What is claimed is:

1. A method of synthesizing a product DNA molecule having a desired sequence comprising:

annealing at least one long oligonucleotide and at least one short oligonucleotide to at least one anchor strand(s) having a sequence at least partially complementary to the at least one long and at least one short oligonucleotide,

wherein after annealing, at least one long oligonucleotide bound to an anchor strand abuts at least one short oligonucleotide bound to the same anchor strand, and

wherein the at least one anchor strand comprises one or more non-standard nucleotides, and optionally one or more degenerate nucleotides;

ligating the abutting at least one long oligonucleotide and at least one short oligonucleotide to form a dsDNA molecule comprising non-standard nucleotides;

contacting the dsDNA molecule with one or more enzymes that degrade DNA comprising one or more non-standard nucleotides to thereby synthesize the product DNA molecule.

2. The method of claim 1 wherein the annealing occurs within a binding set comprising two long oligonucleotides, two short oligonucleotides, and two anchor strands, and further comprising ligating the two short oligonucleotides to the two long oligonucleotides, wherein the long and short oligonucleotides further comprise variable nucleotides.

3. The method of claim 1 wherein the annealing occurs within a binding set comprising two long oligonucleotides, one short oligonucleotide, and at least one anchor strand, and wherein the short oligonucleotide is ligated to two long oligonucleotides, and the short oligonucleotide and two long oligonucleotides comprise variable nucleotides.

4. The method of any one of claims 1-3 wherein (i) the non-standard nucleotide is deoxy-uridine.

~~5.~~ ~~The method of any one of claims 1-4 wherein~~ ; and/or (ii) the dsDNA molecule comprises the non-standard nucleotides on only one strand.

~~6.~~5.The method of any one of claims 1-~~5~~ 4 further comprising amplifying the product DNA molecule using a DNA amplification method.

~~7.~~6.The method of claim ~~6~~ 5 wherein the amplifying is performed by the polymerase chain reaction (PCR) or wherein the amplifying comprises performing multiple cycles of PCR on the product DNA molecule.

~~8.~~7.The method of any one of claims 1-~~7~~ 6 (i) wherein the product DNA molecule comprises flanking sequences for annealing a primer used in the multiple cycles of PCR~~.~~

; optionally wherein the product DNA molecule encodes a guide RNA, and the flanking sequences encode one or more transcriptional elements, and the guide RNA optionally encodes a Cas9-binding hairpin; optionally wherein the transcriptional elements comprise a promoter and a terminator; (ii)

~~9. The method of any one of claims 1-8~~ wherein the product DNA molecule is 8-30 nucleotides in length~~.~~

~~10. The method of any one of claims 1-9~~ ; (iii) wherein the ligation is performed by a DNA ligase~~.~~

~~11. The method of any one of claims 1-10~~ ; (iv) wherein the at least one long oligonucleotide is from 12-24 nucleotides in length, and the at least one short oligonucleotide is from 4-8 nucleotides in length~~.~~

~~12. The method of any one of claims 1-10 wherein the at least one long oligonucleotide is from 12-24 nucleotides in length, and the at least one short oligonucleotide is from 4-8 nucleotides in length, and~~ ; optionally wherein the at least one anchor strand is from 20-60 nucleotides in length~~.~~

~~13. The method of any one of claims 1-12~~ ; (v) further comprising ligating in solution two DNA molecules having double-stranded ends by blunt end ligation and according to the desired sequence~~.~~

; (vi) wherein the one or more enzymes that degrade DNA comprising non-standard nucleotides comprise one or more enzymes selected from the group consisting of: uracil DNA glycosylase, Endonuclease VIII, and Exonuclease T; and/or (vii) wherein each anchor strand comprises 4-6 variable and/or 4-6 degenerate nucleotides comprised in a single degenerate region.

~~14.~~8. The method of any one of claims 2 or 4-~~13~~ 7 further comprising that after annealing, a first short oligonucleotide abuts a first long oligonucleotide, and a second short oligonucleotide abuts a second long oligonucleotide, and ligating the first short and long oligonucleotides, and ligating the second short and long oligonucleotides.

~~15.~~9. The method of any one of claims 3-~~13~~ 7 further comprising that after annealing the at least one short oligonucleotide abuts a first long oligonucleotide and a second long oligonucleotide, and ligating the at least one short oligonucleotide to the first and second long oligonucleotides.

~~16. The method of any one of claims 1-15 wherein the one or more enzymes that degrade DNA comprising non-standard nucleotides comprise one or more enzymes selected from the group consisting of: uracil DNA glycosylase, Endonuclease VIII, and Exonuclease T.~~

~~17. The method of any one of claims 1-16 wherein each anchor strand comprises 4-6 variable and/or 4-6 degenerate nucleotides comprised in a single degenerate region.~~

~~18.~~10. The method of claim 3 wherein the anchor strand comprises 4-6 variable and/or 4-6 degenerate nucleotides comprised in a single degenerate region.

~~19.~~11. The method of any one of claims 1-~~18~~ 10 wherein (i) the long and short oligonucleotides each comprise 4-6 variable nucleotides~~.~~

~~20. The method of claim 3 wherein the long and short oligonucleotides each comprise 4-6 variable nucleotides.~~

~~21. The method of any one of claims 1-20 wherein~~ ; (ii) the two long oligonucleotides further comprise variable nucleotides that bind to the degenerate

nucleotides on their respective at least partially complementary anchor strands during the annealing step~~.~~

~~22.~~ ~~The method of any one of claims 1-21 wherein~~ ; (iii) the long oligonucleotides, short oligonucleotides, and anchor strand each comprise 4-6 variable nucleotides~~.~~

~~23.~~ ~~The method of any one of claims 1-22 wherein~~ ; and/or (iv) the product DNA molecule is single-stranded DNA 8-30 nucleotides in length, not including the flanking sequences; or wherein the product DNA molecule is double-stranded DNA 8-30 base pairs in length, not including the flanking sequences~~.~~

~~24.~~ ~~The method of any one of claims 1-22 wherein~~ ; or (v) the product DNA molecule is single-stranded DNA 16-20 oligonucleotide in length; or wherein the product DNA molecule is double-stranded DNA 16-20 base pairs in length~~.~~

~~25.~~ ~~The method of any one of claims 1-24 wherein~~ ; and/or (vi) the long oligonucleotides and short oligonucleotides are provided to the method from an oligonucleotide library~~.~~

~~26.~~ ~~The method of claim 25~~ ; optionally wherein the short oligonucleotides provided from the oligonucleotide library are 3-7 nucleotides in length~~.~~

~~27.~~ ~~The method of claim 26~~ ; optionally wherein the oligonucleotide library comprises long oligonucleotide members having all four possible nucleotides at each position of a variable nucleotide~~.~~

~~28.~~ ~~The method of any one of claims 1-27 wherein~~ ; and/or (vii) the long oligonucleotides comprise a variable region that anneals to the sequence of degenerate nucleotides on the one or more anchor strands.

~~29.~~12. The method of any one of claims 2 or 4-11~~28~~ wherein

a. the short and long oligos comprise 4-6 variable nucleotides;
b. the anchor strands comprise 4-6 degenerate nucleotides;
c. the anchor strands comprise at least two deoxy-uridine monophosphate nucleotides; and

d. the product DNA molecule is amplified by PCR.

~~30.~~13. The method of any one of claims 3-11~~28~~ wherein

a. the short and long oligos comprise 4-6 variable nucleotides;
b. the anchor strand comprises 4-6 degenerate nucleotides;
c. the anchor strand comprises at least two deoxy-uracil monophosphate nucleotides; and
d. the product DNA molecule is amplified by PCR.

~~31.~~14. The method of any one of claims 1-13 (i)~~30~~ wherein the product DNA molecule has an error rate of fewer than 1 in 25,000~~.~~

~~32. The method of any one of claims 1-31~~ ; (ii) wherein the at least one long oligonucleotide, at least one short oligonucleotide, and at least one anchor strand are selected from an oligonucleotide library comprising less than 20,000 members~~.~~

~~33. The method of claim 32~~ ; optionally wherein the oligonucleotide library comprising less than 20,000 members contains oligonucleotides sufficient to synthesize all possible nucleotide sequences~~.~~

~~34. The method of any one of claims 1-33~~ ; (iii) further comprising a step of contacting the product DNA molecule with a Type IIS restriction endonuclease to generate a product DNA molecule having single-stranded overhangs~~.~~

~~35. The method of claim 34~~ ; optionally wherein in the Type IIS restriction endonuclease is selected from BsaI and BsmBI~~.~~

~~36. The method of any one of claims 1-35~~ ; (iv) wherein the product DNA molecule comprises an encoded non-genetic message~~.~~

~~37. The method of any one of claims 1-36~~ ; and/or (v) wherein the product DNA molecule comprises a sequence corresponding to bytes of information.

~~38.~~15. The method of claim ~~7~~ 6 wherein the multiple cycles of PCR comprise a first step of PCR using primers comprising non-standard nucleotides set two nucleotides back from the 3’ end of the primer.

~~39. The method of any one of claims 8-37 wherein the product DNA molecule encodes a guide RNA, and the flanking sequences encode one or more transcriptional elements, and the guide RNA optionally encodes a Cas9-binding hairpin.~~

~~40. The method of claim 39 wherein the transcriptional elements comprise a promoter and a terminator.~~

~~41.~~16. A method of synthesizing a product DNA molecule comprising:

providing a library of oligonucleotides wherein the library of oligonucleotides comprises fewer than 20,000 oligonucleotide members, and wherein the oligonucleotide members in the library can be assembled into all possible polynucleotide sequences;

assembling oligonucleotide members from the library to obtain the product DNA molecule~~.~~

~~42. The method of claim 41~~ ; optionally wherein (i) the library of oligonucleotides is present on a solid phase and the oligonucleotide members are present at defined physical locations within the library of oligonucleotides~~.~~

~~43. The method of claim 42~~ ; optionally wherein the solid phase is a DNA chip~~.~~

~~44. The method of any one of claims 41-43 wherein~~ ; (ii) the product DNA molecule is double-stranded DNA 8-30 base pairs in length~~.~~

~~45. The method of any one of claims 41-44 wherein~~ ; (iii) the product DNA molecule is subjected to continuing methods to ligate the product DNA molecule with at least one additional DNA molecule to produce a larger product DNA molecule~~.~~

~~46. The method of any one of claims 41-45 wherein~~ ; (iv) the library comprises fewer than 16,000 oligonucleotide members~~.~~

~~47. The method of any one of claims 41-46 wherein~~ ; (v) the larger product DNA molecule is at least 1,000 bp in length~~.~~

~~48. The method of any one of claims 41-47 wherein~~ ; (vi) the product DNA molecule has an error rate of fewer than 1 in 10,000~~.~~

~~49.~~ ~~The method of any one of claims 41-48 wherein~~ ; and/or (vii) assembling oligonucleotide members comprises

annealing at least one long oligonucleotide and at least one short oligonucleotide to at least one anchor strand(s) having a sequence at least partially complementary to the at least one long and at least one short oligonucleotide,

wherein after annealing, at least one long oligonucleotide bound to an anchor strand abuts at least one short oligonucleotide bound to the same anchor strand, and

wherein the at least one anchor strand comprises one or more non-standard nucleotides, and optionally one or more degenerate nucleotides;

ligating the abutting at least one long oligonucleotide and at least one short oligonucleotide to form a dsDNA molecule comprising non-standard nucleotides;

contacting the dsDNA molecule with one or more enzymes that degrade DNA comprising one or more non-standard nucleotides to thereby synthesize the product DNA molecule.

~~50.~~17. A kit comprising a library of 20,000 or less oligonucleotide members, wherein the oligonucleotide members in the library can be assembled into every possible polynucleotide sequence~~.~~

~~51.~~ ~~The kit of claim 50~~ ; optionally wherein (i) the oligonucleotide members are isolated at defined locations and spatially separated~~.~~

~~52.~~ ~~The kit of any one of claims 50-51 wherein~~ ; and/or (ii) the library is comprised on a DNA chip.

~~53.~~18. An oligonucleotide library comprising less than 20,000 defined locations and comprising an oligonucleotide library member at each location, wherein the oligonucleotide library members can be assembled into every possible polynucleotide sequence~~.~~

~~54.~~ ~~The oligonucleotide library of any one of claims 50-53~~ ; optionally wherein the polynucleotide sequence is less than 10 Mbp in length.