure of formula A' is formula A'-1;~~



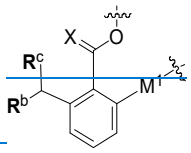
formula A-1



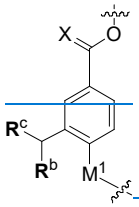
formula A-2



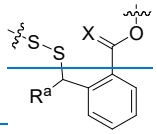
formula A-3



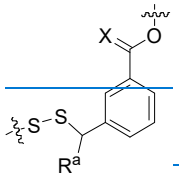
formula A-4



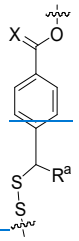
formula A-5



formula A'-1



formula A'-2

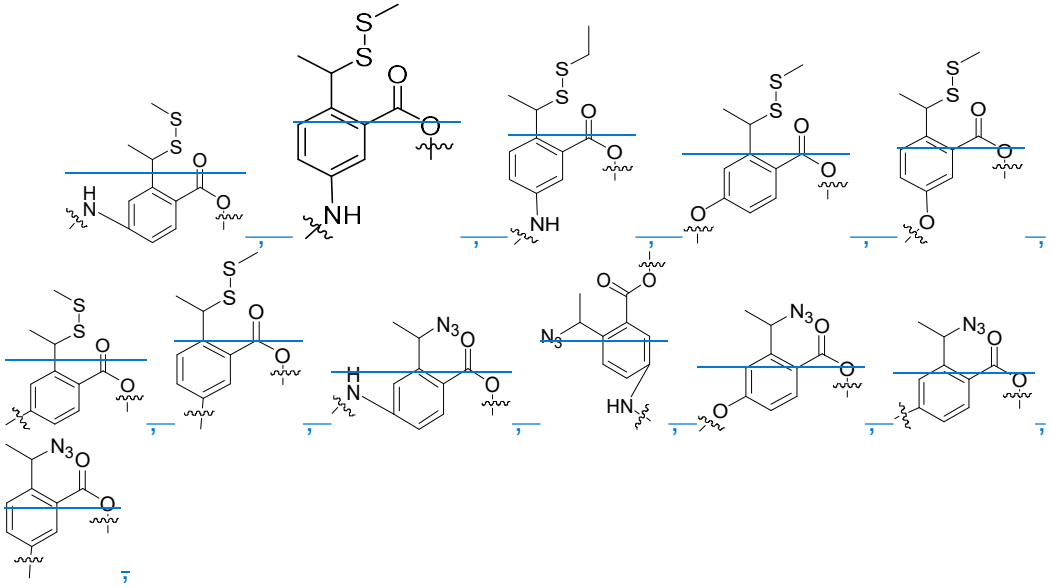


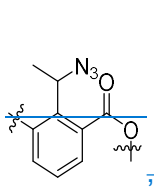
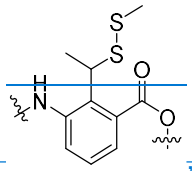
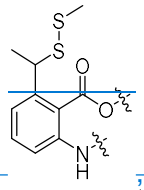
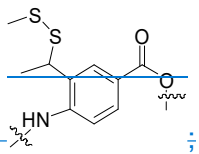
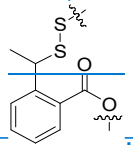
formula A'-3

wherein:

R^a, R^b, R^c, X, M^1 have the same definitions as above.

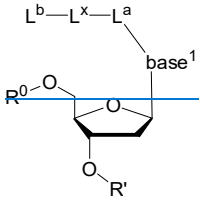
41. The nucleotide analogue according to any one of claims 39 to 40, wherein, the structure of formula A is selected from:



or, the structural of formula A' is .

42. The nucleotide analogue according to any one of claims 39 to 41, wherein the structure of the nucleotide analogue is shown in the following formula B:



formula B

L^x has the structure of formula A, formula A', formula A-1, formula A-2, formula A-3, formula A-4, formula A-5, formula A'-1, formula A'-2 or formula A'-3 according to any one of claims 39 to 41, and the M^1 end or S end of L^x is linked to L^b, the O end of L^x is linked to L^a;

L^b—L^x—L^a represents a linker for linking to a detectable label;

$base^1$ represents a base or deaza base or a tautomer thereof;

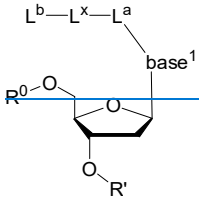
R' represents a reversible blocking group;

R^0 represents H or phosphate group;

L^a represents the moiety in the linker for linking to the base or deaza base or a tautomer thereof;

L^b represents the moiety in the linker for linking to the detectable label.

43. The nucleotide analogue according to any one of claims 39 to 42, wherein the structure of the nucleotide analogue is shown in the following formula B:

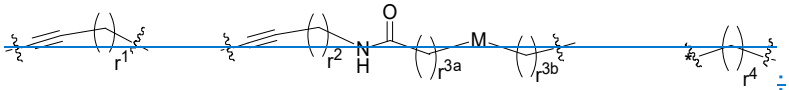


formula B

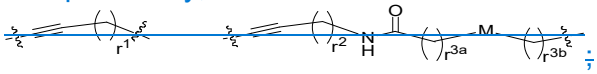
wherein:

L^x has the structure of formula A, formula A', formula A-1, formula A-2, formula A-3, formula A-4, formula A-5, formula A'-1, formula A'-2 or formula A'-3 as shown in any one of claims 39 to 41, and the M^1 end or S end of L^x is linked to L^b, the O end of L^x is linked to L^a;

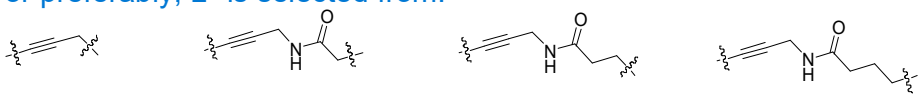
L^a is selected from

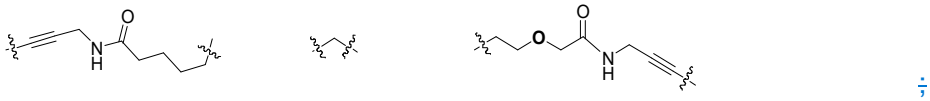


preferably, L^a is selected from

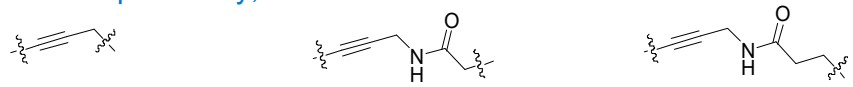


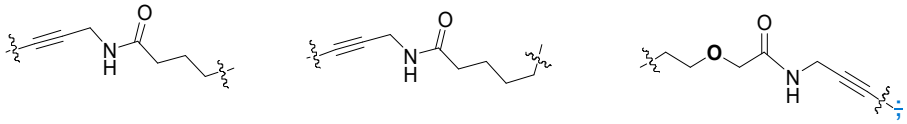
or preferably, L^a is selected from:



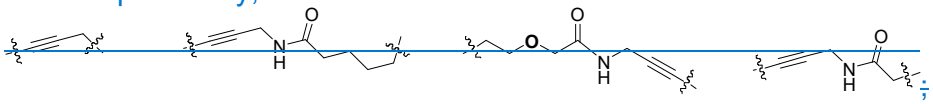


or more preferably, L^a is selected from:





or more preferably, L^a is selected from:



or most preferably, L^a is selected from:



r^1, r^2, r^{3a}, r^{3b}, r^4, independently of each other, are selected from any integer between 1 and 6;

preferably, r^1 is selected from 1, 2, 3;

more preferably, r^1 is 1;

preferably, r^2 is selected from 1, 2, 3;

more preferably, r^2 is 1;

preferably, r^{3a}, r^{3b}, independently of each other, are selected from 0, 1, 2, 3, 4, 5, and r^{3a}, r^{3b} being not 0 at the same time;

more preferably, r^{3a}, r^{3b}, independently of each other, are selected from 0, 1, 2, 3, and r^{3a}, r^{3b} being not 0 at the same time;

further preferably, r^{3a} is selected from 0, 1, r^{3b} is selected from 0, 2, and r^{3a}, r^{3b} being not 0 at the same time;

most preferably, r^{3a} is 1;

most preferably, r^{3b} is 2;

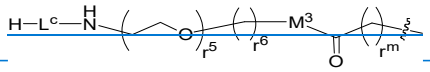
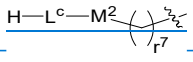
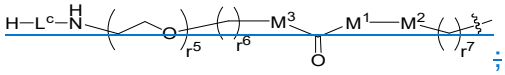
preferably, r^4 is selected from 1, 2, 3;

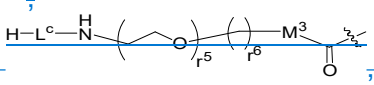
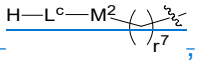
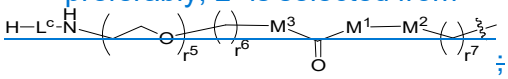
more preferably, r^4 is 1;

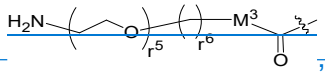
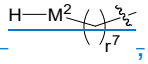
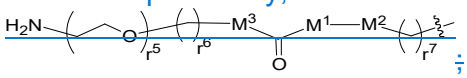
M is selected from a direct bond, CH_2, NH, O, S;

preferably, M is selected from a direct bond, CH_2, O;

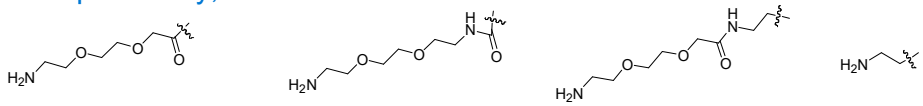
more preferably, M is selected from CH_2, O;

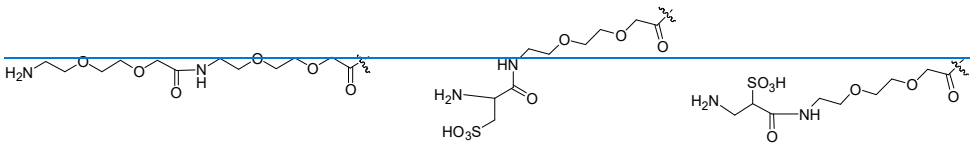
L^b is selected from  ,  ,  ;

preferably, L^b is selected from  ,  ,  ;

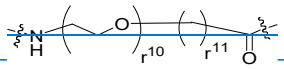
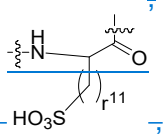
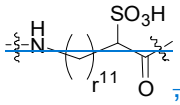
more preferably, L^b is selected from  ,  ,  ;

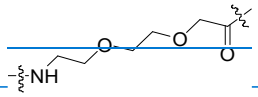
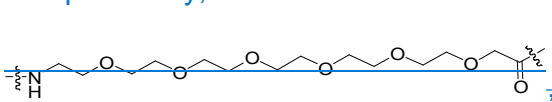
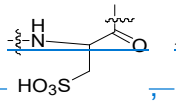
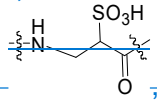
most preferably, L^b is selected from:





 ;

L^c is selected from a direct bond,  ,  ,  , preferably, the NH end in L^c is linked to H in L^b, the =O end in L^c is linked to NH in L^b;

preferably, L^c is selected from a direct bond,  ,  ,  ,  , preferably, the NH end in L^c is linked to H in L^b, the =O end in L^c is linked to NH in L^b;

r^m is selected from any integer between 0 and 6;

preferably, r^m is selected from 0, 1, 2, 3;

more preferably, r^m is selected from 0, 1;

r^5, r^6, r^7, independently of each other, are selected from any integer between 1 and 6;

preferably, r^5 is selected from 1, 2, 3;

more preferably, r^5 is 2;

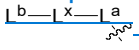
preferably, r^6 is selected from 1, 2, 3;

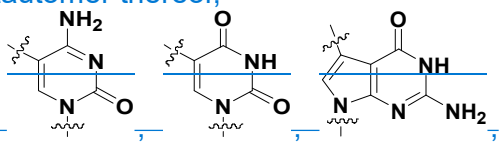
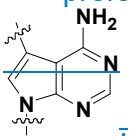
more preferably, r^6 is 1 or 2;

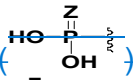
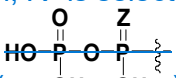
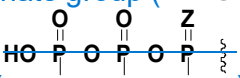
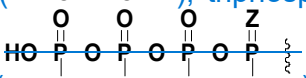
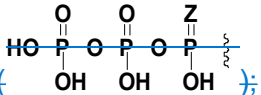
preferably, r^7 is selected from 1, 2, 3;

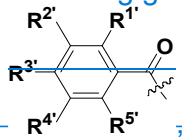
more preferably, r^7 is 2;

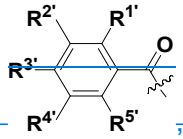
r^{10} is selected from any integer between 1 and 10;

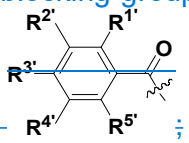
preferably, r^{10} is selected from any integer between 2 and 6;
more preferably, r^{10} is 2 or 6;
r^{11} is selected from any integer between 1 and 6;
preferably, r^{11} is selected from 1, 2, 3;
more preferably, r^{11} is 1;
M^1, M^2, M^3, independently of each other, are selected from a direct bond, NH, O, S, CH_2;
preferably, M^1 is selected from a direct bond, NH, O;
preferably, M^2 is NH;
preferably, M^3 is selected from a direct bond, NH;
$base^1$ represents base or deaza base;
R' represents a reversible blocking group;

represents linker for linking to a detectable label;
R^0 represents H or phosphate group.

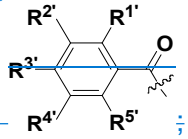
44. The nucleotide analogue according to any one of claims 42 to 43, wherein the $base^1$ is selected from adenine, 7-deazaadenine, thymine, uracil, cytosine, guanine, 7-deazaguanine or a tautomer thereof;
preferably, $base^1$ is selected from 


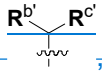
45. The nucleotide analogue according to any one of claims 42 to 44, wherein, R^0 is selected from H, monophosphate group (), diphosphate group (), triphosphate group (), tetraphosphate group ();
preferably, R^0 is a triphosphate group ();
each Z, independently, is selected from O, S, BH;
preferably, Z is O.

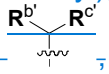
46. The nucleotide analogue according to any one of claims 42 to 45, wherein the reversible blocking group R' is selected from N_3-C_1-C_6 alkyl, C_1-C_6 alkyl-SS-C_1-C_6 alkyl, , NH_2, -ONH_2, -$OCOR_z$, -$OCONHR_z$, wherein each R_z, independently, is selected from aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl) or aromatic alkyl (e.g., phenyl C_1-C_6 alkyl);
preferably, the reversible blocking group R' is selected from N_3-C_1-C_6 alkyl,

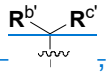

C_1-C_6 alkyl-SS-C_1-C_6 alkyl, , NH_2;

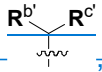
more preferably, the reversible blocking group R' is selected from N_3-C_1-C_6 alkyl, C_1-C_6 alkyl-SS-C_1-C_6 alkyl,  ;

most preferably, the reversible blocking group R' is selected from N_3-CH_2-, CH_3-CH_2-S-S-CH_2-,  ;

in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, any one (e.g., $R^{1'}$ or $R^{5'}$) is  , and the others, independently of each other, are selected from H, azido, nitro, amino, sulfo, carboxyl, aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), aromatic alkyl (e.g., phenyl-C_1-C_6 alkyl), F, I, Br, Cl, alkoxyl (e.g., C_1-C_6 alkoxyl),

preferably, in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, any one (e.g., $R^{1'}$ or $R^{5'}$) is  , another (e.g., $R^{3'}$) is selected from H, C_1-C_6 alkoxyl (e.g., methoxy), and the others are H,

more preferably, in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, any one (e.g., $R^{1'}$ or $R^{5'}$) is  , and the others are H,

most preferably, in $R^{1'}$, $R^{2'}$, $R^{3'}$, $R^{4'}$, $R^{5'}$, $R^{1'}$ is  , and the others are H,

in $R^{b'}$, $R^{c'}$, any one is selected from -N_3, -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), -ONH_2, -$OCOR_x$, -$OCONHR_x$, and the other is selected from H, aliphatic alkyl (e.g., C_1-C_6 alkyl, such as Me, Et, iPr, tBu), aromatic alkyl (e.g., phenyl-C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl), wherein each R_x, independently, is selected from aliphatic alkyl (e.g., C_1-C_6 alkyl), cycloalkyl (e.g., C_3-C_6 cycloalkyl) or aromatic alkyl (e.g., phenyl C_1-C_6 alkyl),

preferably, in $R^{b'}$, $R^{c'}$, any one is selected from -N_3, -SS-C_1-C_6 alkyl (e.g., -SS-Me, -SS-Et, -SS-iPr, -SS-t-Bu), and the other is selected from C_1-C_6 alkyl,

more preferably, in $R^{b'}$, $R^{c'}$, any one is selected from -N_3, -SS-Me, and the other is methyl.

47. The nucleotide analogue according to any one of claims 39 to 46, wherein it is selected from the compound according to claim 9.

48. The nucleotide analogue according to any one of claims 39 to 47, wherein the nucleotide analogue carries an additional detectable label, and the detectable label is linked to a linker (preferably L^b);

preferably, the additional detectable label carried by the nucleotide analogue is introduced by an affinity reagent (e.g., antibody, aptamer, Affimer, Knottin), wherein the affinity reagent carries the detectable label, and the affinity

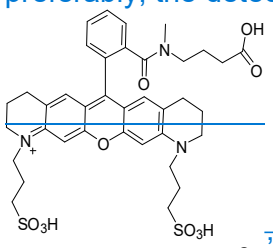
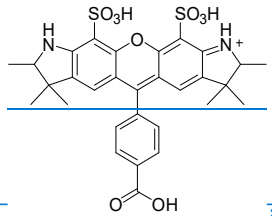
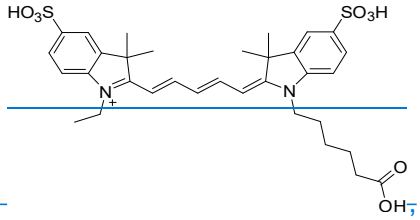
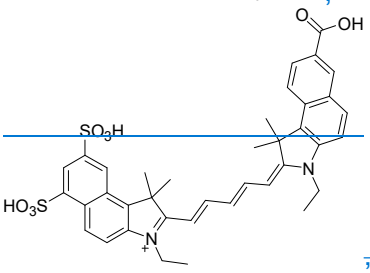
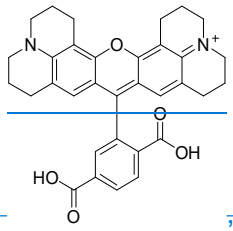
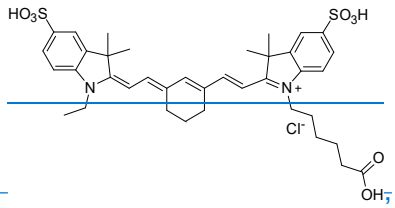
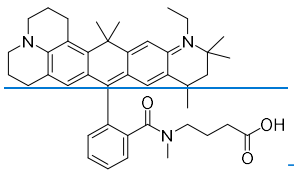
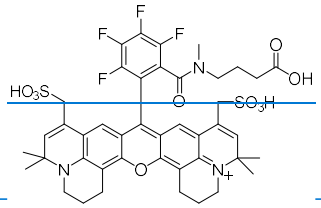
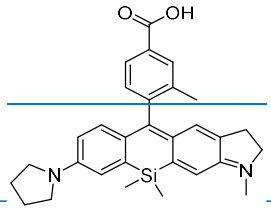
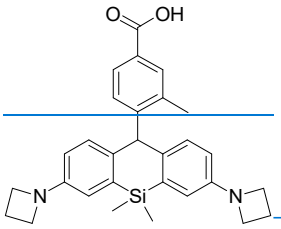
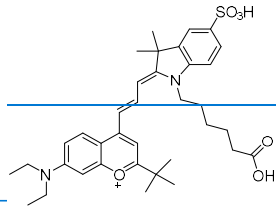
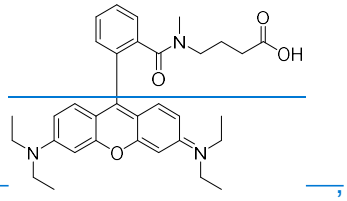
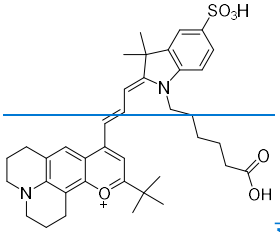
reagent can specifically recognize and bind to an epitope of the nucleotide analogue; preferably, the detectable label is linked to the terminal amino group in L^b;

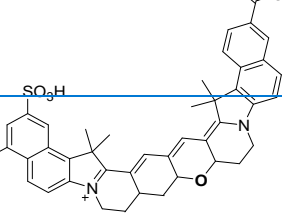
preferably, the carboxyl in the detectable label is linked to the terminal amino group in L^b via formation of an amide bond;

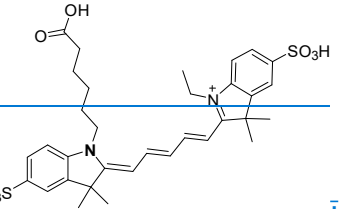
preferably, $base^1$ is different, and the additional detectable label carried by the nucleotide analogue varies;

preferably, the detectable label is a fluorescent label;

preferably, the detectable label is selected from: iF700,





49. The nucleotide analogue according to claim 48, wherein the nucleotide analogue is selected from the compound according to claim 11.

50. A method for terminating a nucleic acid synthesis, comprising: incorporating the nucleotide analogue according to any one of claims 39 to 49 into a nucleic acid molecule to be terminated;

preferably, the incorporation of the nucleotide analogue is achieved by a terminal transferase, a terminal polymerase or a reverse transcriptase;

preferably, the method comprises incorporating the nucleotide analogue into the nucleic acid molecule to be terminated by using a polymerase;

preferably, the method comprises performing a nucleotide polymerization reaction using a polymerase under conditions where the polymerase is allowed to carry out the nucleotide polymerization reaction, thereby incorporating the nucleotide analogue into the 3' end of the nucleic acid molecule to be terminated.

51. A method for preparing a growing polynucleotide complementary to a target single-stranded polynucleotide in a sequencing reaction, comprising incorporating the nucleotide analogue according to any one of claims 39 to 49 into the growing complementary polynucleotide, wherein the incorporation of the nucleotide analogue prevents any subsequent nucleotides from being introduced into the growing complementary polynucleotide;

preferably, the incorporation of the nucleotide analogue is achieved by a terminal transferase, a terminal polymerase or a reverse transcriptase;

preferably, the method comprises incorporating the nucleotide analogue into the growing complementary polynucleotide by using a polymerase;

preferably, the method comprises performing a nucleotide polymerization reaction using a polymerase under conditions where the polymerase is allowed to carry out the nucleotide polymerization reaction, thereby incorporating the nucleotide analogue into the 3' end of the growing complementary polynucleotide.

52. A nucleic acid intermediate, which is formed in determining the sequence of a target single-stranded polynucleotide, wherein,

the nucleic acid intermediate is formed according to the step:

incorporating a nucleotide complementary to the target single-stranded polynucleotide into a growing nucleic acid strand, to form the nucleic acid intermediate, wherein the incorporated complementary nucleotide is the nucleotide analogue according to any one of claims 39 to 49;

or, the nucleic acid intermediate is formed according to the step:

incorporating a nucleotide complementary to the target single-stranded polynucleotide into a growing nucleic acid strand, to form the nucleic acid intermediate, wherein, the incorporated complementary nucleotide is the nucleotide analogue according to any one of claims 39 to 49, and the growing nucleic acid strand is pre-incorporated with at least one nucleotide complementary to the target single-stranded polynucleotide, the at least one pre-incorporated nucleotide complementary to the target single-stranded polynucleotide being the nucleotide analogue according to any one of claims 39 to 49 in which the reversible blocking group and optional detectable label have been removed.

53. A method for determining the sequence of a target single-stranded polynucleotide, which comprises:

1) monitoring the incorporation of nucleotides complementary to the target single-stranded polynucleotide in a growing nucleic acid strand, wherein at least one complementary nucleotide incorporated is the nucleotide

analogue according to any one of claims 39 to 49, and,

2) determining the types of the incorporated nucleotides;

preferably, the reversible blocking group and optional detectable label are removed before a next complementary nucleotide is introduced;

preferably, the reversible blocking group and the detectable label are removed simultaneously;

preferably, the reversible blocking group and the detectable label are removed sequentially; for example, after the detectable label is removed, the reversible blocking group is removed, or, after the reversible blocking group is removed, the detectable label is removed.

54. The method according to claim 53, which comprises the following steps of:

(a) providing a plurality of different nucleotides, wherein at least one nucleotide is the nucleotide analogue according to any one of claims 48 to 49, optionally, the rest of nucleotides are the nucleotide analogue according to any one of claims 39 to 49;

(b) incorporating the plurality of different nucleotides into a sequence complementary to a target single-stranded polynucleotide, wherein the plurality of different nucleotides can be distinguished from each other during the detection;

(c) detecting the nucleotides in step (b) to determine the types of nucleotides incorporated;

(d) removing the reversible blocking groups and optional detectable labels carried by the nucleotides in step (b); and

(e) optionally repeating steps (a)-(d) one or more times;

whereby the sequence of the target single-stranded polynucleotide is determined.

55. The method according to claim 53, which comprises the following steps of:

(1) providing a first nucleotide, a second nucleotide, a third nucleotide and a fourth nucleotide, wherein at least one of the four nucleotides is the nucleotide analogue according to any one of claims 48 to 49, optionally, the rest of nucleotides are the nucleotide analogue according to any one of claims 39 to 49;

(2) contacting the four nucleotides with a target single-stranded polynucleotide; removing the nucleotides not incorporated into the growing nucleic acid strand; detecting the nucleotides incorporated into the growing nucleic acid strand; removing the reversible blocking groups and optional detectable labels carried in the nucleotides that are incorporated into the growing nucleic acid strand;

optionally, it also includes (3): repeating the steps (1)-(2) one or more times.

56. The method according to claim 53, which comprises the following steps of:

(a) providing a mixture comprising a duplex, nucleotides comprising at least one nucleotide analogue according to any one of claims 48 to 49, a polymerase, and an excision reagent; wherein the duplex comprises a

growing nucleic acid strand and a nucleic acid strand to be sequenced;

(b) carrying out a reaction comprising the following steps (i), (ii) and (iii), optionally, repeating the steps for one or more times:

step (i): incorporating the nucleotide analogue into the growing nucleic acid strand by using a polymerase to form a nucleic acid intermediate containing the reversible blocking group and optional detectable label;

step (ii): detecting the nucleic acid intermediate;

step (iii): removing the reversible blocking group and optional detectable label contained in the nucleic acid intermediate by using the excision reagent;

preferably, removal of the reversible blocking group and removal of the detectable label are performed simultaneously, or, removal of the reversible blocking group and removal of the detectable label are performed sequentially (for example, the reversible blocking group is removed first, or the detectable label is removed first);

preferably, the excision reagent used for removal of the reversible blocking group is the same as that used for removal of the detectable label;

preferably, the excision reagent used for removal of the reversible blocking group is different from that used for removal of the detectable label.

57. The method according to claim 56, wherein the duplex is linked to a support;

preferably, the growing nucleic acid strand is a primer;

preferably, the primer is annealed to the nucleic acid strand to be sequenced to form the duplex;

preferably, the duplex, the nucleotide analogue, and the polymerase together form a reaction system containing a solution phase and a solid phase;

preferably, the nucleotide analogue is incorporated into the growing nucleic acid strand by using a polymerase under conditions where the polymerase is allowed to carry out a nucleotide polymerization reaction, thereby forming a nucleic acid intermediate containing the reversible blocking group and optional detectable label;

preferably, the polymerase is selected from KOD polymerase or a mutant thereof (e.g., KOD POL151, KOD POL157, KOD POL171, KOD POL174, KOD POL376, KOD POL391);

preferably, before any step of detecting the nucleic acid intermediate, the solution phase of the reaction system in the previous step is removed, and the duplex linked to the support is retained;

preferably, the excision reagent is in contact with the duplex or the growing nucleic acid strand in the reaction system containing a solution phase and a solid phase;

preferably, the excision reagent can remove the reversible blocking group and optional detectable label carried by the nucleotide analogue that is incorporated into the growing nucleic acid strand, without affecting the phosphodiester bond on the backbone of the duplex;

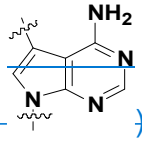
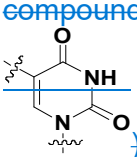
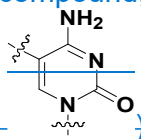
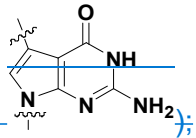
preferably, after any step of removing the reversible blocking group and optional detectable label contained in the nucleic acid intermediate, the solution phase of the reaction system in this step is removed;

preferably, a washing operation is performed after any step comprising a removal operation;

preferably, after step (ii), the method further comprises: determining the type of the nucleotide analogue incorporated into the growing nucleic acid strand in step (i) according to the signal detected in step (ii), and determining the type of nucleotide at a corresponding position in the nucleic acid strand to be sequenced based on the principle of base complementary pairing.

58. A kit, which comprises at least one nucleotide analogue according to any one of claims 39 to 49;

preferably, the kit comprises a first compound, a second compound, a third compound and a fourth compound, wherein the first, second, third and fourth compounds each are, independently, the nucleotide analogue according to any one of claims 39 to 49;

preferably, in the first compound, base[1] is selected from adenine, 7-deazaadenine or a tautomer thereof (e.g., ); in the second compound, base[1] is selected from thymine, uracil or a tautomer thereof (e.g., ); in the third compound, base[1] is selected from cytosine or a tautomer thereof (e.g., ); in the fourth compound, base[1] is selected from guanine, 7-deazaguanine or a tautomer thereof (e.g., );

preferably, wherein the base[1] contained in the first, second, third and fourth compounds are different from each other;

preferably, wherein the additional detectable labels carried by the first, second, third and fourth compounds are different from each other.

59. The kit according to claim 58, wherein the kit further comprises a reagent for pretreating the nucleic acid molecule; a support for linking nucleic acid molecule to be sequenced; a reagent for linking (for example, covalently or non-covalently linking) the nucleic acid molecule to be sequenced to the support; primers for initiating a nucleotide polymerization reaction; a polymerase for carrying out the nucleotide polymerization reaction; one or more buffer solutions; one or more washing solutions; or any combination thereof.

60. Use of the nucleotide analogue according to any one of claims 39 to 49 or the kit according to any one of claims 58 to 59 for determining the sequence of a target single-stranded polynucleotide.