CLAIMS

WHAT IS CLAIMED IS:

1. An engineered host cell comprising:

   a. a first nucleic acid molecule comprising an unnatural nucleotide; ~~and~~

   b. a second nucleic acid molecule comprising~~encoding~~:

      (i) a deletion of a gene encoding a ~~modified~~ transposition-associated protein or transposable element, optionally wherein the deletion is an N-terminal deletion, a C-terminal deletion, a truncation at both termini, an internal deletion, and/or a deletion of the entire gene; or

      ~~(i)~~(ii) a gene encoding a mutated transposition-associated protein or transposable element, wherein the ~~modified~~ mutated transposition-associated protein or transposable element is not expressed, or is expressed at reduced levels; and~~.~~

~~2. The engineered host cell of claim 1, further comprising:~~

   c. a third nucleic acid molecule encoding a ~~modified~~ nucleoside triphosphate transporter that imports unnatural nucleic acids into the cell, wherein the third nucleic acid molecule is incorporated in a genomic sequence of the engineered host cell, or comprises a plasmid encoding the ~~modified~~ nucleoside triphosphate transporter.

~~3.~~2. The engineered host cell of claim ~~2~~1, wherein the ~~modified~~ nucleoside triphosphate transporter exhibits increased stability of expression in the engineered host cell as compared to an expression in an equivalent engineered host cell that does not comprise the second nucleic acid molecule ~~encoding the modified transposition-associated protein or transposable element~~.

~~4.~~3. The engineered host cell of claim ~~2~~1, wherein the ~~modified~~ nucleoside triphosphate transporter comprises an N-terminal truncation, a C-terminal truncation, or a truncation of both termini.

~~5.~~4. The engineered host cell of claim ~~2~~1, wherein the ~~modified~~ nucleoside triphosphate transporter comprises a nucleoside triphosphate transporter from *Phaeodactylum tricornutum.*

~~6.~~5. The engineered host cell of claim ~~2~~1, wherein the ~~modified~~ nucleoside triphosphate transporter comprises *Pt*NTT2.

~~7.~~6. The engineered host cell of claim ~~5~~ 4 or ~~6~~5, wherein the nucleoside triphosphate transporter from *Phaeodactylum tricornutum* or *Pt*NTT2 is under the control of a promoter selected from a pSC plasmid or a promoter from a lac operon.

~~8.~~7. The engineered host cell of claim ~~2~~1, further comprising:

a. a Cas9 polypeptide or a variant thereof; and

b. a single guide RNA (sgRNA) comprising a crRNA-tracrRNA scaffold, wherein the combination of the Cas9 polypeptide or the variant thereof and the sgRNA modulates replication of the first nucleic acid molecule comprising the unnatural nucleotide.

~~9.~~8. The engineered host cell of claim 1, wherein the ~~second nucleic acid molecule comprises a~~ gene ~~comprising~~encoding a transposition-associated protein comprises ~~*catalase* (*cat*), IS1 protein~~ *insB-4* ~~(*insB-4*),~~ and/or ~~IS1 protein~~ *insA-4* ~~(*insA-4*), or a combination thereof~~, or the gene encoding a mutated transposition-associated protein comprises a mutated *insB-4* gene and/or a mutated *insA-4* gene.

~~10.~~9. The engineered host cell of claim 1, wherein the ~~modified transposition-associated protein comprises Insertion element IS1 4 protein InsB, Insertion element IS1 4 protein InsA, or a combination thereof; and wherein the modified transposable element comprises IS*1*~~second nucleic acid molecule comprises a deletion of a gene encoding a transposable element, wherein the transposable element comprises IS*1*.

~~11.~~10. The engineered host cell of claim ~~9~~1, wherein the ~~gene comprises one or more deletions~~second nucleic acid molecule comprises a deletion of a gene encoding a transposition-associated protein, and further wherein the ~~one or more~~ deletion~~s~~ comprise~~s~~ an N-terminal deletion, a C-terminal deletion, a truncation at both termini, an internal deletion, and/or a deletion of the entire gene.

~~12.~~11. The engineered host cell of claim ~~2~~1, further comprising a fourth nucleic acid

molecule encoding a modified DNA repair response-associated protein, wherein the DNA repair response comprises recombinational repair, SOS response, nucleotide excision repair, or methyl-directed mismatch repair, or a combination thereof.

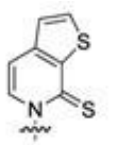
~~13.~~12. The engineered host cell of claim ~~12~~11, wherein the modified DNA repair response-associated protein comprises RecA, RadA, or LexA, or a combination thereof.

~~14.~~13. The engineered host cell of claim 1, wherein the engineered host cell is a prokaryotic cell comprising an *Escherichia coli* cell or an *Escherichia coli* BL21 (DE3) cell.

~~15.~~14. The engineered host cell of claim 1, wherein the unnatural nucleotide comprises an unnatural base selected from the group consisting of 2-aminoadenin-9-yl, 2-aminoadenine, 2-F-adenine, 2-thiouracil, 2-thio-thymine, 2-thiocytosine, 2-propyl and alkyl derivatives of adenine and guanine, 2-amino-adenine, 2-amino-propyl-adenine, 2-aminopyridine, 2-pyridone, 2'-deoxyuridine, 2-amino-2'-deoxyadenosine 3-deazaguanine, 3-deazaadenine, 4-thio-uracil, 4-thio-thymine, uracil-5-yl, hypoxanthin-9-yl (I), 5-methyl-cytosine, 5-hydroxymethyl cytosine, xanthine, hypoxanthine, 5-bromo, and 5-trifiuoromethyl uracils and cytosines; 5-halouracil, 5-halocytosine, 5-propynyl-uracil, 5-propynyl cytosine, 5-uracil, 5-substituted, 5-halo, 5-substituted pyrimidines, 5-hydroxycytosine, 5-bromocytosine, 5-bromouracil, 5-chlorocytosine, chlorinated cytosine, cyclocytosine, cytosine arabinoside, 5-fluorocytosine, fluoropyrimidine, fluorouracil, 5,6-dihydrocytosine, 5-iodocytosine, hydroxyurea, iodouracil, 5-nitrocytosine, 5- bromouracil, 5-chlorouracil, 5- fluorouracil, and 5-iodouracil, 6-alkyl derivatives of adenine and guanine, 6-azapyrimidines, 6-azo-uracil, 6-azo cytosine, azacytosine, 6-azo-thymine, 6-thio-guanine, 7-methylguanine, 7-methyladenine, 7-deazaguanine, 7-deazaguanosine, 7-deaza-adenine, 7-deaza-8-azaguanine, 8-azaguanine, 8-azaadenine, 8-halo, 8-amino, 8-thiol, 8-thioalkyl, and 8-hydroxyl substituted adenines and guanines; N4-ethylcytosine, N-2 substituted purines, N-6 substituted purines, O-6 substituted purines, those that increase the stability of duplex formation, universal nucleic acids, hydrophobic nucleic acids, promiscuous nucleic acids, size-expanded nucleic acids, fluorinated nucleic acids, tricyclic pyrimidines, phenoxazine cytidine([5,4-b][l,4]benzoxazin-2(3H)-one), phenothiazine cytidine (1H- pyrimido[5,4-b][l,4]benzothiazin-2(3H)-one), G-clamps, phenoxazine cytidine (9-(2-aminoethoxy)-H-pyrimido[5,4-b][l,4]benzoxazin-2(3H)-one), carbazole cytidine (2H-pyrimido[4,5- b]indol-2-one), pyridoindole cytidine (H-pyrido [3',2':4,5]pyrrolo [2,3-d]pyrimidin-2-one), 5-fluorouracil, 5-bromouracil, 5-chlorouracil, 5-

iodouracil, hypoxanthine, xanthine, 4-acetylcytosine, 5-(carboxyhydroxylmethyl) uracil, 5-carboxymethylaminomethyl-2-thiouridine, 5-carboxymethylaminomethyluracil, dihydrouracil, beta-D-galactosylqueosine, inosine, N6-isopentenyladenine, 1-methylguanine, 1-methylinosine, 2,2-dimethylguanine, 2-methyladenine, 2-methylguanine, 3-methylcytosine, 5-methylcytosine, N6-adenine, 7-methylguanine, 5-methylaminomethyluracil, 5-methoxyaminomethyl-2-thiouracil, beta-D-mannosylqueosine, 5'-methoxycarboxymethyluracil, 5-methoxyuracil, 2-methythio-N6-isopentenyladenine, uracil-5oxyacetic acid, wybutoxosine, pseudouracil, queosine, 2-thiocytosine, 5-methyl-2-thiouracil, 2-thiouracil, 4-thiouracil, 5-methyluracil, uracil-5-oxacetic acid methylester, uracil-5-oxacetic acid, 5-methyl-2-thiouracil, 3-(3-amino-3-N-2-carboxypropyl) uracil, (acp3)w, and 2,6-diaminopurine and those in which the purine or pyrimidine base is replaced with a heterocycle.

~~16.~~15. The engineered host cell of claim 1, wherein the unnatural nucleotide comprises an unnatural base ~~is~~ selected from the group consisting of:



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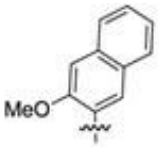
dFTPT3 ,


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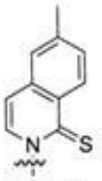

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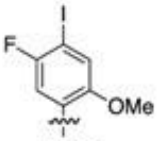
dFEMO ,


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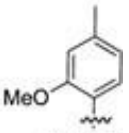

dMMO2

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~~17.~~16. The engineered host cell of claim 1, wherein the unnatural nucleotide further comprises ~~an unnatural~~a modified sugar moiety.

~~18.~~17. The engineered host cell of claim ~~17~~16, wherein the ~~unnatural~~ modified sugar moiety is selected from the group consisting of:

(a) a modification at the 2' position comprising:

(i) OH;

(ii) substituted lower alkyl, alkaryl, aralkyl, O-alkaryl, O-aralkyl, SH, SCH_3, OCN, Cl, Br, CN, CF_3, OCF_3, $SOCH_3$, SO_2CH_3, ONO_2, NO_2, N_3, or NH_2F;

(iii) O-alkyl, S-alkyl, or N-alkyl;

(iv) O-alkenyl, S- alkenyl, or N-alkenyl;

(v) O-alkynyl, S-alkynyl, or N-alkynyl; or

(vi) O-alkyl-O-alkyl, 2'-F, 2'-OCH_3, or 2'-$O(CH_2)_2OCH_3$

wherein the alkyl, alkenyl and alkynyl may be substituted or unsubstituted C_1-C_{10}, alkyl, C_2-C_{10} alkenyl, C_2-C_{10} alkynyl, -O[(CH2)n O]mCH_3, -$O(CH_2)$nOCH_3, -$O(CH_2)$n NH_2, -$O(CH_2)$n CH_3, -$O(CH_2)$n -ONH_2, and -$O(CH_2)$n$ON[(CH_2)$n $CH_3)]_2$, and wherein n and m are from 1 to about 10;

(b) a modification at the 5' position comprising 5'-vinyl, or 5'-methyl (R or S);

(c) a modification at the 4' position comprising 4'-S, heterocycloalkyl, heterocycloalkaryl, aminoalkylamino, polyalkylamino, substituted silyl, an RNA cleaving group, a reporter group, an intercalator, a group for improving the pharmacokinetic properties of an oligonucleotide, or a group for improving the pharmacodynamic properties of an oligonucleotide; and

(d) any combination of (a) to (c).

~~19.~~18. A method of increasing the production of a first nucleic acid molecule comprising an unnatural nucleotide, comprising:

a) incubating an engineered host cell with a plurality of unnatural nucleotides, wherein the engineered host cell comprises a ~~modified~~ nucleoside triphosphate transporter that imports unnatural nucleic acids into the cell and ~~optionally,~~ a ~~modified~~ second nucleic acid molecule comprising: (i) a deletion of a gene encoding a transposition-associated protein or transposable element, optionally wherein the deletion is an N-terminal deletion, a C-terminal deletion, a truncation at both termini, an internal deletion, and/or a deletion of the entire gene; or (ii) a gene encoding a mutated transposition-associated protein or transposable element, wherein the mutated transposition-associated protein or transposable element is not expressed, or is expressed at reduced levels; and

b) incorporating the plurality of unnatural nucleotides into ~~one or more newly-synthesized DNA strands~~the newly-synthesized first nucleic acid molecule~~, thereby generating the unnatural nucleic acid molecule~~;

wherein the ~~modified transposition-associated protein or transposable element~~ second nucleic acid molecule and the ~~modified~~ nucleoside triphosphate transporter increases retention of unnatural base pairs comprising the unnatural nucleotides in the ~~one or more newly synthesized DNA strands~~first nucleic acid molecule.

~~20.~~19. The method of claim ~~19~~18, wherein the ~~modified~~ gene encoding a transposition-associated protein comprises ~~comprises Insertion element IS1 4 protein InsB~~*insB-4* and/or ~~, Insertion element IS1 4 protein InsA~~*insA-4*~~, or a combination thereof; and wherein the modified transposable element comprises IS~~*1*.

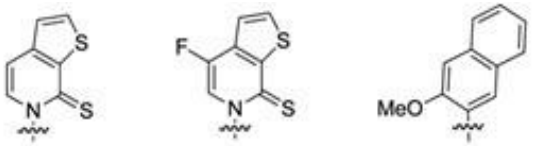
20. The method of claim 18, wherein the second nucleic acid molecule comprises a deletion of a gene encoding a transposable element, wherein the transposable element comprises IS*1*.

21. The method of claim ~~19~~18, wherein the ~~modified~~ nucleoside triphosphate transporter comprises a codon optimized nucleoside triphosphate transporter from *Phaeodactylum tricornutum* (*Pt*NTT_2).

22. The method of claim ~~19~~18, wherein the unnatural nucleotide comprises an unnatural base selected from the group consisting of 2-aminoadenin-9-yl, 2-aminoadenine, 2-F-adenine, 2- thiouracil, 2-thio-thymine, 2-thiocytosine, 2-propyl and alkyl derivatives of adenine and guanine, 2-amino-adenine, 2-amino-propyl-adenine, 2-aminopyridine, 2-pyridone, 2'-deoxyuridine, 2-amino-2'-deoxyadenosine 3-deazaguanine, 3-deazaadenine, 4-thio-uracil, 4-thio-thymine, uracil-5-yl, hypoxanthin-9-yl (I), 5-methyl-cytosine, 5-hydroxymethyl cytosine, xanthine, hypoxanthine, 5-bromo, and 5-trifiuoromethyl uracils and cytosines; 5-halouracil, 5-halocytosine, 5-propynyl-uracil, 5-propynyl cytosine, 5-uracil, 5-substituted, 5-halo, 5-substituted pyrimidines, 5-hydroxycytosine, 5-bromocytosine, 5-bromouracil, 5-chlorocytosine, chlorinated cytosine, cyclocytosine, cytosine arabinoside, 5-fluorocytosine, fluoropyrimidine, fluorouracil, 5,6-dihydrocytosine, 5-iodocytosine, hydroxyurea, iodouracil, 5-nitrocytosine, 5- bromouracil, 5-chlorouracil, 5- fluorouracil, and 5-iodouracil, 6-alkyl derivatives of adenine and guanine, 6-azapyrimidines, 6-azo-uracil, 6-azo cytosine, azacytosine, 6-azo-thymine, 6-thio-guanine, 7-methylguanine, 7-methyladenine, 7-deazaguanine, 7-deazaguanosine, 7-deaza-adenine, 7-deaza-8-azaguanine, 8-azaguanine, 8-azaadenine, 8-halo, 8-amino, 8-thiol, 8-thioalkyl, and 8-hydroxyl substituted adenines and guanines; N4-ethylcytosine, N-2 substituted purines, N-6 substituted purines, O-6 substituted purines, those that increase the stability of duplex formation, universal nucleic acids, hydrophobic nucleic acids, promiscuous nucleic acids, size-expanded nucleic acids, fluorinated nucleic acids, tricyclic pyrimidines, phenoxazine cytidine([5,4-b][l,4]benzoxazin-2(3H)-one),

phenothiazine cytidine (1H- pyrimido[5,4-b][l,4]benzothiazin-2(3H)-one), G-clamps, phenoxazine cytidine (9-(2-aminoethoxy)-H-pyrimido[5,4-b][l,4]benzoxazin-2(3H)-one), carbazole cytidine (2H-pyrimido[4,5- b]indol-2-one), pyridoindole cytidine (H-pyrido [3',2':4,5]pyrrolo [2,3-d]pyrimidin-2-one), 5-fluorouracil, 5-bromouracil, 5-chlorouracil, 5-iodouracil, hypoxanthine, xanthine, 4-acetylcytosine, 5-(carboxyhydroxylmethyl) uracil, 5-carboxymethylaminomethyl-2-thiouridine, 5-carboxymethylaminomethyluracil, dihydrouracil, beta-D-galactosylqueosine, inosine, N6-isopentenyladenine, 1-methylguanine, 1-methylinosine, 2,2-dimethylguanine, 2-methyladenine, 2-methylguanine, 3-methylcytosine, 5-methylcytosine, N6-adenine, 7-methylguanine, 5-methylaminomethyluracil, 5-methoxyaminomethyl-2-thiouracil, beta-D-mannosylqueosine, 5'-methoxycarboxymethyluracil, 5-methoxyuracil, 2-methythio-N6-isopentenyladenine, uracil-5oxyacetic acid, wybutoxosine, pseudouracil, queosine, 2-thiocytosine, 5-methyl-2-thiouracil, 2-thiouracil, 4-thiouracil, 5-methyluracil, uracil-5-oxacetic acid methylester, uracil-5-oxacetic acid, 5-methyl-2-thiouracil, 3-(3-amino-3-N-2-carboxypropyl) uracil, (acp3)w, and 2,6-diaminopurine and those in which the purine or pyrimidine base is replaced with a heterocycle.

23. The method of claim ~~20~~18, wherein the unnatural nucleotide comprises an unnatural base selected from the group consisting of:



and

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24. The method of claim ~~20~~18, wherein the unnatural nucleotide further comprises ~~an unnatural~~a modified sugar moiety.

25. The method of claim 24, wherein the ~~unnatural~~ modified sugar moiety is selected from the group consisting of:

(a) a modification at the 2' position comprising:

(i) OH;

(ii) substituted lower alkyl, alkaryl, aralkyl, O-alkaryl, O-aralkyl, SH, SCH_3, OCN, Cl, Br, CN, CF_3, OCF_3, $SOCH_3$, $SO_2\,CH_3$, ONO_2, NO_2, N_3, or NH_2F;

(iii) O-alkyl, S-alkyl, or N-alkyl;

(iv) O-alkenyl, S- alkenyl, or N-alkenyl;

(v) O-alkynyl, S-alkynyl, or N-alkynyl; or

(vi) O-alkyl-O-alkyl, 2'-F, 2'-OCH_3, or 2'-$O(CH_2)_2OCH_3$

wherein the alkyl, alkenyl and alkynyl may be substituted or unsubstituted C_1-C_{10}, alkyl, C_2-C_{10} alkenyl, C_2-C_{10} alkynyl, -O[(CH2)n O]mCH_3, -$O(CH_2)$nOCH_3, -$O(CH_2)$n NH_2, -$O(CH_2)$n CH_3, -$O(CH_2)$n -ONH_2, and -$O(CH_2)$n$ON[(CH_2)$n $CH_3)]_2$, and wherein n and m are from 1 to about 10;

(b) a modification at the 5' position comprising 5'-vinyl, or 5'-methyl (R or S);

(c) a modification at the 4' position comprising 4'-S, heterocycloalkyl, heterocycloalkaryl, aminoalkylamino, polyalkylamino, substituted silyl, an RNA cleaving group, a reporter group, an intercalator, a group for improving the pharmacokinetic properties of an oligonucleotide, or a group for improving the pharmacodynamic properties of an oligonucleotide; and

(d) any combination of (a) to (c).

26. A method of preparing a modified polypeptide comprising an unnatural amino acid that is encoded by a first nucleic acid molecule comprising an unnatural nucleotide, comprising:

a) incubating an engineered host cell with a plurality of unnatural nucleotides, wherein the engineered host cell comprises a ~~modified~~ nucleoside triphosphate transporter that imports unnatural nucleic acids into the cell and~~, optionally,~~ a ~~modified~~ second nucleic acid molecule comprising: (i) a deletion of a gene encoding a transposition-associated protein or transposable element, optionally wherein the deletion is an N-terminal deletion, a C-terminal deletion, a truncation at both termini, an internal deletion, and/or a deletion of the entire gene; or (ii) a gene encoding a mutated transposition-associated protein or transposable element, wherein the mutated transposition-associated protein or transposable element is not expressed, or is expressed at reduced levels; and

b) incorporating the plurality of unnatural nucleotides into ~~one or more newly~~

synthesized DNA strands,the newly-synthesized first nucleic acid molecule thereby generating an unnatural nucleic acid molecule;

wherein the modified transposition-associated protein or transposable elementsecond nucleic acid molecule and the modified nucleoside triphosphate transporter increases retention of unnatural base pairs comprising the unnatural nucleotides in the first nucleic acid molecule which facilitates incorporation of the plurality of unnatural nucleotides into a newly synthesized polypeptide to generate the modified polypeptide.

27. The method of claim 26, wherein the gene encoding amodified transposition-associated protein comprises comprises Insertion element IS1 4 protein InsB*insB-4*, and/or Insertion element IS1 4 protein InsA*insA-4*, or the gene encoding a mutated transposition-associated protein comprises a mutated *insB-4* gene and/or a mutated *insA-4* gene or a combination thereof; or wherein the modified transposable element comprises IS*1*.

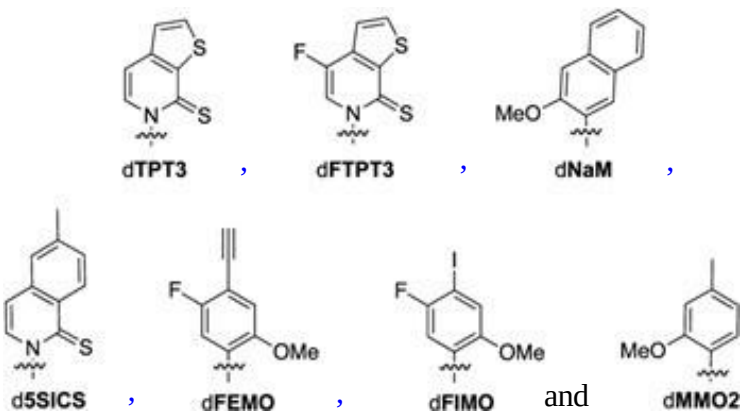
28. The method of claim 26, wherein the second nucleic acid molecule comprises a deletion of a gene encoding a transposable element, wherein the transposable element comprises IS*1*.

28.29. The method of claim 26, wherein the modified nucleoside triphosphate transporter comprises a codon optimized nucleoside triphosphate transporter from *Phaeodactylum tricornutum* (*Pt*NTT2).

29.30. The method of claim 26, wherein the unnatural nucleotide comprises an unnatural base selected from the group consisting of 2-aminoadenin-9-yl, 2-aminoadenine, 2-F-adenine, 2-thiouracil, 2-thio-thymine, 2-thiocytosine, 2-propyl and alkyl derivatives of adenine and guanine, 2-amino-adenine, 2-amino-propyl-adenine, 2-aminopyridine, 2-pyridone, 2'-deoxyuridine, 2-amino-2'-deoxyadenosine 3-deazaguanine, 3-deazaadenine, 4-thio-uracil, 4-thio-thymine, uracil-5-yl, hypoxanthin-9-yl (I), 5-methyl-cytosine, 5-hydroxymethyl cytosine, xanthine, hypoxanthine, 5-bromo, and 5-trifiuoromethyl uracils and cytosines; 5-halouracil, 5-halocytosine, 5-propynyl-uracil, 5-propynyl cytosine, 5-uracil, 5-substituted, 5-halo, 5-substituted pyrimidines, 5-hydroxycytosine, 5-bromocytosine, 5-bromouracil, 5-chlorocytosine, chlorinated cytosine, cyclocytosine, cytosine arabinoside, 5-fluorocytosine, fluoropyrimidine, fluorouracil, 5,6-dihydrocytosine, 5-iodocytosine, hydroxyurea, iodouracil, 5-nitrocytosine, 5- bromouracil, 5-chlorouracil, 5- fluorouracil, and 5-iodouracil, 6-alkyl

derivatives of adenine and guanine, 6-azapyrimidines, 6-azo-uracil, 6-azo cytosine, azacytosine, 6-azo-thymine, 6-thio-guanine, 7-methylguanine, 7-methyladenine, 7-deazaguanine, 7-deazaguanosine, 7-deaza-adenine, 7-deaza-8-azaguanine, 8-azaguanine, 8-azaadenine, 8-halo, 8-amino, 8-thiol, 8-thioalkyl, and 8-hydroxyl substituted adenines and guanines; N4-ethylcytosine, N-2 substituted purines, N-6 substituted purines, O-6 substituted purines, those that increase the stability of duplex formation, universal nucleic acids, hydrophobic nucleic acids, promiscuous nucleic acids, size-expanded nucleic acids, fluorinated nucleic acids, tricyclic pyrimidines, phenoxazine cytidine([5,4-b][l,4]benzoxazin-2(3H)-one), phenothiazine cytidine (1H- pyrimido[5,4-b][l,4]benzothiazin-2(3H)-one), G-clamps, phenoxazine cytidine (9-(2-aminoethoxy)-H-pyrimido[5,4-b][l,4]benzoxazin-2(3H)-one), carbazole cytidine (2H-pyrimido[4,5- b]indol-2-one), pyridoindole cytidine (H-pyrido [3',2':4,5]pyrrolo [2,3-d]pyrimidin-2-one), 5-fluorouracil, 5-bromouracil, 5-chlorouracil, 5-iodouracil, hypoxanthine, xanthine, 4-acetylcytosine, 5-(carboxyhydroxylmethyl) uracil, 5-carboxymethylaminomethyl-2-thiouridine, 5-carboxymethylaminomethyluracil, dihydrouracil, beta-D-galactosylqueosine, inosine, N6-isopentenyladenine, 1-methylguanine, 1-methylinosine, 2,2-dimethylguanine, 2-methyladenine, 2-methylguanine, 3-methylcytosine, 5-methylcytosine, N6-adenine, 7-methylguanine, 5-methylaminomethyluracil, 5-methoxyaminomethyl-2-thiouracil, beta-D-mannosylqueosine, 5'-methoxycarboxymethyluracil, 5-methoxyuracil, 2-methythio-N6-isopentenyladenine, uracil-5oxyacetic acid, wybutoxosine, pseudouracil, queosine, 2-thiocytosine, 5-methyl-2-thiouracil, 2-thiouracil, 4-thiouracil, 5-methyluracil, uracil-5-oxacetic acid methylester, uracil-5-oxacetic acid, 5-methyl-2-thiouracil, 3-(3-amino-3-N-2-carboxypropyl) uracil, (acp3)w, and 2,6-diaminopurine and those in which the purine or pyrimidine base is replaced with a heterocycle.

~~30.~~31. The method of claim 26, wherein the unnatural nucleotide comprises an unnatural base selected from the group consisting of:



and

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~~31.~~32. The method of claim 26, wherein the unnatural nucleotide further comprises ~~an unnatural~~a modified sugar moiety selected from the group consisting of:

(a) a modification at the 2’ position comprising:

(i) OH;

(ii) substituted lower alkyl, alkaryl, aralkyl, O-alkaryl, O-aralkyl, SH, SCH_3, OCN, Cl, Br, CN, CF_3, OCF_3, $SOCH_3$, $SO_2\,CH_3$, ONO_2, NO_2, N_3, or NH_2F;

(iii) O-alkyl, S-alkyl, or N-alkyl

(iv) O-alkenyl, S- alkenyl, or N-alkenyl;

(v) O-alkynyl, S-alkynyl, or N-alkynyl; or

(vi) O-alkyl-O-alkyl, 2’-F, 2’-OCH_3, or 2’-$O(CH_2)_2OCH_3$

wherein the alkyl, alkenyl and alkynyl may be substituted or unsubstituted C_1-C_{10}, alkyl, C_2-C_{10} alkenyl, C_2-C_{10} alkynyl, -O[(CH2)n O]mCH_3, -$O(CH_2)$nOCH_3, -$O(CH_2)$n NH_2, -$O(CH_2)$n CH_3, -$O(CH_2)$n -ONH_2, and -$O(CH_2)$n$ON[(CH_2)$n $CH_3)]_2$, and wherein n and m are from 1 to about 10;

(b) a modification at the 5’ position comprising 5’-vinyl, or 5’-methyl (R or S);

(c) a modification at the 4’ position comprising 4’-S, heterocycloalkyl, heterocycloalkaryl, aminoalkylamino, polyalkylamino, substituted silyl, an RNA cleaving group, a reporter group, an intercalator, a group for improving the pharmacokinetic properties of an oligonucleotide, or a group for improving the pharmacodynamic properties of an oligonucleotide; and

(d) any combination of (a) to (c).

~~32. The engineered host cell of claim 1, comprising one or more deletions in a gene encoding the modified transposition-associated protein or transposable element, wherein the one or more deletions comprise an N-terminal deletion, a C-terminal deletion, a truncation at both termini, an internal deletion, and/or a deletion of the entire gene.~~

~~33. The engineered host cell of claim 2, wherein the transposable element or transposition-associated protein comprises IS*1*.~~

~~34.~~33. The engineered host cell of claim ~~12~~11, wherein the fourth nucleic acid molecule encoding a modified DNA repair response-associated protein comprises an N-terminal deletion, a C-terminal deletion, a truncation at both termini, an internal deletion, and/or a

deletion of the entire gene.

~~35.~~34. The engineered host cell of claim ~~12~~11, wherein the engineered host cell exhibits improved retention of the nucleic acid molecule comprising the unnatural nucleotide during DNA replication as compared to a nucleic acid molecule comprising the unnatural nucleotide in an equivalent engineered host cell that does not comprise the fourth nucleic acid molecule encoding the modified DNA repair response-associated protein.

~~36.~~35. The method of claim ~~19~~18, wherein the nucleoside triphosphate transporter exhibits increased stability of expression in the engineered host cell relative to expression in an equivalent engineered host cell that does not comprise the second nucleic acid molecule ~~encoding the modified transposition-associated protein or transposable element~~.