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 the at least one short oligonucleotide, wherein

(a) the annealing occurs within a binding set comprising at least two long oligonucleotides O1 and O4 of 9-35 nucleotides in length, two short oligonucleotides O2 and O3 of 5-7 nucleotides in length, and at least two anchor strands O5 and O6, wherein after annealing O1 abuts O2, and O3 abuts O4, and O1 and O2 are bound to the same anchor strand O5, and O3 and O4 are bound to the same anchor strand O6, to form a double-stranded DNA molecule; or

(b) the annealing occurs within a binding set comprising at least two long oligonucleotides O1 and O3, one short oligonucleotide O2 of 5-7 nucleotides in length, and at least one anchor strand O4, wherein after annealing O2 abuts O1 and O3, and O1-O3 are bound to the same anchor strand O4 to form a double-stranded DNA molecule; wherein the anchor strand(s) each comprise one or more non-standard nucleotides;

ligating the abutting at least one long oligonucleotide and the 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 form a single-stranded DNA molecule;

performing a step of amplification to produce an amplified double-stranded DNA molecule; and

contacting the amplified double-stranded DNA molecule with a Type II restriction endonuclease to thereby synthesize the product DNA molecule.

2. The method of claim 1 wherein the long and short oligonucleotides further comprise variable nucleotides, and the anchor strand(s) further comprise degenerate oligonucleotides.

3. The method of claim 2 further comprising ligating in solution two DNA molecules having double-stranded ends by blunt end ligation and according to the desired sequence.

4. The method of claim 1 wherein the long oligonucleotides are 9-35 nucleotides in length.

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

6. The method of claim 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.

7. The method of claim 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.

8. The method of any one of claims 1-6 (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) wherein the product DNA molecule is 8-30 nucleotides in length; (iii) wherein the ligation is performed by a DNA ligase; (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; optionally wherein the at least one anchor strand is from 20-60 nucleotides in length; (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 5-7 variable and/or 5-7 degenerate nucleotides comprised in a single degenerate region.

9. The method of any one of claims 1-10 wherein (i) the long and short oligonucleotides each comprise 5-7 variable nucleotides; or (ii) the at least two long oligonucleotides further comprise variable nucleotides that bind to the degenerate nucleotides on their respective at least partially complementary anchor strand(s) during the annealing step; or (iii) the long oligonucleotides, short oligonucleotides, and anchor strand each comprise 5-7 variable nucleotides; 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; 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; or (vi) the long oligonucleotides and short oligonucleotides are provided to the method from an oligonucleotide library; optionally wherein the short oligonucleotides provided from the oligonucleotide library are 5-6 nucleotides in length; optionally wherein the oligonucleotide library comprises long oligonucleotide members having all four possible nucleotides at each position of a variable nucleotide.

10. The method of any one of claims 2 or 5-9 wherein
    a. the short and long oligos comprise 6 variable nucleotides;
    b. the anchor strands comprise 6 degenerate nucleotides;
    c. the anchor strands comprise at least two deoxy-uridine monophosphate nucleotides.

11. The method of any one of claims 4-9 wherein
    a. the short and long oligos comprise 6 variable nucleotides;
    b. the anchor strand comprises 6 degenerate nucleotides;
    c. the anchor strand comprises at least two deoxy-uracil monophosphate nucleotides.

12. The method of any one of claims 1-11 (i) wherein the product DNA molecule has an error rate of fewer than 1 in 25,000; or (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;

optionally wherein the oligonucleotide library comprising less than 20,000 members contains oligonucleotides sufficient to synthesize all possible nucleotide sequences; or (iii) wherein in the Type IIS restriction endonuclease is selected from BsaI and BsmBI; or (iv) wherein the product DNA molecule comprises an encoded non-genetic message; or (v) wherein the product DNA molecule comprises a sequence corresponding to bytes of information.

13. 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; and

assembling oligonucleotide members from the library according to the method of any one of claims 1-15.

14. 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; optionally wherein (i) the oligonucleotide members are isolated at defined locations and spatially separated and the library comprises long oligonucleotides of 9-35 nucleotides in length, and short oligonucleotides of 5-7 nucleotides in length.

15. An oligonucleotide library comprising less than 20,000 defined locations and comprising an oligonucleotide library member at each location and wherein the library comprises long oligonucleotides of 9-35 nucleotides in length, and short oligonucleotides of 5-7 nucleotides in length, further wherein the oligonucleotide library members can be assembled into every possible polynucleotide sequence; optionally wherein the polynucleotide sequence is less than 10 Mbp in length.