# ADDITIONAL INFORMATION: CHAPTER 5

## Design a variety of DNA nanostructures for controlling antibody valency

Leoni Abendstein[1], Willem E. M. Noteborn[1] & Thomas H. Sharp[1,2*]

*unpublished*

*[1]Department of Cell and Chemical Biology, Leiden University Medical Center, 2300 RC Leiden, The Netherlands*
*[2]School of Biochemistry, University of Bristol, Bristol BS8 1TD, United Kingdom*

**To whom correspondence should be addressed: t.sharp@bristol.ac.uk*

# 1 Supplementary Tables

***Supplementary Table 3: DNA sequences for the iDDT4 design.***

| | *Name* | *Sequence* |
|---|---|---|
| **Core strands** | **$S_1$-indi-tet** | CTATCGTTTTGTCCGGACTTATTAAGGCCTCTTTTACCGTAAA TGCATGCAATGCGTTTTCTGAATTATACCGGCCTTACCTTTTG TTCCTAAGTCAGGC |
| | **$S_2$-indi-tet** | TCGCACGTACTCTCGCTTTTGTCGAGCTGCATGATATAGTGT TTTCGGCATTCCTCTTACTGCTCGTTTTGGAGGCCGGCTCGA AGTAAGGTTTTACCGC |
| **Staple strands** | **$S_3$-indi-1-tet** | TGACGGTAATTCGGCATACGAGATGAAGACTTAGGAACGGTA AGGCCGGCTAGCGATCCCAGATATAAGGACGTCA |
| | **$S_3$-indi-4** | TTAAGTCTGCCGCTCGTACGAGAATGTCTATAATTCAGCGCA TTGCATGAAGTAGCTCACCTCCGTCCTAGTCATT |
| | **$S_3$-indi-5** | TCGCGAGCGCTGGCCATGATAGCTATCGCATTTACGGTGAG GCCTTAATTCAGTCTTACAGTACTTCAGTACGGAC |
| | **$S_3$-indi-6** | TTACGGCATGTACTTCATTCATCTGACTAAGTCCGGACCGAT AGGCCTGAGAGTCGCGCTACAGTAAGGCAGCTCG |
| | **$S_4$-indi-1-tet** | ATAGATTCCATTACCGTCAAAGTCATCTGCGAGCGGTCCTTA CTTCGAATGCCGATAGAAGTAAGATATATCTG |
| | **$S_4$-indi-4** | CCGTCTATCGCAGACTTAACAGCGACTGCCGGCCTCCCGAG CAGTAAGTCCGTATATTATCGATCTGACGGAGG |
| | **$S_4$-indi-5** | ACTTAGAGCGCGCTCGCGACTCGCTTCAGGAATGCCGCACT ATATCATGACGTCCCTGCATCGAGAGAAGTACT |
| | **$S_4$-indi-6** | GCCTGATCTCATGCCGTAAGCATTGCCGCAGCTCGACGCGA GAGTACGTTAAGGACGATAATTCCGTTACTGTA |
| | **$S_5$-indi-1** | GCGCGACTCTCTTCATCTCGTATGCCGATGCCTTAAG |
| | **$S_5$-indi-4** | GGATCGCTAGGACATTCTCGTACGAGCGTCTCCTGAC |
| | **$S_5$-indi-5** | TGAGCTACTTCGATAGCTATCATGGCCATCCGGCAGG |
| | **$S_5$-indi-6** | GTAAGACTGAAGTCAGATGAATGAAGTATGCGACGTA |
| | **$S_6$-indi-1** | GAAGGACGCCGGAATTATCGTCCTTAAGATGACTT |
| | **$S_6$-indi-4** | CCGTACGGCTCTTACTTCTATCGGCATAGTCGCTG |
| | **$S_6$-indi-5** | GTAAGGGAGAGATCGATAATATACGGAGAAGCGAG |
| | **$S_6$-indi-6** | AGCTAGATCTCTCGATGCAGGGACGTCGGCAATGC |
| | **$S_7$-indi-3** | TGACGTCCTGCCGTACGG |
| | **$S_7$-indi-4** | AATGACTAGCTCCCTTAC |
| | **$S_7$-indi-5** | GTCCGTACTGATCTAGCT |
| | **$S_7$-indi-6** | CGAGCTGCCGCGTCCTTC |
| | **$S_8$-indi-3** | GTCAGGAGAGATAGACGG |
| | **$S_8$-indi-4** | CCTGCCGGAGCTCTAAGT |
| | **$S_8$-indi-5** | TACGTCGCAAGATCAGGC |
| | **$S_8$-indi-6** | CTTAAGGCAGGAATCTAT |

| | | |
|---|---|---|
| **Modified strands** | **$S_5$-indi-1** | GCGCGACTCTCTTCATC/iDNPTEG/CGTATGCCGATGCCTTAAG |
| | **$S_5$-indi-4** | GGATCGCTAGGACATTC/iDNPTEG/CGTACGAGCGTCTCCTGAC |
| | **$S_5$-indi-5** | TGAGCTACTTCGATAGC/iDNPTEG/ATCATGGCCATCCGGCAGG |
| | **$S_5$-indi-6** | GTAAGACTGAAGTCAGA/iDNPTEG/GAATGAAGTATGCGACGTA |

***Supplementary Table 4: DNA sequences for the iDDT5 design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **Core strands** | **$S_1$-indi-pent** | CTATCGTTTTTGTCCGGACTTATTAAGGCCTCTTTTTACCGTAAATGCATGCAATGCGTTTTTCTGAATTATACCGGCCTTACCTTTTTGGACTATCTAATGACCTGCCATTTTTGTTCCTAAGTCAGGC |
| | **$S_2$-indi-pent** | TCGCACGTACTCTCGCTTTTTGTCGAGCTGCATGATATAGTGTTTTTCGGCATTCCTCTTACTGCTCGTTTTTGGAGGCCGGCTCGAAGTAAGGTTTTTCTTCATGCGCATGAAGGCTACTTTTTACCGC |
| **Staple strands** | **$S_3$-indi-1-pent** | TGACGGTAATTCGGCATACGAGATGAAGACTTAGGAACTGGCAGGTCATCGGAATGCAACGCGACGGTCCGAGATA |
| | **$S_3$-indi-3** | TGCCTGATCGCTCGCTCCTGAGCATTAATAGATAGTCCGGTAAGGCCGGCTAGCGATCCCAGATATAAGGACGTCA |
| | **$S_3$-indi-4** | TTAAGTCTGCCGCTCGTACGAGAATGTCTATAATTCAGCGCATTGCATGAAGTAGCTCACCTCCGTCCTAGTCATT |
| | **$S_3$-indi-5** | TCGCGAGCGCTGGCCATGATAGCTATCGCATTTACGGTGAGGCCTTAATTCAGTCTTACAGTACTTCAGTACGGAC |
| | **$S_3$-indi-6** | TTACGGCATGTACTTCATTCATCTGACTAAGTCCGGACCGATAGGCCTGAGAGTCGCGCTACAGTAAGGCAGCTCG |
| | **$S_4$-indi-1-pent** | ATAGATTCCATTACCGTCAAAGTCATCTGCGAGCGGTGTAGCCTTCATTGCATGCTCGCTTACTGCCCGTCGCG |
| | **$S_4$-indi-3** | TCTCTGACTCGATCAGGCACGAATTCCGCGCATGAAGCCTTACTTCGAATGCCGATAGAAGTAAGATATATCTG |
| | **$S_4$-indi-4** | CCGTCTATCGCAGACTTAACAGCGACTGCCGGCCTCCCGAGCAGTAAGTCCGTATATTATCGATCTGACGGAGG |
| | **$S_4$-indi-5** | ACTTAGAGCGCGCTCGCGACTCGCTTCAGGAATGCCGCACTATATCATGACGTCCCTGCATCGAGAGAAGTACT |
| | **$S_4$-indi-6** | GCCTGATCTCATGCCGTAAGCATTGCCGCAGCTCGACGCGAGAGTACGTTAAGGACGATAATTCCGTTACTGTA |
| | **$S_5$-indi-1** | GCGCGACTCTCTTCATCTCGTATGCCGATGCCTTAAG |
| | **$S_5$-indi-3** | TTGCATTCCGTTAATGCTCAGGAGCGAGTAGAAGCAG |
| | **$S_5$-indi-4** | GGATCGCTAGGACATTCTCGTACGAGCGTCTCCTGAC |
| | **$S_5$-indi-5** | TGAGCTACTTCGATAGCTATCATGGCCATCCGGCAGG |
| | **$S_5$-indi-6** | GTAAGACTGAAGTCAGATGAATGAAGTATGCGACGTA |
| | **$S_6$-indi-1** | GAAGGACGCCGGAATTATCGTCCTTAAGATGACTT |
| | **$S_6$-indi-3** | TATACGTACGCAGTAAGCGAGCATGCAGGAATTCG |
| | **$S_6$-indi-4** | CCGTACGGCTCTTACTTCTATCGGCATAGTCGCTG |

| | | |
|---|---|---|
| | **$S_6$-indi-5** | GTAAGGGAGAGATCGATAATATACGGAGAAGCGAG |
| | **$S_6$-indi-6** | AGCTAGATCTCTCGATGCAGGGACGTCGGCAATGC |
| | **$S_7$-indi-1** | TATCTCGGAGTACGTATA |
| | **$S_7$-indi-3** | TGACGTCCTGCCGTACGG |
| | **$S_7$-indi-4** | AATGACTAGCTCCCTTAC |
| | **$S_7$-indi-5** | GTCCGTACTGATCTAGCT |
| | **$S_7$-indi-6** | CGAGCTGCCGCGTCCTTC |
| | **$S_8$-indi-2** | CTGCTTCTAAGTCAGAGA |
| | **$S_8$-indi-3** | GTCAGGAGAGATAGACGG |
| | **$S_8$-indi-4** | CCTGCCGGAGCTCTAAGT |
| | **$S_8$-indi-5** | TACGTCGCAAGATCAGGC |
| | **$S_8$-indi-6** | CTTAAGGCAGGAATCTAT |
| **Modified strands** | **$S_5$-indi-1** | GCGCGACTCTCTTCATC/iDNPTEG/CGTATGCCGATGCCTTAAG |
| | **$S_5$-indi-3** | TTGCATTCCGTTAATGC/iDNPTEG/CAGGAGCGAGTAGAAGCAG |
| | **$S_5$-indi-4** | GGATCGCTAGGACATTC/iDNPTEG/CGTACGAGCGTCTCCTGAC |
| | **$S_5$-indi-5** | TGAGCTACTTCGATAGC/iDNPTEG/ATCATGGCCATCCGGCAGG |
| | **$S_5$-indi-6** | GTAAGACTGAAGTCAGA/iDNPTEG/GAATGAAGTATGCGACGTA |

***Supplementary Table 5: DNA sequences for the iDDT6 design***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **Core strands** | **$S_1$-indi-hex** | CTATCGTTTTTTGTCCGGACTTATTAAGGCCTCTTTTTTACCG TAAATGCATGCAATGCGTTTTTTCTGAATTATACCGGCCTTAC CTTTTTTGGACTATCTAATGACCTGCCATTTTTTGGATAGCTG AACTGAAGGAACTTTTTTGTTCCTAAGTCAGGC |
| | **$S_2$-indi-hex** | TCGCACGTACTCTCGCTTTTTTGTCGAGCTGCATGATATAGT GTTTTTTCGGCATTCCTCTTACTGCTCGTTTTTTGGAGGCCGG CTCGAAGTAAGGTTTTTTCTTCATGCGCATGAAGGCTACTTTT TTACGGCAGGACTGAAGCTCTAGTTTTTTTACCGC |
| **Staple strands** | **$S_3$-indi-1** | TGACGGTAATTCGGCATACGAGATGAAGACTTAGGAACGTTC CTTCAGTAGTATATCTCAGGACTGACGCAGGCCG |
| | **$S_3$-indi-2** | GTTACGGACTGCGATATAGCAGAATGAGTCAGCTATCCTGGC AGGTCATCGGAATGCAACGCGACGGTCCGAGATA |
| | **$S_3$-indi-3** | TGCCTGATCGCTCGCTCCTGAGCATTAATAGATAGTCCGGTA AGGCCGGCTAGCGATCCCAGATATAAGGACGTCA |
| | **$S_3$-indi-4** | TTAAGTCTGCCGCTCGTACGAGAATGTCTATAATTCAGCGCA TTGCATGAAGTAGCTCACCTCCGTCCTAGTCATT |
| | **$S_3$-indi-5** | TCGCGAGCGCTGGCCATGATAGCTATCGCATTTACGGTGAG GCCTTAATTCAGTCTTACAGTACTTCAGTACGGAC |
| | **$S_3$-indi-6** | TTACGGCATGTACTTCATTCATCTGACTAAGTCCGGACCGAT AGGCCTGAGAGTCGCGCTACAGTAAGGCAGCTCG |

| | | |
|---|---|---|
| | **$S_4$-indi-1** | ATAGATTCCATTACCGTCAAAGTCATCTGCGAGCGGTCTAGA GCTTCAGTAGCCATGATCTCTCGCTCAGTCCT |
| | **$S_4$-indi-2** | CTTAATTAGAGTCCGTAACGAAGGAGAGTCCTGCCGTGTAGC CTTCATTGCATGCTCGCTTACTGCCCGTCGCG |
| | **$S_4$-indi-3** | TCTCTGACTCGATCAGGCACGAATTCCGCGCATGAAGCCTTA CTTCGAATGCCGATAGAAGTAAGATATATCTG |
| | **$S_4$-indi-4** | CCGTCTATCGCAGACTTAACAGCGACTGCCGGCCTCCCGAG CAGTAAGTCCGTATATTATCGATCTGACGGAGG |
| | **$S_4$-indi-5** | ACTTAGAGCGCGCTCGCGACTCGCTTCAGGAATGCCGCACT ATATCATGACGTCCCTGCATCGAGAGAAGTACT |
| | **$S_4$-indi-6** | GCCTGATCTCATGCCGTAAGCATTGCCGCAGCTCGACGCGA GAGTACGTTAAGGACGATAATTCCGTTACTGTA |
| | **$S_5$-indi-1** | GCGCGACTCTCTTCATCTCGTATGCCGATGCCTTAAG |
| | **$S_5$-indi-2** | GAGATATACTCTCATTCTGCTATATCGCTGCGTCTAG |
| | **$S_5$-indi-3** | TTGCATTCCGTTAATGCTCAGGAGCGAGTAGAAGCAG |
| | **$S_5$-indi-4** | GGATCGCTAGGACATTCTCGTACGAGCGTCTCCTGAC |
| | **$S_5$-indi-5** | TGAGCTACTTCGATAGCTATCATGGCCATCCGGCAGG |
| | **$S_5$-indi-6** | GTAAGACTGAAGTCAGATGAATGAAGTATGCGACGTA |
| | **$S_6$-indi-1** | GAAGGACGCCGGAATTATCGTCCTTAAGATGACTT |
| | **$S_6$-indi-2** | GCGCTATCGGCGAGAGATCATGGCTACTCTCCTTC |
| | **$S_6$-indi-3** | TATACGTACGCAGTAAGCGAGCATGCAGGAATTCG |
| | **$S_6$-indi-4** | CCGTACGGCTCTTACTTCTATCGGCATAGTCGCTG |
| | **$S_6$-indi-5** | GTAAGGGAGAGATCGATAATATACGGAGAAGCGAG |
| | **$S_6$-indi-6** | AGCTAGATCTCTCGATGCAGGGACGTCGGCAATGC |
| | **$S_7$-indi-1** | CGGCCTGCGCGATAGCGC |
| | **$S_7$-indi-2** | TATCTCGGAGTACGTATA |
| | **$S_7$-indi-3** | TGACGTCCTGCCGTACGG |
| | **$S_7$-indi-4** | AATGACTAGCTCCCTTAC |
| | **$S_7$-indi-5** | GTCCGTACTGATCTAGCT |
| | **$S_7$-indi-6** | CGAGCTGCCGCGTCCTTC |
| | **$S_8$-indi-1** | CTAGACGCACTAATTAAG |
| | **$S_8$-indi-2** | CTGCTTCTAAGTCAGAGA |
| | **$S_8$-indi-3** | GTCAGGAGAGATAGACGG |
| | **$S_8$-indi-4** | CCTGCCGGAGCTCTAAGT |
| | **$S_8$-indi-5** | TACGTCGCAAGATCAGGC |
| | **$S_8$-indi-6** | CTTAAGGCAGGAATCTAT |
| **Modified strands** | **$S_5$-indi-1** | GCGCGACTCTCTTCATC/iDNPTEG/CGTATGCCGATGCCTTAA G |
| | **$S_5$-indi-2** | GAGATATACTCTCATTC/iDNPTEG/GCTATATCGCTGCGTCTA G |

| | | |
|---|---|---|
| | **$S_5$-indi-3** | TTGCATTCCGTTAATGC/iDNPTEG/CAGGAGCGAGTAGAAGCAG |
| | **$S_5$-indi-4** | GGATCGCTAGGACATTC/iDNPTEG/CGTACGAGCGTCTCCTGAC |
| | **$S_5$-indi-5** | TGAGCTACTTCGATAGC/iDNPTEG/ATCATGGCCATCCGGCAGG |
| | **$S_5$-indi-6** | GTAAGACTGAAGTCAGA/iDNPTEG/GAATGAAGTATGCGACGTA |

***Supplementary Table 6: Staple strand sequences for the wHex 31 bp DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **wHex-31bp-1** | TAAGCTTTTTGTCATACATGATACAGGAGTGTTTTTTACTGGTAATAGGCTGAGACTTTTTTCCTCAAGAGAGGTTTA |
| | **wHex-31bp-2** | GAATTTACCGCCCAATAGGA |
| | **wHex-31bp-3** | TAGCACCACCAGCCATTCCA |
| | **wHex-31bp-4** | ACGTTGCCACGAACCAGTAA |
| | **wHex-31bp-5** | GTACCTTTTTGCCACCCTCACCTCAGAACCGTTTTTCCACCCTCAGCTCATTTTCAGTTTTTGGATAGCAAGTTCCAG |
| | **wHex-31bp-6** | GTACTCAGGAAGGATTAGGA |
| | **wHex-31bp-7** | AAGTATTAAGAAGTTTTAAC |
| | **wHex-31bp-8** | TTGATTTTTTACCGATAGTTGGCTCCAAAAGTTTTTGAGCCTTTAATTATCAGCTTGTTTTTCTTTCGAGGTAACAGC |
| | **wHex-31bp-9** | GAATTTGATGGCTTTTCTTA |
| | **wHex-31bp-10** | CCAAAAAAAAGCGCCAAGCC |
| | **wHex-31bp-11** | TCACGTTTTTTTGAAAATCTAGAATGGAAAGTTTTTCGCAGTCTCTACCCATGTACCTTTTTGTAACACTGAATTTTT |
| | **wHex-31bp-12** | GTTTCGTCACGCGAATAATA |
| | **wHex-31bp-13** | ACAACTTTTTTAAAGGAATTCAGTACAAACTTTTTTACAACGCCTGCAGACAGCCCTTTTTTCATAGTTAGCAAAGGA |
| | **wHex-31bp-14** | GTAACGATCTGTGAGAATAG |
| | **wHex-31bp-15** | AACAGTTTTTTTTCAGCGGAAAAGTTTTGTCTTTTTGTCTTTCCAGATGAATTTTCTTTTTTGTATGGGATTACTTTC |
| | **wHex-31bp-16** | TTGCTGTATATATAAAAACA |
| | **wHex-31bp-17** | CGTCGTTTTTAGAGGGTTGAGCCCGGAATAGTTTTTGTGTATCACCTTAGCGGGGTTTTTTTTTGCTCAGTAAAGTGC |
| | **wHex-31bp-18** | CCAGGTCGGACTATTCGGAT |
| | **wHex-31bp-19** | GTTAATTTTTTGCCCCCTGCACCTATTATTCTTTTTTGAAACATGAGGGGTCAGTGCTTTTTCTTGAGTAACTAAACA |
| | **wHex-31bp-20** | AGTGCTCGGTTTGTACCGTA |

***Supplementary Table 7: Staple strand sequences for the wHex 42 bp DNA design.***

| | Name | Sequence |
|---|---|---|
| staple Strands | **wHex-42bp-1** | CCTTATTAGCACCGTACTCAGGAGGTTTAGTGGTCATAGCCC |
| | **wHex-42bp-2** | ATATAAGTGGATAAGTGCCGTCGATAGCAAGGGAGAGGGTTG |
| | **wHex-42bp-3** | GATTAGCGGAGACTCCTCAAGAGAATTCCGTAGCAGGATTAG |
| | **wHex-42bp-4** | TTATTCTGAAATTTACCGTTCCAGTAAGCGTTTCGGAACCTA |
| | **wHex-42bp-5** | TTAAAGCCAGCCTCAGAACCGCCACCCTCAGATAAATCCTCA |
| | **wHex-42bp-6** | ACCGGAACAAAATCACCGGAACCAGGTGATTCGAGAGCCACC |
| | **wHex-42bp-7** | CGAATAATAACGATAGTTGCGCCGACTGTAGTAAAGGAATTG |
| | **wHex-42bp-8** | CGCCACCCTCACTTTCAACAGTTTCAGCGGAACCCTCAGAAC |
| | **wHex-42bp-9** | AGTTTCGTCAGACGTTAGTAAATGAATTTTCCCGTAACACTG |
| | **wHex-42bp-10** | CGTATAAAGTCAGTGCCTTGAGTACGATCCGTAAACAGTGCC |
| | **wHex-42bp-11** | AGACGATTATTGACAGGAGGTTGAGTGTACAGGAGGCAGGTC |
| | **wHex-42bp-12** | CTTTAATTCAAAAAAAAGGCTCCAGAACCCACCAAAAGGAGC |
| | **wHex-42bp-13** | AAACGCAATAGAGCCAGCAAAATCACCAGTAGGAAACCGAGG |
| | **wHex-42bp-14** | CGTCACCGTATTCATTAAAGGTGAAGCGATCAGTATTATCAC |
| | **wHex-42bp-15** | AGGGAGGGAAAAGGGCGACATTCATTATTCCCCCACCGATTG |
| | **wHex-42bp-16** | AATTCATATTTATTTTGTCACAATCATTCCTTATCAATAGAA |
| | **wHex-42bp-17** | AAAGAAACCATACATAAAGGTGGCAGTTGAGATTAACATATA |
| | **wHex-42bp-18** | TAGCTATCTTATTTTTCCGAAGCCCTATTAACTGAACTTTTTACCCTGAACA |
| | **wHex-42bp-19** | ACGCAGTACTGGCATGATTAAGACAGCAAGAAATTCCTTATT |
| | **wHex-42bp-20** | AGCCGAACAAATTTTTGTTACCAGAAGCACCATTACCTTTTTATTAGCAAGG |
| | **wHex-42bp-21** | AGACGGGAGATTTTAAGAAAAGTAAGCAGATGGAAGCGCATT |
| | **wHex-42bp-22** | ATATAAAGCATTTTCGAGCCAGTACCACCAACCAATAAGAGA |
| | **wHex-42bp-23** | AACAGTAGGGCTTTTTTTAATTGAGAGAGAGAATAACTTTTTATAAAAACAG |
| | **wHex-42bp-24** | CCATCGATAGCTTTTTAGCACCGTAACAGAATCAAGTTTTTTTTGCCTTTAG |
| | **wHex-42bp-25** | ACCAATGAAAAGGAGGTTGAGGCCAACGCTCCCGGAAACGTC |
| | **wHex-42bp-26** | TAACAACGCCATGAAAATAGCAGCCTTTACAATCGCCATATT |

| | |
|---|---|
| **wHex-42bp-27** | GTAATTGAGCGTTTTTCTAATATCAGATAATAAGAGCTTTTTAAGAAACAAT |
| **wHex-42bp-28** | AAGAAACGCATATTATTTATCCCAAGAGGAAGTCATCCAAAT |
| **wHex-42bp-29** | AATCTTACCAATTTTTCGCTAACGAGTATCCGGTATTTTTTTCTAAGAACGC |
| **wHex-42bp-30** | TAAGCCCAAGAGATAACCCACAAGTCCTGTTTTAAATTGAGT |
| **wHex-42bp-31** | AGCCTAATTTGCAAATCAGATATAGAAGGCTCGTCTTTCCAG |
| **wHex-42bp-32** | CATCGAGAACATTTTTAGCAAGCCGTTCCTGAACAAGTTTTTAAAAATAATA |
| **wHex-42bp-33** | AGGTTTTGAAGTTTTTCCTTAAATCACTATTTTGCACTTTTTCCAGCTACAA |
| **wHex-42bp-34** | CTTGCGGGGAGGCGTTTTAGCGAAGCACTGTACCCCTCCCGA |
| **wHex-42bp-35** | TCGTAGGAATTGTTTATCAACAATAGATAAGTTTTATTTTCA |
| **wHex-42bp-36** | CCGGAACCAGATTTTTGCCACCACCGCCTCAGAGCCGTTTTTCCACCCTCAG |
| **wHex-42bp-37** | ATCAATAATCGTTTTTGCTGTCTTTCCAAGAACGGGTTTTTTATTAAACCAA |
| **wHex-42bp-38** | AGAAACCATCCCATCCTAATTTACAATCAATCAAGAGCATGT |
| **wHex-42bp-39** | CAACATGTTTCTGTCCAGACGACGGCCTCGAACCACAATAAA |
| **wHex-42bp-40** | CACCCTCAGAGTTTTTCCGCCACCAGAGAGCCGCCGCTTTTTCAGCATTGAC |
| **wHex-42bp-41** | CATCGGCATTTTTTTTTCGGTCATAGAGCGTTTGCCATTTTTTCTTTTCATA |
| **wHex-42bp-42** | AGCGCGTTTTAACCGCCACCCTCAGAGCCACCGTCAGACTGT |
| **wHex-42bp-43** | GTTTGCCATCTTTTTTTTTCATAATCCGCCTCCCTCATTTTTGAGCCGCCACAATGGAAAGCGTTTTTCAGTCTCTGA |
| **wHex-42bp-44** | ACATGAAAGTATTTTTTTAAGAGGCTGGGTTTTGCTCTTTTTAGTACCAGGCATAGCCCGGAATTTTTTAGGTGTATC |
| **wHex-42bp-45** | ATTTCTTAAACTTTTTAGCTTGATACTTTTTTCACGTTTTTTTGAAAATCTCGTATCGGTTTATTTTTTCAGCTTGCT |
| **wHex-42bp-46** | GTGAGAATAGATTTTTAAGGAACAACCGCGTTTTCATTTTTTCGGCATTTTCACCGCCACCCTTTTTTCAGAACCGCC |
| **wHex-42bp-47** | TGTATGGGATTTTTTTTTGCTAAACAAGAGCCACCACTTTTTCCTCATTTTCAGCCCAATAGGTTTTTAACCCATGTA |
| **wHex-42bp-48** | TAAAGTTTTGTTTTTTCGTCTTTCCACCAGTACAAACTTTTTTACAACGCCTACAGACAGCCCTTTTTTCATAGTTAG |
| **wHex-42bp-49** | CTGGTAATAAGTTTTTTTTTAACGGGCAGTTAATGCCTTTTTCCCTGCCTATCATACATGGCTTTTTTTTTGATGATA |

| | | |
|---|---|---|
| | **wHex-42bp-50** | ACCACCAGAGCTTTTTCGCCGCCAGCGGCCTTGATATTTTTTTCACAAACAAAGCCACCACCCTTTTTTCAGAGCCGC |
| | **wHex-42bp-51** | ATAACGGAATATTTTTCCCAAAAGAATGTTAGCAAACTTTTTGTAGAAAATAGCAAAGACACCTTTTTACGGAATAAG |
| | **wHex-42bp-52** | TGGTTTACCAGTTTTTCGCCAAAGACAAGGTAAATATTTTTTTGACGGAAATACTTGAGCCATTTTTTTTGGGAATTA |
| | **wHex-42bp-53** | AACATGTAATTTTTTTTAGGCAGAGGTACCGACAAAATTTTTGGTAAAGTAATCAGCTAATGCTTTTTAGAACGCGCC |
| | **wHex-42bp-54** | CATTACCGCGCTTTTTCCAATAGCAAGCCAGTTACAATTTTTAATAAACAGCATTTTTTGTTTTTTTTAACGTCAAAA |

***Supplementary Table 8: Staple strand sequences for the pHex DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **pHex-1** | TGTACTTTTTAGACCAGGCGGACCTTCATCATTTTTAGAGTAATCTCTTGAGATGGTTTTTTTTAATTTCAATGAATT |
| | **pHex-2** | AGAGGACAGATCGGAACAACAT |
| | **pHex-3** | TAATGAAAATCGGAAGACAGAT |
| | **pHex-4** | CCTCGTGGCTCAAGAACTTTAC |
| | **pHex-5** | ACCTTTTTTTATGCGATTTTATTATACCAGTTTTTTCAGGACGTTGTACGTTAATAATTTTTAACGAACTAAGAACGG |
| | **pHex-6** | TCAGATCATTGCTTTAAAGCAA |
| | **pHex-7** | AGTAAATTGGGTGACAAGAACC |
| | **pHex-8** | GGCGCTTTTTAGACGGTCAAATTTGTATCATTTTTTCGCCTGATAAAATCCGCGACCTTTTTTGCTCCATGTGAACGA |
| | **pHex-9** | TACTTCTGGCTCATAGGAGCCG |
| | **pHex-10** | CTGACTTTTTCAACTTTGAATATTACAGGTATTTTTGAAAGATTCACAATAC |
| | **pHex-11** | TACAACGGAGTCATAAGGGA |
| | **pHex-12** | TGCGGTTTTTAATCGTCATATATACCAAGCGTTTTTCGAAACAAAGACCGAA |
| | **pHex-13** | TCAGTTGAGAGGATAGCGTC |
| | **pHex-14** | TAAAATTTTTTGTTTAGACTTTTAGGAATACTTTTTCACATTCAACACATAACGCCATTTTTAAAGGAATTATAATAG |
| | **pHex-15** | CGAGGCATAGCCAGAGGGGG |
| | **pHex-16** | GCAAATTTTTAGAAGTTTTGTAAGAGCAACATTTTTCTATCATAACCAGACGACGATTTTTTAAAAACCAAAGCTTTT |
| | **pHex-17** | CCCTGTTTTTACTATTATAGAGCGGATTGCATTTTTTCAAAAAGATCCCGAA |
| | **pHex-18** | ATAGCTCAGGAAAAAGAGAG |
| | **pHex-19** | AGACTTTTTTTCAAATATCGAAACGAGAATGTTTTTACCATAAATCTCTTTA |

| | | |
|---|---|---|
| | **pHex-20** | TAAGACCCTGGCTTGGGAAG |
| | **pHex-21** | CATTCTTTTTAGTGAATAAGACGAGAAACACTTTTTCAGAACG AGTGGATATTCATTTTTTTACCCAAATCAGCTGCT |
| | **pHex-22** | ACGTAGTCGAATTGTACAAA |
| | **pHex-23** | AATCCCCCTCGCGAACCAGACCGCCAGCGATAATATTCATTG |
| | **pHex-24** | ACAGTTCAGACGTTTTAATTCGAGCTTCAAAAAATGCTTTAA |

***Supplementary Table 9: Staple strand sequences for the bpHex 31 bp DNA design.***

| | ***Sequence Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **bpHex-31bp-1** | GAAGCTTTTTCCTTTTTAAGATTCATATGGTTTTTTTTACCAGC GCGCACCA |
| | **bpHex-31bp-2** | CAGCCTTTTTATATTATTTAAATAAGAAACGTTTTTATTTTTTGT TCCCACA |
| | **bpHex-31bp-3** | CCAGTTACAACAATAGCTAT |
| | **bpHex-31bp-4** | CCAATAACCGAGAAGGAAATAA |
| | **bpHex-31bp-5** | AGAATTTTTTTGAGTTAAGCGAGCAAGAAACTTTTTAATGAAA TAGAATAAA |
| | **bpHex-31bp-6** | AATAGTTTTTCAGCCTTTACACATAAAAACATTTTTGGGAAGC GCAGAATTA |
| | **bpHex-31bp-7** | TAACGTCAAAAGAGAGATAA |
| | **bpHex-31bp-8** | CAAAGAAAGAATACCCATCAGA |
| | **bpHex-31bp-9** | ACTGATTTTTACACCCTGAAGGGTAATTGAGTTTTTCGCTAAT ATCAATGAA |
| | **bpHex-31bp-10** | ATCCTTTTTTCATTAAAGCCCTCAGAGCCGCTTTTTCACCAGA ACCCCGCCG |
| | **bpHex-31bp-11** | TTAGACAAACATTCACGGGA |
| | **bpHex-31bp-12** | AAACGTTTTTTAGAAAATACGGCAACATATATTTTTAAAGAAAC GCGAATAAGTTTATTTTTTTTTGTCACAGATAGC |
| | **bpHex-31bp-13** | GGTTGCAGTATATTACGAGGCA |
| | **bpHex-31bp-14** | CCAGCTTTTTATTGACAGGAGGTCAGACGATTTTTTTGGCCTT GATAAATAA |
| | **bpHex-31bp-15** | CGGAATTTTTCCGCCTCCCTCAGACTGTAGCTTTTTGCGTTTT CATGGTCAT |
| | **bpHex-31bp-16** | ACCACAGAGCGAACCCAGAG |
| | **bpHex-31bp-17** | GTTTGAAAGGTATACATCCATC |
| | **bpHex-31bp-18** | AGCCCTTTTTCCTTATTAGCTTTTCATAATCTTTTTAAAATCAC CGCACCAC |
| | **bpHex-31bp-19** | CGGCATAAAGTTCATTTTTC |
| | **bpHex-31bp-20** | TATTGTTTTTACGGAAATTAGTGAATTATCATTTTTCCGTCACC GATTGGGA |

| | | |
|---|---|---|
| | **bpHex-31bp-21** | AGGGAACCACGAAAGACGGGAA |
| | **bpHex-31bp-22** | CGAACTTTTTAAAGTTACCAGGAAACGCAATTTTTTAATAACG GAACTGGCATGATTTTTTTAAGACTCCTTGTTAGC |
| | **bpHex-31bp-23** | AAAAGTAAGCAATCAATAGAAA |
| | **bpHex-31bp-24** | GAAACTTTTTCATCGATAGCAGTAGCGACAGTTTTTAATCAAG TTTCCCTCAGAACCTTTTTGCCACCCTCACGCAGT |
| | **bpHex-31bp-25** | CCGGAAACGTCCAGTGCCGAGC |
| | **bpHex-31bp-26** | TTACCTTTTTATTAGCAAGGGTCTTTCCAGATTTTTGCCTAATT TGCTTACC |
| | **bpHex-31bp-27** | CAAAGACAAAATCACCAGTA |
| | **bpHex-31bp-28** | ATTAGTTTTTAGCCAGCAAAAGGGCGACATTTTTTTCAACCGA TTGGGTAAA |
| | **bpHex-31bp-29** | CTTGAGTAATCAGCACCGCCAT |
| | **bpHex-31bp-30** | CAGAGCCGCCAGCCTTTAGCGT |
| | **bpHex-31bp-31** | CTCTGTTTTTAATTTACCGTCATACATGGCTTTTTTTTTGATGA TAGGTAATAAGTTTTTTTTTAACGGGGTACCAAT |
| | **bpHex-31bp-32** | AGAATGGAAAGGAGCCACCACC |
| | **bpHex-31bp-33** | AGAGAAAGCGTTCCAGTGAATA |
| | **bpHex-31bp-34** | TCCCATGTACTCAGGAGATCCA |
| | **bpHex-31bp-35** | AATAACCGAGAAGGAAATAACC |
| | **bpHex-31bp-36** | AAGAAAGAATACCCATCAGACA |
| | **bpHex-31bp-37** | TTGCAGTATATTACGAGGCAGG |
| | **bpHex-31bp-38** | TTGAAAGGTATACATCCATCGT |
| | **bpHex-31bp-39** | GGAACCACGAAAGACGGGAAAG |
| | **bpHex-31bp-40** | AAGTAAGCAATCAATAGAAAAA |
| | **bpHex-31bp-41** | TTACAACAATAGCTATCCAG |
| | **bpHex-31bp-42** | GTCAAAAGAGAGATAATAAC |
| | **bpHex-31bp-43** | ACAAACATTCACGGGATTAG |
| | **bpHex-31bp-44** | CAGAGCGAACCCAGAGACCA |
| | **bpHex-31bp-45** | ATAAAGTTCATTTTTCCGGC |
| | **bpHex-31bp-46** | CAGTACAAAGACAAAATCAC |
| **Modified** | **bpHex-31bp-AGHandle-35** | AATAACCGAGAAGGAAATAACCCCCGCTCACTTGATTTTCGG |

| | | |
|---|---|---|
| | **bpHex-31bp-AGHandle-36** | AAGAAAGAATACCCATCAGACACCCGCTCACTTGATTTTCGG |
| | **bpHex-31bp-AGHandle-37** | TTGCAGTATATTACGAGGCAGGCCCGCTCACTTGATTTTCGG |
| | **bpHex-31bp-AGHandle-38** | TTGAAAGGTATACATCCATCGTCCCGCTCACTTGATTTTCGG |
| | **bpHex-31bp-AGHandle-39** | GGAACCACGAAAGACGGGAAAGCCCGCTCACTTGATTTTCGG |
| | **bpHex-31bp-AGHandle-40** | AAGTAAGCAATCAATAGAAAAACCCGCTCACTTGATTTTCGG |
| | **bpHex-31bp-CholHandle-41** | ATGCTAAGGTCATCTCCGTTACAACAATAGCTATCCAG |
| | **bpHex-31bp-CholHandle-42** | ATGCTAAGGTCATCTCCGGTCAAAAGAGAGATAATAAC |
| | **bpHex-31bp-CholHandle-43** | ATGCTAAGGTCATCTCCGACAAACATTCACGGGATTAG |
| | **bpHex-31bp-CholHandle-44** | ATGCTAAGGTCATCTCCGCAGAGCGAACCCAGAGACCA |
| | **bpHex-31bp-CholHandle-45** | ATGCTAAGGTCATCTCCGATAAAGTTCATTTTTCCGGC |
| | **bpHex-31bp-CholHandle-46** | ATGCTAAGGTCATCTCCGCAGTACAAAGACAAAATCAC |
| | **DNP-strand** | /DNPTEG/TTCCGAAAATCAAGTGAGCGGG |
| | **3'Cholesterol-strand** | CGGAGATGACCTTAGCATTT/3CholTEG/ |
| | **5'Cholesterol-strand** | /5CholTEG/TTCGGAGATGCCTTAGCAT |

***Supplementary Table 10: Staple strand sequences for the bpHex 42bp DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| staple strands | **bpHex-42bp-1** | CGTTTTTATTTTTTTTTCATCGTAGGTAGACGGGAGATTTTTATTAACTGAA |
| | **bpHex-42bp-2** | AACATGTAATTTTTTTTAGGCAGAGGCCAGTAATAAGTTTTTAGAATATAAA |
| | **bpHex-42bp-3** | ATCGGCTGTCTTTTTTTTCCTTATCAGGGTATTAAACTTTTTCAAGTACCGC |
| | **bpHex-42bp-4** | ATTCTGTCCAGTTTTTACGACGACAAGTTCAGCTAATTTTTTGCAGAACGCG |
| | **bpHex-42bp-5** | AACAATAGATATTTTTAGTCCTGAACATATCCCATCCTTTTTTAATTTACGA |
| | **bpHex-42bp-6** | TAGCCCCCTTATTTTTTTAGCGTTTGAGGCCGGAAACTTTTTGTCACCAATG |
| | **bpHex-42bp-7** | TAGCAGCACCGTTTTTTAATCAGTAGAAGTTTGCCTTTTTTTTAGCGTCAGA |

| | |
|---|---|
| **bpHex-42bp-8** | AAAGGTGAATTTTTTTATCACCGTCAGTTTATTTTGTTTTTTCACAATCAAT |
| **bpHex-42bp-9** | TATGGTTTACCTTTTTAGCGCCAAAGGACATTCAACCTTTTTGATTGAGGGA |
| **bpHex-42bp-10** | CACAAGAATTGTTTTTAGTTAAGCCCTAGCTATCTTATTTTTCCGAAGCCCT |
| **bpHex-42bp-11** | CTGGCATGATAGGAGGTTGAGGCCAACGCTCACCCAAAAGAA |
| **bpHex-42bp-12** | GAAACGCAATATTTTTATAACGGAATAACAGTAGGGCTTTTTTTAATTGAGA |
| **bpHex-42bp-13** | AGTAAGCAGATTTTTTAGCCGAACAAGTAATTGAGCGTTTTTCTAATATCAG |
| **bpHex-42bp-14** | TACATAAAATGTTAGCAAACGTAGAGAAATTTTAAAAATACA |
| **bpHex-42bp-15** | CATTTGGGAACGCAAAGACACCACGGAATAACCGACTTGAGC |
| **bpHex-42bp-16** | TAATCAAAATGTAGCACCATTACCATTAGCACCATCTTTTCA |
| **bpHex-42bp-17** | CACCCTCACGGAACCGCCTCCCTCAACATTAAACAGAGCCGC |
| **bpHex-42bp-18** | CCACCACCCCACCCTCAGAGCCGCTCGAGCATTTCACCAGAA |
| **bpHex-42bp-19** | GCGTCTTTCCATTTTTGAGCCTAATTATCCCAATCCATTTTTAATAAGAAACCAGCCTTTACATTTTTGAGAGAATAA |
| **bpHex-42bp-20** | CAAGCAAATCATTTTTGATATAGAAGTTAGCGAACCTTTTTTCCCGACTTGCTGCTATTTTGCTTTTTACCCAGCTAC |
| **bpHex-42bp-21** | TAAGACTCCTTTTTTTATTACGCAGTGGTGGCAACATTTTTTATAAAAGAAATTAGAGCCAGCTTTTTAAAATCACCA |
| **bpHex-42bp-22** | CACCGGAACCATTTTTGAGCCACCACGAACCGCCACCTTTTTCTCAGAGCCAAGAGCCGCCGCTTTTTCAGCATTGAC |
| **bpHex-42bp-23** | GAGGCGTTGCTTATCCGGTATTCTAGAACTTCCAAAGAACGC |
| **bpHex-42bp-24** | AGATTAGTGGGAGGTTTTGAAGCCAAATAAAGAATTAAATCA |
| **bpHex-42bp-25** | GCTAACGAAATTTTATCCTGAATCGAATCCGACATTACCAAC |
| **bpHex-42bp-26** | TATTATTTTGCCAGTTACAAAATAAGGGCACAAAAACAGCCA |
| **bpHex-42bp-27** | GAAAATAGGATTTTTTGTTTAACGTAACCAGAGATCAAAAAT |
| **bpHex-42bp-28** | CCCAATAGCATAAAAACAGGGAAGCGCATAATCATTACCGCG |
| **bpHex-42bp-29** | CATATTTAACAACGCCACTCATCGAGAACAAGCAAGCATCGC |
| **bpHex-42bp-30** | GACAAAAGGTAAAGTAGCATGTAGAAACCAATCAATAGTACC |
| **bpHex-42bp-31** | TCGGCATTTTCGGTCACTGTAGCGCGTTTTCATTATCCCTGT |
| **bpHex-42bp-32** | CACGGAAATTATTCATTGGGAAGGTAAATATTGATCGAAAAC |
| **bpHex-42bp-33** | AAACAATGAAATAGCAAAATAATAAGAGCAAGAATTCAAGAA |

| | | |
|---|---|---|
| | **bpHex-42bp-34** | ACCAGAAGGAAACCGAGCACCCTGAACAAAGTCAGAGGAGTT |

***Supplementary Table 11: Staple strand sequences for the bpHex 52 bp DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **bpHex-52bp-1** | AGCGAAAGACATTTTTGCATCGGAACTGACCTTCATCTTTTTAAGAGTAATC |
| | **bpHex-52bp-2** | TCGTCACCAGTTTTTTACAAACTACATAGTTAGCGTATTTTTACGATCTAAA |
| | **bpHex-52bp-3** | ACACTGAGTTAGGCCGCTTT |
| | **bpHex-52bp-4** | TTCGGTCGTCGCCCACGCATAACGGTAAAAT |
| | **bpHex-52bp-5** | CGCCGACAATGTTTTTACAACAACCACTGAGGCTTGCTTTTTAGGGAGTTAA |
| | **bpHex-52bp-6** | AATTTTCTGTATTTTTTGGGATTTTGGAGAATAGAAATTTTTGGAACAACTA |
| | **bpHex-52bp-7** | TTAGTAAATGAATTTCTTAA |
| | **bpHex-52bp-8** | TATCGGTTCTCCAAAAGGAGCCTAAGAATAC |
| | **bpHex-52bp-9** | TGAAAATCTCCTTTTTAAAAAAAAGGTATCAGCTTGCTTTTTTTTCGAGGTG |
| | **bpHex-52bp-10** | TGTCTGGAAGTTTTTTTTCATTCCATGAACCAGACCGTTTTTGAAGCAAACT |
| | **bpHex-52bp-11** | TGTTTTAAATAATAATTT TTTCACGTAAGG |
| | **bpHex-52bp-12** | GCTTAATTTCATTTTTGCGGATGAACAAAGT |
| | **bpHex-52bp-13** | ATTGCTCCTTTTTTTTTGATAAGAGGGCTGAATATAATTTTTTGCTGTAGCT |
| | **bpHex-52bp-14** | TTTACCCTGACTTTTTTATTATAGTCTTTGCAAAAGATTTTTAGTTTTGCCA |
| | **bpHex-52bp-15** | GAATGACCATATAGAGAG TACCTTTACCAAC |
| | **bpHex-52bp-16** | CCCCCTCATCGTCATAAATATTCGCGACCTG |
| | **bpHex-52bp-17** | ATAGCGTCCAATTTTTTACTGCGGAAAATGCTTTAAATTTTTCAGTTCAGAA |
| | **bpHex-52bp-18** | TGAGATGGTTTAAATGTT TAGACTGGGAGGG |
| | **bpHex-52bp-19** | CACCAGAACGATTTTTGTAGTAAATTATTGTGAATTATTTTTCCTTATGCGA |
| | **bpHex-52bp-20** | ACGAGAAATCAGTGAATAAGGCTGGGAACCG |
| | **bpHex-52bp-21** | CGGCTACAGAAGACCAGGCGCATAGGCTGGCGAGGGTAGCAA |
| | **bpHex-52bp-22** | TAGGAATACCAGGCAAGGCAAAGCCACCCTCCAGTTGAGATT |

| | |
|---|---|
| **bpHex-52bp-23** | ACATTCAACTTAAATCATAC |
| **bpHex-52bp-24** | ATTACAGGTAGTTTTTAAAGATTCATATTTTCAGGGATTTTTTAGCAAGCCC |
| **bpHex-52bp-25** | TTACCCAAATCGTTAATAAA |
| **bpHex-52bp-26** | GACGTTGGGAATTTTTGAAAAATCTACAACGTAACAATTTTTAGCTGCTCAT |
| **bpHex-52bp-27** | GCAACACTAAGGAATTACGAGGCACATTATA |
| **bpHex-52bp-28** | CCAGTCAGTTTTAAGAACTGGCTTAGTAAGA |
| **bpHex-52bp-29** | GGATTGCATCAAACCAAAATAGCGAGAGGCTAGAAGCAAAGC |
| **bpHex-52bp-30** | AAAAAGATTAACGACGATAA |
| **bpHex-52bp-31** | TTCCCAATTCTTTTAATTCGAGCTTCAAAGCATAACAGTTGA |
| **bpHex-52bp-32** | TGCGAACGAGAAATATCGCG |
| **bpHex-52bp-33** | CCTGTTTAATACATTTCGCAAATGCAGTTTC |
| **bpHex-52bp-34** | AGCGGAGTCTAAACAACTTTCAAGTCAATAA |
| **bpHex-52bp-35** | CTACTAATCGAGCTGAAAAGGTGGCACAGAC |
| **bpHex-52bp-36** | AGCCCTCAACGCCTGTAGCATTCCATCAATT |
| **bpHex-52bp-37** | GATTTGTATCATTTTTTCGCCTGATATACTTAGCCGGTTTTTAACGAGGCGCAACTTTGAAAGTTTTTAGGACAGATG |
| **bpHex-52bp-38** | ACTAAAGACTTTTTTTTTTTCATGAGGCCACTACGAAGTTTTTGCACCAACCTACTCATCTTTGTTTTTACCCCCAGCG |
| **bpHex-52bp-39** | AATGCAGATACTTTTTATAACGCCAAATCATAACCCTTTTTTCGTTTACCAGAGAGGAAGCCCTTTTTGAAAGACTTC |
| **bpHex-52bp-40** | TAGATTTAGTTTTTTTTGACCATTAGGCTATATTTTCTTTTTATTTGGGGCGAGTAGTAGCATTTTTTTAACATCCAA |
| **bpHex-52bp-41** | ACGTAATGAAGTTTCCATTAAACGCGATATA |
| **bpHex-52bp-42** | ACTAAAACAAAACGAAAGAGGCAATTAATTG |
| **bpHex-52bp-43** | ACAACGGAATTATACCAAGCGCGAGCTTAGA |
| **bpHex-52bp-44** | CTCCATGTAATTGTGTCGAAATCCATTGAAT |
| **bpHex-52bp-45** | AACTGACCAGACGGTCAATCATAATGCCCTG |
| **bpHex-52bp-46** | CTTTGAGGAACGGTGTACGG |
| **bpHex-52bp-47** | GAACCCATGTACCGTATGCGGGATCGTCACCCTCAGCAATAG |
| **bpHex-52bp-48** | TGTCGTCTTTCCAGACGACAGCTTGATACCGATAGTTGGTTT |

| | | |
|---|---|---|
| | **bpHex-52bp-49** | AATTGCGAATATGCAACTA AAGTACGGCAACA |
| | **bpHex-52bp-50** | AGGTCAGGATAATCAAAA ATCAGGTCAACGA |
| | **bpHex-52bp-51** | GGTAATAGTAAATTTCAA CTTTAATCGGGCT |
| | **bpHex-52bp-52** | CTAACGGAACAACATTTTGACAAGAACCGGATATTCAACGAA |

***Supplementary Table 12: Staple strand sequences for the bpHex 63 bp DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **bpHex-63bp-1** | AAGAACTGGCTTTTTTCATTATACCAAGCGAACCAGATTTTTC CGGAAGCAA |
| | **bpHex-63bp-2** | TACGTAATGCCTTTTTACTACGAAGGCACTAAAACACTTTTTT CATCTTTGA |
| | **bpHex-63bp-3** | CCACATTCTTCATCAGTTGAGATTACACCAGA |
| | **bpHex-63bp-4** | ACGAGTAGCTTGCCCTGACGAGAATAGGAATA |
| | **bpHex-63bp-5** | AACTAATGCAGGTAGAAAGA |
| | **bpHex-63bp-6** | CTGCTCATTCATTTTTGTGAATAAGGTAAATTGGGCTTTTTTT GAGATGGTT |
| | **bpHex-63bp-7** | ATTTGTATCATTTTTTCGCCTGATAAACTTAGCCGGATTTTTAC GAGGCGCA |
| | **bpHex-63bp-8** | CCTCGTTTTAGTAAGAGCAACACTGCGCATAG |
| | **bpHex-63bp-9** | GCTGGCTGACGGTGTACAGACCAGATCATAAC |
| | **bpHex-63bp-10** | ACCAGACGACTTACGAGGCA |
| | **bpHex-63bp-11** | ACTTTGAAAGATTTTTGGACAGATGAACCTTCATCAATTTTTG AGTAATCTT |
| | **bpHex-63bp-12** | GGATAGGTCACTTTTTGTTGGTGTAGATTTTGTTAAATTTTTAT TCGCATTA |
| | **bpHex-63bp-13** | TCAATCATAAGGAACAAAC GGCGGATTGTCGG |
| | **bpHex-63bp-14** | GACCGTAATGGTAACAACCC |
| | **bpHex-63bp-15** | AATAGTAAAAAAGAAGTTTTGCCACCTGTAGC |
| | **bpHex-63bp-16** | CAGCTTTCATTCGCGTCTGGCCTTGAGGGGGT |
| | **bpHex-63bp-17** | AATGTTTAGAAGGCTTTTGC |
| | **bpHex-63bp-18** | ATAGGAACGCCTTTTTATCAAAAATAATCAACATTAATTTTTAT GTGAGCGA |
| | **bpHex-63bp-19** | ACAAGAGAATCTTTTTGATGAACGGTATGCAATGCCTTTTTTG AGTAATGTG |

| | |
|---|---|
| **bpHex-63bp-20** | TTGTTAAATCAGGTCATTG CCTGAGAGTCTAC |
| **bpHex-63bp-21** | TCTGGAGCAATTTTGAGAGA |
| **bpHex-63bp-22** | AATGCTTTTAAATATTCATTGAATTTCTAGCT |
| **bpHex-63bp-23** | GATAAATTATATGATATTCAACCGCCCCCTCA |
| **bpHex-63bp-24** | AAACAGTTCAGGAATCGTCA |
| **bpHex-63bp-25** | GAGACAGTCAATTTTTATCACCATCAAATGCCGGAGATTTTTG GGTAGCTAT |
| **bpHex-63bp-26** | AAAGATTCAAAGGAAGTTT CATTCCATCTAAA |
| **bpHex-63bp-27** | ATAACAGTTGAAATATGCAA |
| **bpHex-63bp-28** | TGCTGTAGCTCTTTTTAACATGTTTTATTCCCAATTCTTTTTTG CGAACGAG |
| **bpHex-63bp-29** | CAGAAGCAGGTCTTTACCCTGACTTAATTGCT |
| **bpHex-63bp-30** | GAATATAACGGATGGCTTAGAGCTATTATAGT |
| **bpHex-63bp-31** | AAGCGGATTGTCAAAAATCA |
| **bpHex-63bp-32** | GGGAAGAAAAGCGTTTTAATTCGAGCTTCAAGTCAGGACGTT |
| **bpHex-63bp-33** | TAAAACGAACGCCCGAAAGACTTCAAATATCATCTACGTTAA |
| **bpHex-63bp-34** | TAAATCATACGGTAACGCCAGGGGTAGCAACTTAACATCCAA |
| **bpHex-63bp-35** | ATTCTACTAATTTTTTAGTAGTAGCAGGCTACAGAGGTTTTTC TTTGAGGAC |
| **bpHex-63bp-36** | AAATGGTCAATTTTTTAACCTGTTTATTTGATAAGAGTTTTTGT CATTTTTG |
| **bpHex-63bp-37** | TATGACCCCTAAATCGGTTGTACCATTAGATA |
| **bpHex-63bp-38** | CATTTCGCTAGATTTAGTTTGACCAAAAACAT |
| **bpHex-63bp-39** | TAGCATGTCATAGAACCCTCATATATTTTAAAATCGTAAAAC |
| **bpHex-63bp-40** | GTAACCGTGCATTTAAATTGTAAACGTTAATATGGGCGCATC |
| **bpHex-63bp-41** | CTGGTGCCCCAGCCAGCTTTCCGGCGACCTGC |
| **bpHex-63bp-42** | TCCATGTTATTGTGTCGAAATCCGCACCGCTT |
| **bpHex-63bp-43** | GGCCTCTTCTGTTGGGAAGGGCGAAAGAGGCA |
| **bpHex-63bp-44** | AAAGAATACACCAACCTAAAACGATCGGTGCG |
| **bpHex-63bp-45** | TTACCTTATGCGATTTTTAAAGACTTTTTCATGAGGAATGAA |

| | | |
|---|---|---|
| | **bpHex-63bp-46** | AAATCAACGTAACAAAGCCCCCAGCGATTATACCAAGCACCC |
| | **bpHex-63bp-47** | TACCTTTAATTGCTCCTGCTATATTTTCATTTGGGGCGAGAG |
| | **bpHex-63bp-48** | CTGGATAGCGTTTTTTCCAATACTGCGAAAACGAGAATTTTTT GACCATAAACATCAAAAAGATTTTTTTAAGAGGAA |
| | **bpHex-63bp-49** | TAACGGAACAATTTTTCATTATTACAGATACATAACGTTTTTCC AAAAGGAAGATAAAAACCATTTTTAAATAGCGAG |
| | **bpHex-63bp-50** | AAATTAAGCAATTTTTTAAAGCCTCATTGCGGGAGAATTTTTG CCTTTATTTAATCAGAAAAGTTTTTCCCCAAAAAC |
| | **bpHex-63bp-51** | ACGACAGTATCTTTTTGGCCTCAGGACAAAGCGCCATTTTTTT CGCCATTCACCAGCTGGCGATTTTTAAGGGGGATG |
| | **bpHex-63bp-52** | TAATTAGCATGCTGCAAGGCGATTAAGTTGAGGCAAGGCAAA G |
| | **bpHex-63bp-53** | TTAATACTTGAGCATAAAGTG |
| | **bpHex-63bp-54** | TCGGTTGATCAACGCAAGGATAAAAATTTTATCATATGTACCC |
| | **bpHex-63bp-55** | TAGGGGACGAGGAAGATTGTATAAGCAAATATCTGCCAGTTT G |
| | **bpHex-63bp-56** | TAAACCAGGAGATCGCACTGG |
| | **bpHex-63bp-57** | TCTATTACGGGCTGCGCAACG |
| | **bpHex-63bp-58** | TTCAACTTTAATCATTGGTTTCCATTAAACGGGTAAAATAAT |
| | **bpHex-63bp-59** | AGAACCGGATATTCATTGCGAAACAAAGTACAACGGAGGACA |
| | **bpHex-63bp-60** | ATTCTCCGTGGGGAACCGA ACTGACCAGACGG |
| | **bpHex-63bp-61** | AAAGGCTATCAGCTCATTT TTTAACCAAATTT |
| | **bpHex-63bp-62** | GTACGGTGTCTAGGGTGAG AAAGGCCGTAGGT |
| | **bpHex-63bp-63** | CAACAGGTCAGGATTAGCGAGCTGAAAAGGTGGCATCAACT C |

***Supplementary Table 13: Staple strand sequences for the Hex DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **Hex-31bp-1** | GAATACCCAAGACAGAATCA |
| | **Hex-31bp-2** | ACCGTTTTTTAATCAGTAGCAAGAACTGGCATTTTTTGATTAA GACGGCCGGAAACGTTTTTTCACCAATGAAGCAGC |
| | **Hex-31bp-3** | AACCACAAAAATAATTCGAT |
| | **Hex-31bp-4** | TAGCCCCCTTCCCCCTGCCT |
| | **Hex-31bp-5** | TATAATTTTTACAGTTAATGATTAGCGTTTGTTTTTCCATCTTT TCTCACCGGAACCTTTTTAGAGCCACCATGCCCG |
| | **Hex-31bp-6** | CCGGAACCGCTGAGTAACAG |
| | **Hex-31bp-7** | TCAAGAATAACTGGTAGAAG |

| | | |
|---|---|---|
| | **Hex-31bp-8** | TGATATTTTTCAGGAGTGTAGTTTTAACGGGTTTTTGTCAGTG CCTCTCCCTCAGAGTTTTTCCGCCACCCTTTTTGA |
| | **Hex-31bp-9** | CAGAACCGCCCATACATGGC |
| | **Hex-31bp-10** | CAGTCTCTGACCGCCAGCAT |
| | **Hex-31bp-11** | CCACCTTTTTACCAGAGCCGATTTACCGTTCTTTTTCAGTAAG CGTACCCTCAGAGCTTTTTCACCACCCTCCCAGAA |
| | **Hex-31bp-12** | AGAGCTCACCCACCGCGCCA |
| | **Hex-31bp-13** | TGACGGAAATATTTTGTCAC |
| | **Hex-31bp-14** | CCACGTTTTTGAATAAGTTTTATTCATTAAATTTTTGGTGAATT ATGACTTGAGCCATTTTTTTTGGGAATTAAGACA |
| | **Hex-31bp-15** | AGAGCCAGCAAAGAAACGCA |
| | **Hex-31bp-16** | CCGAATTTTTCAAAGTTACCGAGCAAGAAACTTTTTAATGAAA TAGCTTACCGAAGCTTTTTCCTTTTTAAGAGATAG |
| | **Hex-31bp-17** | GGTGGTTTTTCAACATATAAAAATCACCAGTTTTTTAGCACCA TTAGCAGTATGTTATTTTTGCAAACGTAGCATAAA |
| | **Hex-31bp-18** | AAAAGACATAAAAATTAAGC |
| | **Hex-31bp-19** | CCAATAATAAAGAAGGAAAC |
| | **Hex-31bp-20** | AGAATTTTTTTGAGTTAAGCCGAGGAAACGCTTTTTAATAATA ACGAGTTTGCCTTTTTTTTTAGCGTCAGACCCCACA |
| | **Hex-31bp-21** | TGTAGCGCGTGTATCGATAA |
| | **Hex-31bp-22** | TAGCCTTTTTCGGAATAGGTTTTCATCGGCATTTTTTTTTCGG TCAATTTCGGAACCTTTTTTATTATTCTGTAAGTA |
| | **Hex-31bp-23** | AAACATGAAAAGGGTTGATA |
| | **Hex-31bp-24** | ATAAGTTTTTTGCCGTCGAGGTATTAAGAGGTTTTTCTGAGAC TCCGATTAGGATTATTTTTGCGGGGTTTTAGGCGG |
| | **Hex-31bp-25** | GCTCACCTCATAAATGTACC |
| | **Hex-31bp-26** | ATATTTTTTTCACAAACAAATTAAAGCCAGATTTTTATGGAAAG CGTGACAGGAGGTTTTTTTGAGGCAGGTGCCTTG |
| | **Hex-31bp-27** | CAGACCCGATTTCAAGATTG |
| | **Hex-31bp-28** | GACAATTTTTAAGGGCGACATGAGGGAGGGATTTTTAGGTAA ATATAATCAATAGAATTTTTAATTCATATGGCCAAA |
| | **Hex-31bp-29** | GTTTAGCTATCAATACCAGC |
| | **Hex-31bp-30** | TCCTTATTACCCATTAGCAA |

***Supplementary Table 14: Staple strand sequences for the twistedHex DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **twistedHex-1** | CCCGGTTTTTAATAGGTGTACAGGAGGTTTATTTTTGTACCGCC ACGCCACC |
| | **twistedHex-2** | GGTTGATATAAAAGCCCGAGGT |
| | **twistedHex-3** | GCCAGTTTTTTTACAAAATATTATTTATCCCTTTTTAATCCAAATA ACCAGA |
| | **twistedHex-4** | TTTCCAGAGCCATGATTAAGAC |

| | |
|---|---|
| **twistedHex-5** | AGTAATTTTTGCAGATAGCCTTTTGTTTAACTTTTTGTCAAAAATGCCTTTA |
| **twistedHex-6** | GAATACTTTTTGAAGCCAGTTT |
| **twistedHex-7** | CGGGGTTTTTTCAGTGCCTTGCCCGTATAAATTTTTCAGTTAATGCTGAATT |
| **twistedHex-8** | AACTGAATAAGACTGGTAACAC |
| **twistedHex-9** | AAGCCTTTTTAGAATGGAAATTTCGGAACCTTTTTTATTATTCTGAATCAAA |
| **twistedHex-10** | CAAATAAATCCACCCTCAGAAC |
| **twistedHex-11** | TCACCTCATAGTTTCGGAATGA |
| **twistedHex-12** | CACCGTTTTTACTTGAGCCAAGAGCCAGCAATTTTTAATCACCAGTCCATTA |
| **twistedHex-13** | GGTGAATTATAATCAGTAGC |
| **twistedHex-14** | AAGTGTTTTTCCGTCGAGAGTTTGAAGCCTTTTTTTAAATCAAGATTGACGG |
| **twistedHex-15** | CGTTTTTTTTTCATCGGCATCCCCCTTATTATTTTTGCGTTTGCCATATTAA |
| **twistedHex-16** | AGCGTCAGACTCTCAGTACCAG |
| **twistedHex-17** | CTCAGTTTTTAACCGCCACCACCCTCATTTTTTTTTCAGGGATAGCGTATAG |
| **twistedHex-18** | CCTCACCATAAACAGGAACC |
| **twistedHex-19** | ACGCTTTTTTAACGAGCGTCTCCTTATTACGTTTTTCAGTATGTTATTCAAC |
| **twistedHex-20** | ATCCTGCCACCCTCAGAGAATC |
| **twistedHex-21** | AGGAATTTTTACCGAGGAAAGGAATACCCAATTTTTAAGAACTGGCTAATTT |
| **twistedHex-22** | AGAAACGATTGAACAAAGTT |
| **twistedHex-23** | CGCAATTTTTAGACACCACGATTTTGTCACATTTTTATCAATAGAAGTTTAC |
| **twistedHex-24** | CAACAAATAACCGCAATTATAA |
| **twistedHex-25** | CAGAGTTTTTAGAATAACATAATAGCAATAGTTTTTCTATCTTACCAAGAAA |
| **twistedHex-26** | AAAATACAGTGAGTAAGCAG |
| **twistedHex-27** | TTAGATTTTTCGGGAGAATTCCTGAACAAAGTTTTTTCAGAGGGTAAATATC |
| **twistedHex-28** | AGAAACAATGAAAAAACAGGGA |
| **twistedHex-29** | TACCGTTTTTTTCCAGTAAGCTTTTGATGATTTTTTACAGGAGTGTTTTTAA |
| **twistedHex-30** | CCCCTGCCTAGCGCAGTCTC |
| **twistedHex-31** | CTTGATTTTTTATTCACAAACGCCACCCTCATTTTTGAGCCACCACGCCACC |
| **twistedHex-32** | AGGTCACATGGCGTCATAGACG |
| **twistedHex-33** | ATCACTTTTTCGGAACCAGAACCGCCTCCCTTTTTTCAGAGCCGCCTCATTA |

| | | |
|---|---|---|
| | **twistedHex-34** | GAGGCTTTTTTGAGACTCCTATTAGGATTAGTTTTTCGGGGTTTTGGTAGCG |
| | **twistedHex-35** | AACATGAAAGTCTTTTCATA |
| | **twistedHex-36** | GCAAGTTTTTGCCGGAAACGAACCATCGATATTTTTGCAGCACCGTCACCGT |
| | **twistedHex-37** | AGCACACCGGAGCCACCCATTA |
| | **twistedHex-38** | AAATTTTTTTATTCATTAAAGACAGAATCAATTTTTGTTTGCCTTTGCGGAT |
| | **twistedHex-39** | TAGTTGCTATAGGTAAATAT |
| | **twistedHex-40** | CGATTTTTTTGAGGGAGGGATTTGCACCCAGTTTTTCTACAATTTTTTACCA |
| | **twistedHex-41** | GCAAACGTAGAAGGGCGACA |
| | **twistedHex-42** | CAGCGTTTTTCCAAAGACAAAAAATACATACTTTTTATAAAGGTGGAAGAAA |
| | **twistedHex-43** | AATTCTTGAGAAGAAATATG |
| | **twistedHex-44** | AGAGATTTTTGATAACCCACTTAAGCCCAATTTTTTAATAAGAGCAAGCGCA |
| | **twistedHex-45** | ATTGACGCCAGCCGCGCGCT |
| | **twistedHex-46** | AGAACTTTTTCACCACCAGAGCATTGACAGGTTTTTAGGTTGAGGCATTGGC |
| | **twistedHex-47** | CCTCAGAATTTTTGGGAGCC |
| | **twistedHex-48** | TCACCGAAGGCAAGAGTACT |

***Supplementary Table 15: Staple strand sequences for the tHex-1 DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **tHex-1-1** | AAAGAAAAAAGTGCATCATACA |
| | **tHex-1-2** | AGGCTCGGTGTAAAGTATGCAG |
| | **tHex-1-3** | ATCAGCAAAATAAAAACTTGAG |
| | **tHex-1-4** | GCAACCTCCGTCGGATTTGTTG |
| | **tHex-1-5** | TCAATATAAAGTAAGCAATGAT |
| | **tHex-1-6** | TGTCGAAATCCAAGAACCGGAT |
| | **tHex-1-7** | TGAGGACTAAAAACGGAGATTT |
| | **tHex-1-8** | TTCGAGGTGAACGGAACGAGGG |
| | **tHex-1-9** | AGCTTTCCGGCCCAGGGTAATT |
| | **tHex-1-10** | TGCCTGAGTAAAGTATCGGCCT |
| | **tHex-1-11** | AACAAAGCTGCATTTTTAGAAC |
| | **tHex-1-12** | AAGAAAACAGTGCTTTAAAATC |
| | **tHex-1-13** | CTTCAAAGAGGTTTGATAATAT |
| | **tHex-1-14** | ACAGTCAAATATATAAGTGATT |

| | |
|---|---|
| **tHex-1-15** | TCAACATTAAAAACTAGCATGT |
| **tHex-1-16** | AGGCTACAGGCAATCATATCAG |
| **tHex-1-17** | TGGCTCATATTACCTTATGCGATTTGAACACAGATTAAGAAC |
| **tHex-1-18** | GCGTCTGGTAGGAACGCCATCAAACGCTACTCTTAATAATTC |
| **tHex-1-19** | GAGAGGGTAGCGTAATGGGATAGGTCACGTTAATTAATGCCG |
| **tHex-1-20** | GAGAGGGTAGCGTAATGGGATAGGTCACGTTAATTAATGCCG |
| **tHex-1-21** | CTATCATAACCGGTTGTACCAAAAACATTATTAAGAGCAACA |
| **tHex-1-22** | GATGGTTTAACTAATGCAGATACATAACGCCATTGGGCTTGA |
| **tHex-1-23** | TGACTATTAAATCAAAAATCAGGTACCGAAGGGACTTTACCC |
| **tHex-1-24** | GTAGCTCAAGCTTAATTGCTGAATGGCACACGAAATAATGCT |
| **tHex-1-25** | TTTGTTAATTTTGTTAAAATTCGCCGCATGCCCAATTAAATT |
| **tHex-1-26** | CAGAATTTTTCGAGTAGTAAAAAAGGAATTATTTTTCGAGGCATAGGACCCT |
| **tHex-1-27** | AGACGTTTTTGTCAATCATAACTGACCAACTTTTTTTTGAAAGAGGGGTGTA |
| **tHex-1-28** | ATACGTTTTTTAATGCCACTCAACCTAAAACTTTTTGAAAGAGGCACTAAAA |
| **tHex-1-29** | ATGACTTTTTAACAACCATCAACCGATATATTTTTTTCGGTCGCTGGGAGTT |
| **tHex-1-30** | CGCCATTTTTTTCAGGCTGCGGAAGGGCGATTTTTTCGGTGCGGGCTTACGC |
| **tHex-1-31** | GATGGTTTTTGCGCATCGTACCAGTTTGAGGTTTTTGGACGACGACTGTGTA |
| **tHex-1-32** | TTACCTTTTTAGACGACGATAGCGAGAGGCTTTTTTTTTGCAAAAGTAGTAG |
| **tHex-1-33** | AATAATTTTTAACGAACTAATTATTACAGGTTTTTTAGAAAGATTCATTTAG |
| **tHex-1-34** | TTAATTTTTTTCGAGCTTCATTCATTGAATCTTTTTCCCCTCAAATTCAGAA |
| **tHex-1-35** | TCTGCTTTTTGAACGAGTAGAGAGTACCTTTTTTTTAATTGCTCCTTCATTT |
| **tHex-1-36** | TATGTTTTTTACCCCGGTTGGCCCCAAAAACTTTTTAGGAAGATTGTTTAAA |
| **tHex-1-37** | GCCTGTTTTTAGAGTCTGGAATCGATGAACGTTTTTGTAATCGTAATGTGAG |
| **tHex-1-38** | CAGACTTTTTCAGGCGCATATTCATCAAGAGTTTTTTAATCTTGACGCGACCTGCTCTTTTTCATGTTACTTAGGCGC |
| **tHex-1-39** | CACTCTTTTTATCTTTGACCACCAAGCGCGATTTTTAACAAAGTACGACTTTTTCATTTTTTGAGGAAGTTTGGTAAA |
| **tHex-1-40** | AAAGGTTTTTCCGCTTTTGCCTCAGCAGCGATTTTTAAGACAGCATTTTCTTAAACATTTTTGCTTGATACCCCGACA |
| **tHex-1-41** | CAGCTTTTTTGGCGAAAGGGAGGCGATTAAGTTTTTTTGGGTAACGACCGCTTCTGGTTTTTTGCCGGAAACGCCATT |
| **tHex-1-42** | GAATATTTTTCCACATTCAATTTCAACTTTATTTTTATCATTGTGATATACCAGTCATTTTTGGACGTTGGGTACGTT |

| | | |
|---|---|---|
| | **tHex-1-43** | CGGCTTTTTTACAGAGGCTTGTATCATCGCCTTTTTTGATAAA TTGATTCATTACCCTTTTTAAATCAACGTCCTCAT |
| | **tHex-1-44** | GGTAATTTTTAGATTCAAAACCGGAGACAGTTTTTTCAAATCA CCAATTCAACCGTTTTTTTCTAGCTGATAGGTGTA |
| | **tHex-1-45** | ATATTTTTTTTTAAATGCAACAGGAAGATCGTTTTTCACTCCA GCCGTATCGGTTTATTTTTTCAGCTTGCTTAGCAA |
| | **tHex-1-46** | CCAATTTTTTACTGCGGAATACCGGAAGCAATTTTTACTCCAA CAGCCATTAGATACTTTTTATTTCGCAAACCTGTT |
| | **tHex-1-47** | AACGATTTTTGAATGACCATATAGTCAGAAGTTTTTCAAAGCG GATATTAAGAGGAATTTTTGCCCGAAAGACGCGTT |
| | **tHex-1-48** | TTGCGTTTTTGATGGCTTAGACATGTTTTAATTTTTATATGCA ACTCTGGAAGTTTCTTTTTATTCCATATACCCAAT |
| | **tHex-1-49** | TTGTATTTTTAACGTTAATAATCAGCTCATTTTTTTTTTTAACC AACCTTCCTGTAGTTTTTCCAGCTTTCACAATCA |
| | **tHex-1-50** | TAGCTTTTTTATATTTTCATAGCTGAAAAGGTTTTTTGGCATC AATGAGGGGGTAATTTTTTAGTAAAATGTTAGCGT |
| | **tHex-1-51** | CGAGTTTTTTAACAACCCGTGGGAACAAACGTTTTTGCGGAT TGACCTATTTTTGAGTTTTTAGATCTACAAGTCATT |
| | **tHex-1-52** | CATTATTTTTACATCCAATAAAGGCAAAGAATTTTTTTAGCAA AATCCTCAGAGCATTTTTTAAAGCTAAATCCTCGT |
| | **tHex-1-53** | GAACTGGATTAGACAACACG |
| | **tHex-1-54** | CGAACCAGCGTCATAAATAAAG |
| | **tHex-1-55** | TAGTTTGAGTCAGGATTAGATT |
| | **tHex-1-56** | ATCAATAATGGTCAGAAAAATA |
| | **tHex-1-57** | AACGCGCGTTGGGAAGAGAGCA |
| | **tHex-1-58** | TTTTGCCATCTACTAATAGAAG |
| | **tHex-1-59** | GAACTGGATTAGACAACACGC |
| | **tHex-1-60** | CGAACCAGCGTCATAAATAAAGC |
| | **tHex-1-61** | TAGTTTGAGTCAGGATTAGATTC |
| | **tHex-1-62** | ATCAATAATGGTCAGAAAAATAC |
| | **tHex-1-63** | AACGCGCGTTGGGAAGAGAGCAC |
| | **tHex-1-64** | TTTTGCCATCTACTAATAGAAGC |
| | **tHex-1-65** | TGACCGGCTGGACGAGCCCTGC |
| | **tHex-1-66** | ATTATCCCAGCGAACGAGCCGG |
| | **tHex-1-67** | TCACCGGGATCAAACGCCATTG |
| | **tHex-1-68** | CTGCAGGATGTTTGCGGATAGG |
| | **tHex-1-69** | ATCTGACCGTGAAAGCCAGGCC |
| | **tHex-1-70** | AGCCTTGAGAAGAAAGGGGGTG |
| **Modified** | **tHex-1-CholHandle-65** | ATGCTAAGGTCATCTCC GTGACCGGCTGGACGAGCCCTGC |

| | | |
|---|---|---|
| | **tHex-1-CholHandle-66** | ATGCTAAGGTCATCTCC GATTATCCCAGCGAACGAGCCGG |
| | **tHex-1-CholHandle-67** | ATGCTAAGGTCATCTCC GTCACCGGGATCAAACGCCATTG |
| | **tHex-1-CholHandle-68** | ATGCTAAGGTCATCTCC GCTGCAGGATGTTTGCGGATAGG |
| | **tHex-1-CholHandle-69** | ATGCTAAGGTCATCTCC GATCTGACCGTGAAAGCCAGGCC |
| | **tHex-1-CholHandle-70** | ATGCTAAGGTCATCTCC AGCCTTGAGAAGAAAGGGGGTG |

***Supplementary Table 16: Staple strand sequences for the tHex-2 DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **tHex-2-1** | ATAAAATAAGTGGTATCCTC |
| | **tHex-2-2** | CAGAGAATGACCGACCCGCC |
| | **tHex-2-3** | CAGCAACCCTTCTTTGCGAA |
| | **tHex-2-4** | CTTCACGAGCGGGCGAAGCG |
| | **tHex-2-5** | CAATAAAGCCTTGATTCCCA |
| | **tHex-2-6** | TTATTAGACCTGTACACAGG |
| | **tHex-2-7** | AGTACCCGCCCAGAACAGGC |
| | **tHex-2-8** | TTCCGGCACCCAGGGGTAGC |
| | **tHex-2-10** | TGTCAATCATCAAAAATAAT |
| | **tHex-2-11** | ATTCAAAAGGGAATCGATGA |
| | **tHex-2-12** | GATGGTTTAAAATGCAATGC |
| | **tHex-2-13** | GTCATAGCCCAACACCAGAA |
| | **tHex-2-14** | ATGAACATTCTGTAGAGTAT |
| | **tHex-2-15** | GCTAAAAAGGAAAAAACAAC |
| | **tHex-2-16** | AAAATCTGCGCAATAACGTA |
| | **tHex-2-17** | GCTTAGAGCTGCTTTTGCAA |
| | **tHex-2-18** | TAAGACCTGCCGCGAGCAAC |
| | **tHex-2-19** | TTCGCAACCGCCCTCAGTATTA |
| | **tHex-2-20** | GTTGGAGGCCGAGTTAATGTAG |
| | **tHex-2-21** | TGTTAACTTCACGAAAGAAATT |
| | **tHex-2-22** | CTATTGCAAGGATACAGTTTGA |
| | **tHex-2-23** | CTACGTTAATATTTGCGGGAGA |

| | | |
|---|---|---|
| | **tHex-2-24** | CATACATGGCTTTCATTACCCA |
| | **tHex-2-25** | ACCACCGGAACGCAGTCTCTGA |
| | **tHex-2-26** | ACTGTTATATTAACCGATGGGA |
| | **tHex-2-27** | ACGGCTTGCATAGCGGAGGATT |
| | **tHex-2-28** | GCAAAAGTAGTACTAATTATTT |
| | **tHex-2-29** | CTAGCCCAAAAGTTGTATGATA |
| | **tHex-2-30** | TTATAAAGAGTTTCATCCCAGT |
| | **tHex-2-31** | TCAGACTATTTCCCTGCCGATT |
| | **tHex-2-32** | TTTCTGTAAATACGTTATAAAC |
| | **tHex-2-33** | AAACGTCATGAACTTTTAGAAT |
| | **tHex-2-34** | TCAATTTTGATGCTCCTAACCT |
| | **tHex-2-35** | TACATAACGCCACGGTGTCTGG |
| | **tHex-2-36** | ACCGTACTCAGCTGACCAACTT |
| | **tHex-2-37** | GCCGCCGATCTGCGTAACAGCA |
| | **tHex-2-38** | AGCAACGGCTAGTATCGGTTTA |
| | **tHex-2-39** | CAACAGGTCAGGAATCCCCCTC |
| | **tHex-2-40** | AGTTTAACATGTAGCTCGACCA |
| | **tHex-2-41** | ATTTACAGACGGAGGCGGGAAT |
| | **tHex-2-42** | GAGTAACAGTGTTGATATAAGT |
| | **tHex-2-43** | ACCGGTTTTTAACCAGAGCCATTTACCGTTCTTTTTCAGTAAGCGTAATCAA |
| | **tHex-2-44** | CATTCTTTTTAGGCTGCGCAAGGGCGATCGGTTTTTTGCGGGCCTCCGCCAG |
| | **tHex-2-45** | TCTCCTTTTTGTGGGAACAAGACCGTAATGGTTTTTGATAGGTCACATGGGC |
| | **tHex-2-46** | AGGAATTTTTGATTGTATAAAAATTGTAAACTTTTTGTTAATATTTCGCATT |
| | **tHex-2-47** | TGATATTTTTTTCAACCGTTAATTAATGCCGTTTTTGAGAGGGTAGGAGATC |
| | **tHex-2-48** | TATTTTTTTTCAACGCAAGGTTAGAACCCTCTTTTTATATATTTTATTTCAA |
| | **tHex-2-49** | CATAATTTTTGGGAACCGAAGAGGTTTAGTATTTTTCCGCCACCCTACCCTC |
| | **tHex-2-50** | GCTGATTTTTGACTCCTCAAAGGATTAGCGGTTTTTGGTTTTGCTCGGATAA |
| | **tHex-2-51** | CAGTTTTTTTTCAGCGGAGTACCAGTACAAATTTTTCTACAACGCCCACAGA |
| | **tHex-2-52** | CTACGTTTTTAAGGCACCAATTTTTCACGTTTTTTTGAAAATCTCCCTCCAA |
| | **tHex-2-53** | TTTTGTTTTTCCAGAGGGGGATGTTTAGACTTTTTTGGATAGCGTCGAATCG |
| | **tHex-2-54** | ATAACTTTTTCCTCGTTTACTAAAAACCAAATTTTTATAGCGAGAGTAATTG |

| | |
|---|---|
| | CTGGCTTTTTGAAAGGGGGAGGCGATTAAGTTTTTTTGGGTA |
| **tHex-2-55** | ACGCGCTTCTGGTGCTTTTTCGGAAACCAGATTCGC |
| | GCATCTTTTTGTAACCGTGCTTGAGGGGACGTTTTTACGACA |
| **tHex-2-56** | GTATTCAACATTAAATTTTTTGTGAGCGAGTCGGAT |
| | AAATTTTTTTTTTGTTAAATTTTAACCAATATTTTTGGAACGCC |
| **tHex-2-57** | ATATGTACCCCGGTTTTTTTGATAATCAAAAAAC |
| | TACAATTTTTAGGCTATCAGGAGAGTCTGGATTTTTGCAAACA |
| **tHex-2-58** | AGAGTGAGAAAGGCTTTTTCGGAGACAGTTCAATA |
| | CGTAATTTTTCAAAGCTGCTATAAGGCTTGCTTTTTCCTGACG |
| **tHex-2-59** | AGACCTTATTAGCGTTTTTTTTGCCATCTAAAATC |
| | GCCAGTTTTTAATGGAAAGCCGCCTCCCTCATTTTTGAGCCG |
| **tHex-2-60** | CCACCACCCTCAGAGTTTTTCCACCACCCTACCAGA |
| | GACAATTTTTGAACCGGATATTTGATGATACTTTTTAGGAGTG |
| **tHex-2-61** | TACTTTTAACGGGGTTTTTTCAGTGCCTTATAGCC |
| | ACCACTTTTTCACCAGAGCCTTGACAGGAGGTTTTTTTGAGG |
| **tHex-2-62** | CAGGGGCCTTGATATTTTTTTCACAAACAAATTAAA |
| | CCATCTTTTTGCCCACGCATCGGTCGCTGAGTTTTTGCTTGC |
| **tHex-2-63** | AGGGCTTTTGCGGGATTTTTTCGTCACCCTAGACAG |
| | CATCGTTTTTGAACGAGGGTTCAGCTTGCTTTTTTTTCGAGG |
| **tHex-2-64** | TGAAAGCTTGATACCTTTTTGATAGTTGCGCAACAA |
| | TATAGTTTTTTCAGAAGCAACAAAAAGATTATTTTTAGAGGAA |
| **tHex-2-65** | GCCAATATCGCGTTTTTTTTTAATTCGAGAACCAG |
| | ACCGGTTTTTAAGCAAACTCAAATGCTTTAATTTTTACAGTTC |
| **tHex-2-66** | AGAGACCATAAATCTTTTTAAAAATCAGGGACTAT |
| | GGTGGTTTTTCATCAATTCTAGCATTAACATTTTTTCCAATAA |
| **tHex-2-67** | ATCCAAAGAATTAGTTTTTCAAAATTAAGATTCTG |
| | CGAACTTTTTGAGTAGATTTTTAGATACATTTTTTTTCGCAAAT |
| **tHex-2-68** | GGGTTTAGCTATATTTTTTTTTCATTTGTGAAAA |
| | CATAATTTTTAGCTAAATCGACATTATGACCTTTTTCTGTAATA |
| **tHex-2-69** | CTAAACGAACTAATTTTTCGGAACAACATAGAAA |
| | GATTCTTTTTATCAGTTGAGACCACATTCAATTTTTCTAATGC |
| **tHex-2-70** | AGAAAGTTTCATTCTTTTTCATATAACAGTCAGAG |
| | CGGAATTTTTTAGGTGTATCTGAAAGAGGACTTTTTAGATGAA |
| **tHex-2-71** | CGGAGGCGCATAGGTTTTTCTGGCTGACCAATCTT |
| | GTGCCTTTTTGTCGAGAGGGCCCGTATAAACTTTTTAGTTAA |
| **tHex-2-72** | TGCCCGGAACCTATTTTTTTATTCTGAAACTAAGAG |
| | AGAACTTTTTCGCCACCCTCCTGATAAATTGTTTTTTGTCGAA |
| **tHex-2-73** | ATCTCCATGTTACTTTTTTTAGCCGGAACGTCAAT |
| | CTGGCTTTTTCTTCCTGTAGAAGATCGCACTTTTTTCCAGCCA |
| **tHex-2-74** | GCTGCGTTTTCATCTTTTTGGCATTTTCGCGAGTA |
| | CTTTATTTTTATCATTGTGAGCGATTTTAAGTTTTTAACTGGCT |
| **tHex-2-75** | CACAGGACGTTGGTTTTTGAAGAAAAATAGCCTT |
| | GTAAATTTTTTTGGGCTTGACTGAGTAATGTTTTTTGTAGGTA |
| **tHex-2-76** | AAGACGGTAATCGTTTTTTAAAACTAGCATCGCGT |
| | ATGTATTTTTCCGTAACACTAGGAACAACTATTTTTAAGGAAT |
| **tHex-2-77** | TGCAAGAGGCAAAATTTTTGAATACACTACTTTGA |
| | CAGCCTTTTTCTCATAGTTAAAAGTTTTGTCTTTTTGTCTTTCC |
| **tHex-2-78** | AGGAATTTTCTGTTTTTTATGGGATTTTTTTCAA |
| | AAGGATTTTTGCCTTTAATTCAGAGGCTTTGTTTTTAGGACTA |
| **tHex-2-79** | AAGGGAAGTTTCCATTTTTTTAAACGGGTATGCCA |
| | TCATATTTTTAATATTCATTGATTAGAGAGTTTTTTACCTTTAA |
| **tHex-2-80** | TTAAGAGGTCATTTTTTTTTTGCGGATGAAGAAG |

| | | |
|---|---|---|
| | **tHex-2-81** | CCCCCTTTTTAGCGATTATAAACAAAGTACATTTTTACGGAGA<br>TTTCCCTCATTTTCTTTTTAGGGATAGCAGAACCC |
| | **tHex-2-82** | CTGAATTTTTTATAATGCTGTTTTAAATATGTTTTTCAACTAAA<br>GTAAAAGGAATTATTTTTCGAGGCATAGACTATC |
| | **tHex-2-83** | CCAGCTTTCACGGCCTCAGG |
| | **tHex-2-84** | GAAAATAGAGCCCGGATTGA |
| | **tHex-2-85** | GAATAGAAGAGTTTCGTCGA |
| | **tHex-2-86** | TAAAACGAGAATAATAATCC |
| | **tHex-2-87** | ATACTCATAAACAGTAAATA |
| | **tHex-2-88** | GACCGCGACCAAGGACGACA |
| | **tHex-2-89** | AGCCACCAGTATCATCGCAG |
| | **tHex-2-90** | GAAAATAGAGCCCGGATTGAC |
| | **tHex-2-91** | GAATAGAAGAGTTTCGTCGAC |
| | **tHex-2-92** | TAAAACGAGAATAATAATCCC |
| | **tHex-2-93** | ATACTCATAAACAGTAAATAC |
| | **tHex-2-94** | GACCGCGACCAAGGACGACAC |
| | **tHex-2-95** | AGCCACCAGTATCATCGCAGC |
| | **tHex-2-96** | GCAATGTGCTAATCTTTCAT |
| | **tHex-2-97** | CAGTATCTGGCGCCGCAAAC |
| | **tHex-2-98** | ATTTCAGCTACCCGTAACAC |
| | **tHex-2-99** | GCCTGTCATGCCCCGAAAAT |
| | **tHex-2-100** | ATTTATAAACACCACAAATA |
| | **tHex-2-101** | AGTGACATTCCTTATATTAC |

***Supplementary Table 17: Staple strand sequences for the scHDT6 DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **Core strands** | **scHDT-1** | GATACATAATTTTAAGAACTGG |
| | **scHDT-2** | TCAAAAAGATTTCCAATACTGC |
| | **scHDT-3** | TCCGCGACCTTTTAAGAGGAAG |
| | **scHDT-4** | TGGATAGCGTTCGCCAAAAGGA |
| | **scHDT-5** | GACAAGAACTTTGCTCCATGTT |
| | **scHDT-6** | TATGCGATTTTCGGATATTCAT |
| | **scHDT-7** | GCGCAGACGGTTTTTTTAATCATAAGGG |
| | **scHDT-8** | GGACGTTGGGATTTTTTGAAAAATCTAC |
| | **scHDT-9** | ACAAAGCTGCTTTTTTTATTCAGTGAAT |
| | **scHDT-10** | TTCATTGAATCTTTTTTCCCTCAAATGC |
| | **scHDT-11** | AGAGCAACACTTTTTTTTCATAACCCTC |

| | | |
|---|---|---|
| | **scHDT-12** | TATCGCGTTTTTTTTTTATTCGAGCTTC |
| **staple strands** | **scHDT-arm-1** | TACCCAAACGCATAGGCTGGCTTTCGGTGTAC |
| | **scHDT-arm-2** | ATTACGAGAGTTGAGATTTAGTTTGGTAGAAA |
| | **scHDT-arm-3** | CCCGAAAGCCCTGACTATTATTTTAAAAATCA |
| | **scHDT-arm-4** | GGAATCGTGTTTTGCCAGAGGTTTGGCTTTTG |
| | **scHDT-arm-5** | CTCATTATTGGTTTAATTTCATTTTAAATTGG |
| | **scHDT-arm-6** | ACTTAGCCGAGATTTGTATCATTTGAAACAAA |
| | **scHDT-arm-7** | TTTGAATACCACATTCAACGAACTAACGGAAC |
| | **scHDT-arm-8** | TTTTGACCTTCATCAATGACCAACTTTGAAAG |
| | **scHDT-arm-9** | TTTTCGCCTGATAAATCCAGACCGCCAGCGAT |
| | **scHDT-arm-10** | TTTGGGTAATAGTAAAGACGACGATAAAAACC |
| | **scHDT-arm-11** | TTTACTTTAATCATTGCCCTGACGAGAAACAC |
| | **scHDT-arm-12** | TTTAGTCAGAAGCAAAGTTCAGAAAACGAGAA |
| | **scHDT-arm-13** | CAAAAGAACATAAATAGTTTACCAATGTTTAGAC |
| | **scHDT-arm-14** | GGTCTTTAACTTCAAATTTAAACAGCGGATTGCA |
| | **scHDT-arm-15** | GTACAACGGGAACGAGAAAGCGAATGTGTCGAAA |
| | **scHDT-arm-16** | GATTCATCGCATAGTAGTTAATAAAACTAATGCA |
| | **scHDT-arm-17** | AGACCAGGTCAACGTAAACCGAACGAGTAATCTT |
| | **scHDT-arm-18** | GCTTGAGAACCAGTCAAAGGCTTGTGAATTACCT |

***Supplementary Table 18: Staple strand sequences for the scDDT6-small DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **scDDT-small-1** | CGAACAAAGGAAACCAATAATAACGGAATAGCGACGCGCGTT |
| | **scDDT-small-2** | CAAACAGATAAAAAAAATAGCAGCCTTTCACCACCCCCTCAG |
| | **scDDT-small-3** | AACCAGAAGTTAGATAAGAAAAGTAAGCGACTGTAAGAATCA |
| | **scDDT-small-4** | ATGAAATTGCCATCCAAAATCACCGGAATAATTGAGCGCTAA |
| | **scDDT-small-5** | CAATCAACTTAATTAGTGCGACTTGCGGACCGTTCAATGGAA |
| | **scDDT-small-6** | TTGAAGCGATTAGTCACCCAGCTACAATAAGCCAGCAGTAAG |
| | **scDDT-small-7** | GAATAACGGAAGCGGAGAATTAACTGAAGCCGCCACTCAGAG |

| | | |
|---|---|---|
| | **scDDT-small-8** | AGCATTGAACGATTCATATTATTTATCCAGTTACAAAATAAA |
| | **scDDT-small-9** | AAAATCACATTACCCCGGAAACGTCACCTAAGACTCCTTATT |
| | **scDDT-small-10** | TAGCGTTAGCAATACAATAATAAGAGCACAAGAATTGAGTTA |
| | **scDDT-small-11** | TAAGCACCCAGTCTCATTTGGGAATTAGCGTAGAAAATACAT |
| | **scDDT-small-12** | AATAAGAACAGGAGGTCAGACGATTGGCCTAACGAGCGTCTT |
| | **scDDT-small-13** | CCGCCACCAGAACCATTTTTTTCCACCAGAGCTTCACAAACATTTTTTTAATAAATC |
| | **scDDT-small-14** | TTCATCGGCATTTTCTTTTTTTGGTCATAGCCCACCACCGGATTTTTTTACCGCCTC |
| | **scDDT-small-15** | ACATAAACTTGAGCGGTAATAAGTTTTTTTTTTAACGGGGTCAAAGGTG |
| | **scDDT-small-16** | CAGAGGGTGAGGGCTTTTGTTTAACGTTTTTTTCAAAAATGAGACAAAA |
| | **scDDT-small-17** | CGTCATACATGGCTTTTTTTTTTTGATGATACCCATCGATAGTTTTTTTCAGCACCG |
| | **scDDT-small-18** | GAATAAGTTTTTTTTTTATTTTGTCGAAAATTCATTTTTTTTATGGTTTACCAGCGC |
| | **scDDT-small-19** | TAATCAGTACCCAAAAGTTTTTTAACTGGCATGATAATGAAAAGGAGTG |
| | **scDDT-small-20** | AATTATCATTTTTTTCCGTCACCGAGGTGGCAACATTTTTTTTATAAAAGAAACGCA |
| | **scDDT-small-21** | AGCAATAACAATCCGCTATCTTACCGTTTTTTAAGCCCTTTTCACCACG |
| | **scDDT-small-22** | GGGCGACATTTTTTTTTCAACCGATAAGGTAAATATTTTTTTTTGACGGAAATTATT |
| | **scDDT-small-23** | CTCATTATTTATCCTGATTTTTTATCTTACCAACGCTTGATACGCCGCC |
| | **scDDT-small-24** | CCTCAGACACCCTGAACTTTTTTAAAGTCAGAGGGCCAGAGCCCCTTAT |

***Supplementary Table 19: Staple strand sequences for the scDDT6-tall DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **scDDT-tall-1** | GATTGTTAGCGGAAGAGAAGTGTTTTTAGGGAGCTCCGAGGACGTCACCGTAGTAACAAA |
| | **scDDT-tall-2** | TAGTCTTATAAATAACGCGAGACCCTCAGGGTAGCGCATTAATATTATAGTCAGAACAAA |
| | **scDDT-tall-3** | AACACCTTTAGCGTCAGAGCTATCTAACTGGCCACGTATAACGTGCAAAAGAGTTATCAT |
| | **scDDT-tall-4** | AAATCCTTTTTTGTAAATAAAATTAAGACGCTGAGGAAAAATGTCAGTTGGCAAATACAA |
| | **scDDT-tall-5** | TCAACCAGCATTGACAGGAAGCGCACAATAATTAAAACAGAAATAATATTAAAACTAACA |
| | **scDDT-tall-6** | AGCAAATAAGAGTCATTTGCCCGTATAACTCATCTGGATCCCTGGCTTAGAGCTTAATTC |

| | |
|---|---|
| **scDDT-tall-7** | TTCGAGCCAGTCACATAAAAGGGACATTTTATACACCGTTTTTAGGAACATTCGGTAGTG |
| **scDDT-tall-8** | AACAACAGTTAATGCCCCCTTTCCAGCAGCCTATTAATTACATTTACAACAGTAGCCAGC |
| **scDDT-tall-9** | ACTAATAAGCAAAAGGAGAATGCCGCCGTCATAAGAACCAGGATATTTTCATTTGGAGCA |
| **scDDT-tall-10** | ACAACTATGAACAAAAGGTGGCCGCCGCGCTTAATTCACTTGATTACCGCCAGCCATCAG |
| **scDDT-tall-11** | TAGCGATTGCTGAACAAACCCTCAATCATTTTTAAAAACGATCATTAAAGATTTGTATTA |
| **scDDT-tall-12** | AATAACAGCGCCGCAAAATACAGGGCGAACCAGTCTAAAACTGGTAGCTATTTTTGGGAA |
| **scDDT-tall-13** | GCGTTTGAGATAACACACCCTATTTCAATTACCTGGATTAGAAATTCGACAACTCGAGAA |
| **scDDT-tall-14** | TTTAATGTAAAACAAAATACCGAACGAAATATAACAATCAAGACTCCTCGTTTCCACAAT |
| **scDDT-tall-15** | TTATCACAACGCAAAAGTAAGTACTTCTGAATAATAACAAAGTGAGGCCACCGAGTTTTC |
| **scDDT-tall-16** | AATGGATTACCGACATTCCAATGAATTTCCGATAGTTATAAATAGCGAGAGGCTTTCCCT |
| **scDDT-tall-17** | GGCTGAGATTAGTTAGCGAACATACCGACCGTGTGTAATGCGCAGAAGATAAAACAACCT |
| **scDDT-tall-18** | TTTGCGGGGAAGGGGCCCTTTAAGTTTGAAGCTGCTCATCAACGGGAGAAGCCTTTGGCC |
| **scDDT-tall-19** | AGCCCAATATTTTCTATTAAAAAGAGAATATAAAGTATTTACACAGAGATAGAACCGCCT |
| **scDDT-tall-20** | GATATCTGTATGGGATTTTGTCTTTCCCAATAAATTACTAGAAAAACTTCTGACGTCTGA |
| **scDDT-tall-21** | GAGGCGAATACATTGAAGTATTAGACTTGTTTAACATCAGAGCCATCTTCAGACCAGGGA |
| **scDDT-tall-22** | TTATCATTCAACCGATTGGTTAGCAATTTACGAATAAACAACATGTTTGCAACGATTAGT |
| **scDDT-tall-23** | ACGAGAACCGCCACCCTCCCGGTATATTTTATAGACTACCTTTTTAGAGGTGATGGCTAT |
| **scDDT-tall-24** | CGTAACCCTCAAACGCTGGTAATATCCATGTTTATTAAGTCCAAGGAATCCAAAAAACGT |
| **scDDT-tall-25** | TTTCAAAAATATTCACAAATTGTGATCGGTGGAACGAGTAGATTTTTGCGGACGGGTAC |
| **scDDT-tall-26** | CTAAATATCCGAGAATAGAGCCTTACAAGAGCGAGGCATAGTAAGCGGAGAGAGCATGT |
| **scDDT-tall-27** | AGATATTCATTGAATCCTGCAAAAATCGGCAAAATCCCTTGCGCCGCTTGCAGATAGCA |
| **scDDT-tall-28** | TATAAAAGGGTGAGAAAATTTCAACCTGTAGCCAGCTTTCATTCATTGAGATAGGTGAA |
| **scDDT-tall-29** | CTCGGAATACTCATTAAGGTTTAAAAAACAGGACAGTCAAATCACACTTTTGCATTAAA |
| **scDDT-tall-30** | ATTAATTGAGTAGCCCCCTGACCTAAACGGCAAGCCTCAGAGCATTTTAGCTCAAAGCG |
| **scDDT-tall-31** | GTTGAATCATTTTCAGGGGGAGTTAGGGTGGATGCTTTAAACAGTACCAAAATCAAAAG |
| **scDDT-tall-32** | TAGAATTAGCAAAATTAGGCGCGACTTCTGGTGCCGGAGGAACCGAGGCTGGCTTATTA |

| | |
|---|---|
| **scDDT-tall-33** | GGAACATAACGCCAAAAAGAGATCATGAACGGTAATCGAGG ACGTCCAAAAGGAAAGGA |
| **scDDT-tall-34** | CGCACAGTTGATTCCCAATTGCTGAGGTCGACTCTAGATTGA CCCCCTGATAAACAAAT |
| **scDDT-tall-35** | TCCAACCAGACCGGAAGGCAAAGCCTGTCGTGCCAGCTAAC GGCTGGTAAAAATTAAGA |
| **scDDT-tall-36** | CCGTGCACCCTGAAAGTTACGTAATGTGAAACAACAGGTCA GGATCCCTGACTGAATCG |
| **scDDT-tall-37** | ATAGGATTGACCGTAATGGCGCATAACTGACGAACCACCAC CAGATAACTGACCAC |
| **scDDT-tall-38** | CGTCATTTGAATTACCTATATCTGCTAAAGCATCACCTAGCTT AGCAGCCATAGTG |
| **scDDT-tall-39** | TGCCGGGCCTCTTCGCTATCATCGCCAGCGATGAGTAACAG TGCCAGTTACATTAA |
| **scDDT-tall-40** | CAATTTTTCTTTTCACCCGCTGAGGACAATGCAGACGTTAGT AAAGAACGGGATCG |
| **scDDT-tall-41** | CCATTCGGCGCAGAGAGTAATGGCATTTTCGGTCATTAAGCC TTAGACGGAAGATG |
| **scDDT-tall-42** | TGTGAGCAAATCAATTTAATCTTGACGGAAATTATCCAAAAGT ACCGAATTAGAAC |
| **scDDT-tall-43** | TCGCGTCCCCTGACAGAACGAGACTTGAGCCATTTCCACCA GAAGTTATTAATCCT |
| **scDDT-tall-44** | TTATCCACTATTAAAGAAAAGGCTTGGGAAGGCGCCAAAGAC AAAATACATAGAAA |
| **scDDT-tall-45** | AATAGCCTAAACAGGCTTTTGGCCACCACCCTCATTACCGCG CCTTATCAAAAGGT |
| **scDDT-tall-46** | GCTTTCCGAAAGAGCGGTGTATTCATAATCAAAATCCTTGAG GGTAACTTCGCGCA |
| **scDDT-tall-47** | CAATCATAACTGGCATCGGTTAGTTTCAGCGGAGTCATCCTA AACGTAGTACAGGG |
| **scDDT-tall-48** | CGAGCTCAATACACCCGCGACCGATTGGCCTTGATGAAAAT AGAGCCTAAATAGTG |
| **scDDT-tall-49** | TTTGCTTAGGTTGGGTTCCACCAGCGAACTGATAGCCCGTTT GAACTCCCGACTCA |
| **scDDT-tall-50** | GCTTGCAAAGCGCGCAACGGAGCCAGAATGGAAAGTCAATC CATCCCATGAAAACA |
| **scDDT-tall-51** | GGAGAAGATTGTATAAGATTGGGCGTGAATAGTAGCGACAG AATCTTAAGAATAAT |
| **scDDT-tall-52** | AAGGCGTAGATTTTCAGTACAAACGCCGTCAATAGATAATTA TTCGAACAAAGCCA |
| **scDDT-tall-53** | CTCTTGTTATCCGCTCATTAAACGACAGAGGGGTTTAGTACC GCCGCGTTTTGCTA |
| **scDDT-tall-54** | AACGTTAGAATCAGAGCTAATCAGAAACCACCAGAAGGTGG ATTACAGATAGGTAA |
| **scDDT-tall-55** | ATGGTGGCCATCGCCCGATATCCATGTACCGTAACCCAGAA CCATCGTGAGGCATT |
| **scDDT-tall-56** | TCCAGTCGACTAAATGAGGAAAAGAGAAGGATTAGTATTTGA GAGGTAGACCTAAA |
| **scDDT-tall-57** | AATATGCAGAACGCGCCGAACAATCCTGAGTAGAAGAAACC ACACCAACATATTTA |
| **scDDT-tall-58** | GCCAACGCAGCATCACGAAGGATTATTCTGAAACAAGCTACA TCTAAGAAGGCGTT |

| | |
|---|---|
| **scDDT-tall-59** | TAGTAGTATCATATGCGCTGGCCAATTGGCAGATTCACCAGTAATCCAAGTAGTCT |
| **scDDT-tall-60** | GCGCGCAGTCTGGGTAAGGGATGTCTGGAAGTTTCATTGCTCAACGTGCCAA |
| **scDDT-tall-61** | ACGACTGAGTAGAGTTGTTGCCCTATACTGCGGAATCGGGGGGTACTGTTTG |
| **scDDT-tall-62** | GCAGGGAATTAAATTTTTTAATATGTAATGTGTAGGTATTTTTTAGAAATAAT |
| **scDDT-tall-63** | CCTCACCGGATGCCAGTGATGGGCAATCATACAGGCAAATCAATTCCAGCCA |
| **scDDT-tall-64** | GGAGATTAGCGGGTGCCCCGGAAGTTTAATTCGAGCTTAGATTAACCCGCTT |
| **scDDT-tall-65** | AAGCACGTTGATAAAACGAAAATTCATATGGTAAAAGAAACGCAACGCTGCG |
| **scDDT-tall-66** | TAGTTTCGGACTAAATTGGCGAAACCACATTCAACTAAGGTCATTCTGGAGC |
| **scDDT-tall-67** | TCAAGGCTTGTGGCCTTCGCAAGGATAAAAAAAGATTCTTAAATTGTAA |
| **scDDT-tall-68** | TTCACAACAATTCCGAAGAAGTTTTGCCAGATCATAAACGGGCAACAGC |
| **scDDT-tall-69** | CCAAAAAATCAGAATCGTACAAAGGCTATCATGCAGATCTCCAACGTCA |
| **scDDT-tall-70** | GGACTTTGAGGGGAAACGGATTGCATCAAAACAAAGCGACACAACATAC |
| **scDDT-tall-71** | CCTTTATACCTGCCTGCAATATAATGCTGTACCATATACAGCTGGCGAA |
| **scDDT-tall-72** | CCACAACTTTGGCACCGGCTGAAAAGGTGGCGGCAAAGGTCACGTTGGT |
| **scDDT-tall-73** | ATAGAACTAAAAAGAGTGCCTGGATTCATCAAGGAATAAACCGTC |
| **scDDT-tall-74** | ATAGAGTGAGCTCACTGGAGGAAGCCCGAAAATCGCGTCATAAAG |
| **scDDT-tall-75** | TAAAGGGTTTACGGCCAATGTTTTAAATATGACGGTGTGCTGCAA |
| **scDDT-tall-76** | CGAAAGCGGTGAAAATCATAGTAAAATGTTTGCGTCCATCACCGC |
| **scDDT-tall-77** | CCAAAATCAGCCATCAAAACCCTCATATATTTGCCTGATTTGTTA |
| **scDDT-tall-78** | CCAGGGGACGTCGCACTCTACTAATAGTAGTTCCAATAGCATCGT |
| **scDDT-tall-79** | ACGTGACACCGAGAATTTCGATAGCAGCACCCCGAACAAAGG |
| **scDDT-tall-80** | GAGTATTTCAGACTTATGGTGTATCACCGTACTTGCGGAGCC |
| **scDDT-tall-81** | TGACACATAACCACGGCTCTAAAGTTTTGTCCCGCACTAAGC |
| **scDDT-tall-82** | AGGCGAAGTAAAACACCGTTTTAACGGGGTCATTATTTAAAT |
| **scDDT-tall-83** | GTATTATGAAGACAGGACCACCCTCAGAGCCGTCAGAGCGCT |
| **scDDT-tall-84** | AAACAAGTACGTTAAAAATCTTGCGAATAATAATTAGCTT |
| **scDDT-tall-85** | CCCTTAGCGCTATTGAATAACCTTGCTTAAATCAAGTAA |

| | |
|---|---|
| **scDDT-tall-86** | TGTAATTATTTAACGTAGGGCTTAATTGTAAAGCCTACA |
| **scDDT-tall-87** | AAGTGTAGGCGCTAGGAAGGGAAGAAAGGGCGAACGATT |
| **scDDT-tall-88** | ACCAAGTGCCTGATCATCGGGAGAAACACAGTAACACCG |
| **scDDT-tall-89** | GCAATTCCTGATTAGGAACGGTACGCCATTAAAGGAGTA |
| **scDDT-tall-90** | AATTTCATCAAATAAGACAAAGAACGCGGATGCAAAGGC |
| **scDDT-tall-91** | GACGATAGACAACAGGGAAAGCCCGGCCTTTATCGAA |
| **scDDT-tall-92** | TTATATATGTAAATGCTAGATTAATCGCCAA |
| **scDDT-tall-93** | AAGTGGAAACAGTACATCTAATATCCTCAGT |
| **scDDT-tall-94** | AAGAATTCTTACCAGTAAGCAGTAACGACAA |
| **scDDT-tall-95** | AAAAAACAGGAGGCCGAGAATCCTTTATCAT |
| **scDDT-tall-96** | AATGTCAGATGAATATAATATTTATGAGGAA |
| **scDDT-tall-97** | AGGAAGAACGACAGGTGCATCACCAGAG |
| **scDDT-tall-98** | CACCCTCGCCACCCCACCGGAAGTACCT |
| **scDDT-tall-99** | CGTTGCGCTAACTCAAGCCTGGGGGTTT |
| **scDDT-tall-100** | TGTACTGTTTTGATCGTTCCATATATGT |
| **scDDT-tall-101** | TGTCACAACGGAATAGCCCCCGTGGCGA |
| **scDDT-tall-102** | AGGTAGACGGAACATAAAGCAACCCTAA |
| **scDDT-tall-103** | CACCAATAGCAAGGAATCACCGATTTTA |
| **scDDT-tall-104** | TATAGCCGAGAGGGCAGTACCATCCAAT |
| **scDDT-tall-105** | AGTTAGCCCACAGATACAAACAACGCTC |
| **scDDT-tall-106** | AGCAGGCCCACGCTCCCTGAGTTCGTCA |
| **scDDT-tall-107** | AGGAACGCTCATTTTCGCATTAGAGCCA |
| **scDDT-tall-108** | TAAAACGTCCCAGTATTAAGTTCTGAAT |
| **scDDT-tall-109** | AAATCGTAATCCTTACATGGCGTAA |
| **scDDT-tall-110** | CGGATTCTACAAAACAGAGCCAGAG |
| **scDDT-tall-111** | AGGAGCGGCGGTCAAGACACCATCA |
| **scDDT-tall-112** | CATATTCATCAATATACCATTGAAA |
| **scDDT-tall-113** | AACTTTTTCTTCTGTGCCGTCCGGA |
| **scDDT-tall-114** | TCGCCATTAGGCAGTAGCATTGTAA |

| | | |
|---|---|---|
| | **scDDT-tall-115** | CTGTAATCATCAATTCAGAAAAGCCCCATTTCAACCGT |
| | **scDDT-tall-116** | TAACCTGAAAGCTATTCTCCGTGGGAACTCATCAACGG |
| | **scDDT-tall-117** | GTCTTTATAGAGAGATAGCTGTTTCCTGTGCCACTGGA |
| | **scDDT-tall-118** | TTAATGCAGCAACATGTTCCAGTTTGGATAATTGTTCA |
| | **scDDT-tall-119** | GTCATTTAGTTTGATGTTGGGAAGGGCGTCGAAATTAA |
| | **scDDT-tall-120** | GATAAAATCAGAAAGCGTATTGGGCGCCAAAGGCCCTT |
| **Hub strands** | **scDDT-tall-Hub-1** | CCATTCAGGTTTTTTTCTGCGCAACCCATTAGATACATTTTTTTTTTCGCAAATGGTCAA |
| | **scDDT-tall-Hub-2** | GAATTCGTATTTTTTTATCATGGTCTACCTTTAATTGCTTTTTTTTCCTTTTGATAAGAG |
| | **scDDT-tall-Hub-3** | GAGTAACAATTTTTTTCCCGTCGGAAATCGGTTGTACCATTTTTTTAAAACATTATGACC |
| | **scDDT-tall-Hub-4** | CGAGATAGGTTTTTTTGTTGAGTGTCTATCATAACCCTCTTTTTTTGTTTACCAGACGAC |
| | **scDDT-tall-Hub-5** | ATGTACCCCTTTTTTTGGTTGATAAATGATATTCAACCGTTTTTTTTTCTAGCTGATAAA |
| | **scDDT-tall-Hub-6** | CTGTAGCGCTTTTTTTGTTTTCATCCTTGACAAGAACCGTTTTTTTTGATATTCATTACCC |
| | **scDDT-tall-Hub-7** | CTGCCTATTTTTTTTTTCGGAACCTCACCAACCTAAAACTTTTTTTTGAAAGAGGCAAAAG |
| | **scDDT-tall-Hub-8** | TGCTAAACATTTTTTTACTTTCAACTATCAGCTTGCTTTTTTTTTTTCGAGGTGAATTTCT |
| | **scDDT-tall-Hub-9** | CGCGGGGAGTTTTTTTAGGCGGTTTACGAGAATGACCATTTTTTTTAAATCAAAAATCAG |
| | **scDDT-tall-Hub-10** | AGGGAGGGATTTTTTTAGGTAAATAATTGTGAATTACCTTTTTTTTTATGCGATTTTAAG |
| | **scDDT-tall-Hub-11** | AGAACCGCCTTTTTTTACCCTCAGACGGGATCGTCACCCTTTTTTTTCAGCAGCGAAAGA |
| | **scDDT-tall-Hub-12** | AGGTTGAGGTTTTTTTCAGGTCAGACTGCTCCATGTTACTTTTTTTTTAGCCGGAACGAG |
| | **scDDT-tall-Hub-13** | TTCTGTCCATTTTTTTGACGACGACAGCATGTAGTTTTTTTAATCAATAATCGGC |
| | **scDDT-tall-Hub-14** | CAAAATCATTTTTTTTAGGTCTGAGCCTGAATCTTTTTTTTACGCTAACGAGCGT |
| | **scDDT-tall-Hub-15** | ATCAAAATTTTTTTTTATTTGCACGAAGAGCAAGTTTTTTTATGAAATAGCAATA |
| | **scDDT-tall-Hub-16** | AATAAACACTTTTTTTCGGAATCATGCAAGCAAATTTTTTTTATAGAAGGCTTAT |
| | **scDDT-tall-Hub-17** | TATGGTTGCTTTTTTTTTTGACGAGATGATTAAGTTTTTTTTTATTACGCAGTAT |
| | **scDDT-tall-Hub-18** | AAACATCAATTTTTTTGAAAACAAATTACAGAGATTTTTTTACATAAAAACAGGG |
| | **scDDT-tall-Hub-19** | AAAGTAAGCTCAATCCTGAAAGCGTAAGAATTTTTTTGGCACAGACAATAT |
| | **scDDT-tall-Hub-20** | CTACCATAGTAACATCTGTCCATCACGCAATTTTTTTCCGTTGTAGCAATA |

| | | |
|---|---|---|
| | **scDDT-tall-Hub-21** | AATTTATCGCTGAGTGAAAGGAATTGAGGATTTTTTTATCTAAAATATCTT |
| | **scDDT-tall-Hub-22** | ATGAAACTAGGAGCTCCTTTGCCCGAACGTTTTTTTTATTTTAAAAGTTTG |
| | **scDDT-tall-Hub-23** | AAATAAGTTTTGAAGGCGGTCAGTATTAACTTTTTTTCTGCAACAGTGCCA |
| | **scDDT-tall-Hub-24** | CGCGTACCTTCTTTAGGAAAAACGCTCATGTTTTTTTACCTACATTTTGAC |

***Supplementary Table 20: Staple strand sequences for the mHex DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **Mhex-core-1** | AAAAGTACTAATAGTGCAACA |
| | **Mhex-core-2** | TCAGACGAAGGCCGGGTTTAC |
| | **Mhex-core-3** | ATCATGGGCTCACAGTGTAAA |
| | **Mhex-core-4** | CAAGGCGACAAACGGGCGGAT |
| | **Mhex-core-5** | GTGAATTTGATAAATTTCATG |
| | **Mhex-core-6** | ACCAGACGTTGAATTTAACAA |
| | **Mhex-core-7** | CGCCAGGCCCGTCGTAAGCAA |
| | **Mhex-core-8** | AGTCACAGGCCGATAAAGGAG |
| | **Mhex-core-9** | TGCGCAAGCATCTGTGAAACA |
| | **Mhex-core-10** | TATGTTAAACATATTATTTTGTC |
| | **Mhex-core-11** | CTTGCAGCCTCAGCCGGCTACAG |
| | **Mhex-core-12** | TCCTGCCAGCTTTCCGGACGGATT |
| | **Mhex-core-13** | TGATGATGTCAGTGTGCCCCCTGCC |
| | **Mhex-core-14** | CCTGAGCGTCGCTAATAAATTAATGCC |
| | **Mhex-core-15** | TAGTCTTCATTAAACAGAGGTGAGGCGG |
| | **Mhex-core-16** | AGTTTAAACAGCTTGATCCACCCTGCCGTCG |
| | **Mhex-core-17** | CGCCTGACTGAGAAAAGGGTGAGAAAGGGTG |
| | **Mhex-core-18** | GAAACAATCACCGGAATTTTTTTCCAGAGCC |
| | **Mhex-core-19** | CAGCAGTCACGACGTTGTTAAATGAACGTTA |
| | **Mhex-core-20** | ACCACCGTAGCCCCCTTTTTTTTATTAGCGT |
| | **Mhex-core-21** | AGCGAATACCAAGTTACGCGATAGCAGTCAA |
| | **Mhex-core-22** | ATTTACAACAGGAAAGAAAGGAAGGGAAAACA |
| | **Mhex-core-23** | TCCCTTGCTTTCGAGGTTCATTTTTCAGAAAAGC |
| | **Mhex-core-24** | TTGCCATCTAAGGGAAACCTGTCGTACTGCCCAGTATC |
| | **Mhex-core-25** | GGCCTCATTTTTTGGAAGATCGCACTCCAGTGATGAGTG |
| | **Mhex-core-26** | TGTTACTTTTTTTTAGCCGGAACGAACACCAGGTTTTAG |
| | **Mhex-core-27** | GCAGCACTTTTTTCGTAATCAGTAGCCGCCACTAGAACC |

| | |
|---|---|
| **Mhex-core-28** | GCCAGAATTTTTTTCCTGAGAAGTGACCTACACCTAATT |
| **Mhex-core-29** | GCCTGGGCCGGAGACTTAGATTAAGACGTTGCTTTTGTT |
| **Mhex-core-30** | TATTAAATAAGAAGGGAAGCGCATTATAGAAAAGGTGGCA |
| **Mhex-core-31** | TTTCATTTGAAAATAATAATTTTTTCTACAAACTCTGGAG |
| **Mhex-core-32** | AGGCTATGAGAATCGATGTTTTTTTAACGGTAATCGTAAA |
| **Mhex-core-33** | CAAACAACAGGTCAAATGGAAACAGTACTAATTACAAATC |
| **Mhex-core-34** | GCGCGAGGTGTTGTTCCATTTTTTTGTTTGGAACAATCAAA |
| **Mhex-core-35** | GTCTGGACTTGACGGGGATTTTTTTAAGCCGGCGAATACCA |
| **Mhex-core-36** | TCGGTTGAGCTGATTGCCTTTTTTTCTTCACCGCCTCTGGT |
| **Mhex-core-37** | GATTAGACAATACTGCGGTTTTTTTAATCGTCATAACAGTT |
| **Mhex-core-38** | AGGTAAATCACATTAATTTTTTTTTGCGTTGCGCTCGCCAG |
| **Mhex-core-39** | CCTGTAGATTGCGACAAGCAAGCCGTTTTACCGCATAAGAG G |
| **Mhex-core-40** | AACATGTTGCTATTCCAAATCAACGTAATGAAAGAGCAAAAG |
| **Mhex-core-41** | TTAATTTGCGACCTTTGAATCCCGACTAAAGACTTTTGTGTC |
| **Mhex-core-42** | TTGACAGGAAACCAAGAGAGTTGGAAAATTCATATGAAACGT |
| **Mhex-core-43** | GCCACCCTAGCGTCGGGTGGTTTTTCTTGTAATACTCGCAAG |
| **Mhex-core-44** | TACCATAACGCGAGAACATTATGACCCTTTCACCAATCAAGT |
| **Mhex-core-45** | TCATTCCTTACCGCCAGCGGAGTGAGAAAGTTAGCTCTTTAC |
| **Mhex-core-46** | GTAGAAATCAACTAGGCATAGTAAGAGCGAAAGCGTAAAGG G |
| **Mhex-core-47** | TAAGAATCCCTGAAGAGAGATAACCCACACTCGTATTATAAA |
| **Mhex-core-48** | GATTAGTTCAGCTATTAGAGCTTAATTGGGCTTTTGGACAGA |
| **Mhex-core-49** | GAGGCCAAGGAAAATAAACAGCCATATTAACATGTCAATTCT |
| **Mhex-core-50** | CAGTGAAGGGAACCGGGGTAATAGTAAATTGATAACAACAAT |
| **Mhex-core-51** | AAGCCCGATTATAGCAGACAGCCCTCATTAGAAAGCATCGTA |
| **Mhex-core-52** | TGCCAGTCATTTTCTTCCATATAACAGTAAGGGAGAATCAGT |
| **Mhex-core-53** | TCAATTCAATAGCCCAAACAATTCGACAAAGAATTGAATTAA |
| **Mhex-core-54** | TTGCAACCCGAGTAAAATCGGAACCCTATGATTCCAATTTAG |
| **Mhex-core-55** | TTGCCTTTCAGAGCTATTTGCACGTAAAAATCCAATTTTGCG |
| **Mhex-core-56** | ATTGCGTCTATATGTTCAACGCAAGGATGGAGAGGGGCATTT |
| **Mhex-core-57** | GGTACCGACGCCATCAAAAATAATTCGCCTAGAGGTCAATTA |
| **Mhex-core-58** | ATCATAATAAGGCTTGCGGGAGGTTTTGTGTTTATGAGGTCA |
| **Mhex-core-59** | TAAAGGACATTCCATCAGAAGCAAAGCGGATTGAGTACAACG |
| **Mhex-core-60** | CTTTGCCAATATCACAAAGTCAGAGGGTAATAAGGTAAATCA |
| **Mhex-core-61** | GCAGAGGTACAAAAACGCTCATGGAAATTTTTTATCCCCCGA |

| | |
|---|---|
| **Mhex-core-62** | ACAAAGATCAAAATCACCACCCTCAGAGCGACAGAGTGAGAC |
| **Mhex-core-63** | AGCGCCACGACGACGCTTTCCAGAACCTATTATTCCCAGTTT |
| **Mhex-core-64** | CTGAACAAAACACCAGTAGTAGCATTAAAAATCCCTTAAATC |
| **Mhex-core-65** | AAATAAGATCGCCATTAGTTTGACCATTTTTTGGGAATTAAC |
| **Mhex-core-66** | GCCCAATGACTTTACGAGATAGGGTTGACTGAAAAAGCCTGT |
| **Mhex-core-67** | ATTGAGAAAACGATATATCCAGAACAATTCACGCAGTCGAGG |
| **Mhex-core-68** | TATATAAAGATTTTCTCCCTCAGAGCCGTTTCATCCGGTTTG |
| **Mhex-core-69** | GGAATCAAAGAACGTCAAATATCGCGTTAATCAGGGTAACGA |
| **Mhex-core-70** | CTTACCGTAGATAACTATTAAAGATTAACACCGCCATTAGAG |
| **Mhex-core-71** | CGAACCTTCCTGAATTTAATTGCTCCTTATGTTTAACGGTCA |
| **Mhex-core-72** | AGATAAGCCCGACTTGCCCTGACGAGAAGGCGCAGGACTGGA |
| **Mhex-core-73** | GCTTGTATGGGATTTTTTTTTTTGCTAAACAACTTTCATTTTG |
| **Mhex-core-74** | CCGCCCCAGAAGGAGCTTTTTTTGGAATTATCATCATAGTTTG |
| **Mhex-core-75** | CTGAAGAGTAATCTTGTTTTTTTACAAGAACCGGATATTGTAC |
| **Mhex-core-76** | TCATTTTTTACTAGCTGTTAATTAATTTTCCATTCATTATCCCCG |
| **Mhex-core-77** | CAATAACCTGTTTTATATTTTCGTTATACAAATTTTACCAGTATAAA |
| **Mhex-core-78** | GGAGAGGGTAGCTTTTGAGAGAAATATATGTGTTTTATAACCTTGCT |
| **Mhex-core-79** | TATATTTTAAATGTGCCTGAGTAAATCATAGGTTTTGAGACTACCTT |
| **Mhex-core-80** | CAACATGTTTTAATCAACTAAAAAAGTACCGATTTTGGTAAAGTAAT |
| **Mhex-core-81** | AACCAGACCGGAATACTCCAACCTAATTTACGTTTTGTAGAAACCAA |
| **Mhex-core-82** | TTAAGCAATAAAGTGAGCATAATAGTTAATTTTTTTTCTGACCTAAA |
| **Mhex-core-83** | TTAGTATTAAAAACGCAAGAAACAATTTTTTTTGAAATAGCAAGTAGA |
| **Mhex-core-84** | CGTTGTAGCTGGTATTTTTGTTTAACGTAACAGTATTTCGCAAATGGT |
| **Mhex-core-85** | TCGGTCAGAACCGCCAGGTTTAACGTCAGGCTTAGTTTAGAACCCTCA |
| **Mhex-core-86** | TGAACGGTCATTACTTGCACCCAGCTACCGACGACTAATGCTGTAGCT |
| **Mhex-core-87** | TGTGATAAAAGATGATGGCAATTCATCATGAAATAAGAATTAGCAAAA |
| **Mhex-core-88** | TCTAAAGACAGTTTGCCCAATAGCAAGCGCTGTCTGAGCTTCAAAGCG |
| **Mhex-core-89** | CAGAAATTTTTTTACGAGAATGACCATAAATCAAATTAATTCTTCCTTA |

| | |
|---|---|
| **Mhex-core-90** | AGAGGGTAGTACCAGCGGATTGACCGTTTTTTTAATGGGATAGGATTAG |
| **Mhex-core-91** | TTGCCCTTTTTTTCAGCAGGCGAAAATCCTGTTTGAAGGCAACCGACCG |
| **Mhex-core-92** | GACGACTTTTTTTGATAAAAACCAAAATAGCGAGACTGAATAAATAAAC |
| **Mhex-core-93** | CTGCATTTTTTTTTTAATGAATCGGCCAACGCGCGGAAAAATTGTTGGGT |
| **Mhex-core-94** | GGGCGATTTTTTTAAAACCGTCTATCAATCAAGTTAGATACAGGGCTTA |
| **Mhex-core-95** | AGGAACGAGCCGGAATCAATATTCCTTGAAAACATAAAAATCGATTCGTA |
| **Mhex-core-96** | ATTATCTTGAGCGCTCGAACGTTTCCGAAATCGGCACATCCAACGTTAAA |
| **Mhex-core-97** | TCCAAATTTTTTTAAAAAGGCTCCAAAATAACACTGAGTTTTTTTTTCGTC |
| **Mhex-core-98** | CACTTATACCAGTCAGGACGTTGGGTTTTTTTAAGAAAAATCTACGTCCAGC |
| **Mhex-core-99** | CCTACGGCCAGTGCCAAGCTTGCATTTTTTTTGCCTGCAGGTCGACTGTCTG |
| **Mhex-core-100** | AGAACTTTTTTTTCAAACTATCGGCCTTGCAATACTTCTTTTTTTTTGATTA |
| **Mhex-core-101** | CGTGGAAACCGAGGAAACGCAATAATTTTTTTTAACGGAATACCCAACAGTT |
| **Mhex-core-102** | AAACAACAGAGATAGAACCCTTCTGTTTTTTTACCTGAAAGCGTAAGCGAGC |
| **Mhex-core-103** | ACTATCCTCATTAAAGCCAGAATGGTTTTTTTAAAGCGCAGTCTCTGAGCCA |
| **Mhex-core-104** | ACTAGCAGTTAAAAAGCTTTCATCAACATAAAACGTTAATTGTATCGGTCCAA |
| **Mhex-core-105** | GCCTTTTTTTTCCTGTAGCCTTCGCATTAAATTTTTTTTTTTTGTTAAATCAGC |
| **Mhex-core-106** | ACAGAAGGGCGATCGGTAGATGGGGGCTGAGACTCCTCTTAAAGGTGAATCCGTA |
| **Mhex-core-107** | ATTTAATAAAAGGGACACAGAGCGCTGGCAAGTGTAGCAAGAATACACTACCAAA |
| **Mhex-core-108** | TATTTGATATTCACAAAAGTAGCAAAAGGGCGACATTCTCAATCAATATCCACCA |
| **Mhex-core-109** | ACAACATAGCTCGACGCAGAGGCGAATTCTTAGAAGATATTCAACCGTTACCAAT |
| **Mhex-core-110** | GTCGCGATTTTAAGAACACGGAGAAAACGGGTAAAATACGTACTCAGGAGGGAAC |
| **Mhex-core-111** | GAAAGCCGAACAAAGTTTATCTTTGCCAGCAGCAAATGCGCTACAGGGCGCCAGC |
| **Mhex-core-112** | ACGTATTTTTTTAACGTGCTCTGCGCGTAACCACCTTTTTTTACACCCGCCGCGCTT |
| **Mhex-core-113** | GATTATTTTTTTACCAAGCGCCACTACGAAGGCACTTTTTTTCAACCTAAAACGAAA |
| **Mhex-core-114** | TCGTCTTTTTTTTTCCAGACGTTAGTAATTTCAAATGCTTTAAAATATTCAGCTCCA |
| **Mhex-core-115** | GAAAGTTTTTTGAATTGAGGTAAAGCATCACCTTGTTTTTTTCTGAACCTCAAATAT |

| | |
|---|---|
| **Mhex-core-116** | AGTAATTTTTTCATTATCATTTTGCGGACAGCAAGCGGTCCACGGGCCCTGTCGATA |
| **Mhex-core-117** | TTTGGTTTTTTGAATTAGAGTGAGGGAGGGAAGGTTTTTTTTAAATATTGACGGAAA |
| **Mhex-core-118** | AGACCTTTTTTAGGCGCATAGGCTGGCTTTTCATAACCCTCGTTCGTGGCGCGGTAC |
| **Mhex-core-119** | GTAATAACAAGCGTGGACTCCAACGGAGTCCATACATTTGAGGATTTTTTTTTAGAAG |
| **Mhex-core-120** | TCAATAATCGAAATCAGATATAGAAGGCTTCGGTATTCTAAGAACTCCCATCAGGTCAG |
| **Mhex-core-121** | TAGCGTCGAGTACCCAAGAAAAATAATAGCGAGGCAACGAGTAGTATTTTTTTAATTGG |
| **Mhex-core-122** | GATTAGCGTTTTTTTGGGTTTTGCTCTGATATAAGTATTTTTTTTAGCCCGGAATAGGT |
| **Mhex-core-123** | TTTAATGGTTATATAATCCTGATTGTTTGTTACTTCTGAATAATGTATATTTAGCTAAA |
| **Mhex-core-124** | TCTGTAAATCAAAAGAAGATGATGAAACATTTTTTTTTTTTTTATATAAATCTCTACAA |
| **Mhex-core-125** | AGCTAACGATTCAAGAGTCAATAGTGAAAACAATACACCGCTTCTGTTTTTTTTGTGCCG |
| **Mhex-core-126** | TTTAACCTCCGATGAATATACAGTAACAGTTTTTACATCGGGAGATTTATCAAATGTGT |
| **Mhex-core-127** | TTTAGAGAGTTTCAGAGCCAGTAATAAGTCCAGAGTTTTGACGCTCTTTTTTTTAATCGT |
| **Mhex-core-128** | TCTGTCCAGAAATTTTATCCTGAATCTTATGCTAACGAGCGTCTTAGAATATGTACGGT |
| **Mhex-core-129** | GGGCAACTACCAAAAAAACTTTTTCAAAGAAGGGTCAGAACCACCATTTTTTTTCCAGAG |
| **Mhex-core-130** | GCCAACGCTCCAAAAATGAAAATAGCAGCTACAGAGAGAATAACACATATGCATTTGGG |
| **Mhex-core-131** | TACTCTTCGCTATTACGCCAGCTGGTTTTTTTCGAAAGGGGGAGTTGCGCCGACTTTTTTTTAATGACAA |
| **Mhex-core-132** | ATCACCAGCATAAAATTCCAC |
| **Mhex-core-133** | CCTATGAAATTGTTATCCTCAT |
| **Mhex-core-134** | TACAGGCATGGTGGTATTAATTTTAAAATTCCTG |
| **Mhex-core-135** | CCTGACTAAAGACTGGTATTAAACCAAGTTATTTTGAACAAC |
| **Mhex-core-136** | TCAAAAGTACTAATGGAATCATAATTACGACGGGAGAGTTAA |
| **Mhex-core-137** | AAGTTTTGGATGGCATGCAGAACGCGCCAAGCCTTGCTCATT |
| **Mhex-core-138** | GGAGAAGGGCGCCAAGACTGTAGCGCGTCCACCCTTAAAGAA |
| **Mhex-core-139** | AAAGATCTCATCGAGATTACCTTTTTTTTGCCTGAGCATCAA |
| **Mhex-core-140** | GCGAACGAAGCACTAAAGAGTCTGTCCAATTACCGCCAATCC |
| **Mhex-core-141** | TTTTTGCGCCAGAGGAACTGACCAACTTCAAAGCTAAATCAA |

| | |
|---|---|
| **Mhex-core-142** | TGCCGTAAGTAGATTATTTAACAACGCCATTTATCCCAGCCA |
| **Mhex-core-143** | CGTATTGCCTTTATTAAATGCTGATGCAACAGAAACAGAACC |
| **Mhex-core-144** | CGATATATCGTTTAGTACCGCCACCCTCCGCC |
| **Mhex-core-145** | GTAAGCGGCTATCACCGTCACCGACTTGAATT |
| **Mhex-core-146** | AACGGAACGAAACACTCATCTTTGACCCTAAT |
| **Mhex-core-147** | TTAAGACGATGGTCAGTTGGCAAATCAAAAGA |
| **Mhex-core-148** | ACAATATCACGTACTATGGTTGCTTTGAAATA |
| **Mhex-core-149** | CAACCATAGAACCGCCATTTTTTCCCTCAGAACCGACCGATA TGTGCTG |
| **Mhex-core-150** | AAAGGAAGATTGTAGATTCTC CGTGGGAATTA |
| **Mhex-core-151** | AATGCGCAAAAATCAAGGTTATCTAAAAACCAGAAGGCACAG |
| **Mhex-core-152** | TTATTCAAAGAGAAGGTCACGTTGGTGTGCGGGCCCGTTCC A |
| **Mhex-core-153** | GAGGCAAGGTCACGTTCCTCGTTAGAATTTCTGGCACGAACT |
| **Mhex-core-154** | GTATCACCGTAATGCGAAACAAAGTACATGGCTCAGCATAAC |
| **Mhex-core-155** | CAAACCCAACCGATCCAGCAAAATCACCCAAATAAGGCATGA |
| **Mhex-core-156** | CGGGCGCATTACGAATGCAGATACATAACAAC |
| **Mhex-core-157** | TGAAAGTCAGTTAACCTTGAGTAACAGTTCAT |
| **Mhex-core-158** | AGGAAGTGTAGCAAAGCGAAAGACAGCATTCG |
| **Mhex-core-159** | CAGCGCCATAAGTTAAAAGAAACGCAAATCCT |
| **Mhex-core-160** | GTGCCACGATAAAAAATACCGAACGAACTTTT |
| **Mhex-core-161** | CCCAAAAACGTCAGAGCCACCACCCGAATTTCTGGGTAA |
| **Mhex-core-162** | GAGGTTCCATTTTTGTATCATCGCCACCTTATGCTGAGG |
| **Mhex-core-163** | CGGAAAAGACACCATTACCATTAGCATTGGCCTACGCAG |
| **Mhex-core-164** | TAAAATTAAGACGCATCGTAACCGTCTGTTGGTGGCTTT |
| **Mhex-core-165** | AGAAGCTGAGAAGGAGCACTAACAAAGCAGATTGGCTAT |
| **Mhex-core-166** | AGGATAGGGCGGGAGCTAAACAGGACGACCAGATTACAG |
| **Mhex-core-167** | TAGCATATGTACCCCGGAATTGTATGAGCGAGTAACAAGTTT |

| | | |
|---|---|---|
| | **Mhex-core-168** | CTATAGGAATACCACATGATTCATATTCACC |
| | **Mhex-core-169** | ATATTTATTGATAACAGGGATAGCAAGCTTAT |
| | **Mhex-core-170** | TCAGTAACCCTAAAACATCGCTAATGCGTTTTAAG |
| | **Mhex-core-171** | TATTTCGGTCTAAGTTTTAACGGGACAGGAGTTCAGGC |
| | **Mhex-core-172** | ACAATCAATACATACATAAAGGTGGCGCAAACGAGGCAGG |
| | **Mhex-core-173** | AGGCTTTGAGCCTGCGGGATCGTCACGGAGTTAAATCATT |
| | **Mhex-core-174** | ATATTTTTGTCAATGAACCCATGTACCGGGAG |
| | **Mhex-core-175** | CCGTCAAAAGCCCTCGAACTGATTCACTTGCCTGATAGCTAT |
| | **Mhex-core-176** | GAGGGGATTCGCCATGTACTGGTTTTCATAATCAACAGGCAA |
| | **Mhex-core-177** | ATTTTAGTTGGCAGCAGTTGAGAGACCTTCATCAAATGGATT |
| | **Mhex-core-178** | CACCAATGAGGTTGTAGAAAATAACAAAGAAACCAGCCAGCA |
| | **Mhex-core-179** | GAAATCCCAACTTTAAGGCCGCTATGAATTTTCTGAGATGGT |

***Supplementary Table 21: Staple strand sequences for the tiny Toroid DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **TinyToroid-1** | AGGCAAAGGCTATTTTTGCATCAAAAATAATTCGCGT |
| | **TinyToroid-2** | CTGGCCTTCTTCTACTAAAATTAAGCAATAAAG |
| | **TinyToroid-3** | TAATGCAGGCCTGAGAGTTGTTAAATCAGCTCATT |
| | **TinyToroid-4** | GCATGTCAATCATATGTACCCCACATTATTACGGTGTCATTGCT |
| | **TinyToroid-5** | AAACGAGAATGACACCTTTATGGAAGTT |
| | **TinyToroid-6** | TTTTAACCAAAAAAAAGGCGCCATCATACTGC |
| | **TinyToroid-7** | TTGCCAGAGGGGGTCAAAATAGAAAAGGT |
| | **TinyToroid-8** | TTTAGAAATTGGGATAGTGTGAATTACCTTATGCG |
| | **TinyToroid-9** | TCATTCCACTGAAGCCCTCAGAAGCTCATTATACCA |
| | **TinyToroid-10** | TAAGCAAATACTAAAGTACAGGTAGGTTCAGA |
| | **TinyToroid-11** | TAAAATTCGAATGCTGTGAATACCATTGAATCCCCCTCAAA |
| | **TinyToroid-12** | GTGAGCGAGTATTTGGGGTAAATCGGGAAGTT |
| | **TinyToroid-13** | GAGAGGGTAAATTAGCAATAGTAGTTACCAGACGACGATAAAAACAAT |
| | **TinyToroid-14** | ATCAGTTGGGTAATCGTAGTAAACGTTAATATTTTGT |

| | |
|---|---|
| **TinyToroid-15** | ATTTTAAGAATATAACAGTTAATAAAACGAACTA |
| **TinyToroid-16** | GTCAGGACGAATCTACGTTGATTCCACAGGTCAGGATTAGAGAGTCATA |
| **TinyToroid-17** | CATCCAATTAGGAACGCAGAGATCTACAAAGGCTAT |
| **TinyToroid-18** | AGAAGCCTTGAGTAATGTAATTGGGCTTGAGATGGTT |
| **TinyToroid-19** | AAAACATTGGCCGGAGATCGCTTGCCCTGACGAGAA |
| **TinyToroid-20** | ACACCAGAAAAATGGTCGTAATACTTCAAAAAGATTAAGA |
| **TinyToroid-21** | AATATCATTAAATTTTCTGGAGCAAACAAGAGAA |
| **TinyToroid-22** | GGCATCAACTGTAGCCAGAGCTGATAAATTAATGCCG |
| **TinyToroid-23** | ACGGAACAGGTTGATAACAAAAACAGGAAGATTGTA |
| **TinyToroid-24** | GGGTGAGAAAATGACCCTAATAACCTATATCG |
| **TinyToroid-25** | TCGATGAACAGATTTAGAGCTCAACTTTGCGG |
| **TinyToroid-26** | CAGGTCATTATACATAAAATTACGAAGAGCAA |
| **TinyToroid-27** | CGAACGAGCTTTAATCATAACCCTCATATATTTTAAA |
| **TinyToroid-28** | AATCACCATCAATATGATATTCCATAAAGCCGCGAGCTGCGAGAG |
| **TinyToroid-29** | TAATTTCAATAGATTTAACGCAAGGTTATAGT |
| **TinyToroid-30** | TGCAATGCCTTATTTCAGTTTGACCAGCGAAC |
| **TinyToroid-31** | TTCGCCGAGTAGTAGTAGGTAAAGATTCAAAA |
| **TinyToroid-32** | CCTCAGAGAACCGTTCTCTTTCATCAACATTAAAT |
| **TinyToroid-33** | ATGGCTTAGAGCTTATTCACATTCAAC |
| **TinyToroid-34** | CACTATCATAACCCGTCCAATACAGGCA |
| **TinyToroid-35** | CCTTTTGATAAGAGTTAAACAAAAGATTC |
| **TinyToroid-36** | CGTTTTAATTCGAGGATTGCATTTGCGGG |
| **TinyToroid-37** | CAGACCGGAAGCATGACTAATAAAAAT |
| **TinyToroid-38** | GCTTTTGCAAAAGCCCGAAATTGTACCA |
| **TinyToroid-39** | TGCTGTCATTATGTTTTAAATATGCAATTTAAATTAAACTA |
| **TinyToroid-40** | CAGAAGCAAAGCGCTTCAAATTAGATACAT |

| | | |
|---|---|---|
| | **TinyToroid-41** | AGTAAAATGTTTAGACTGGATAGCTCGTTAGCATTAA |
| | **TinyToroid-42** | AATCAAAAATCAGGTCTTTACCCAACTCCACAATTCTG |
| | **TinyToroid-43** | GGAAGACTTCAAGTTTAGCTATATTTTCAACAACCCGCAGTCA |
| | **TinyToroid-44** | GGAATCGTCATAAATAAAGTAGGCATTTGCTG |

***Supplementary Table 22: Staple strand sequences for the DNA disk DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **DNADisk-1** | ATCTAAAATTGCGAATTCAACAGTCGGTTTATCATTGAGG |
| | **DNADisk-2** | CTTGATACCGATAGTTGCGCGTTGAAATAAT |
| | **DNADisk-3** | TTTTCACCGACAATTGCTTTCGGCTGAG |
| | **DNADisk-4** | TTGATATACTGAGACTCCTCA |
| | **DNADisk-5** | CACCCAACAACCATCGATCGTCACGGAGTTAAAGGCCGCT |
| | **DNADisk-6** | CAGAGCCGCCACCCTCCCGGAACCGCCGCCAGCAT |
| | **DNADisk-7** | ATAGCAATAGTTAGCACCAGTATTTGCT |
| | **DNADisk-8** | TGTCTATGGGATCAAACTACAACGCCTGTAG |
| | **DNADisk-9** | AAACATTAACGGGGTCAGACCTATTATTCTGAACG |
| | **DNADisk-10** | CAGGTCAAAAGCGCAGTCTCTAATT |
| | **DNADisk-11** | GTAAGATTTCGGATGCCTTGAGATTAGCGGGGTTTTGCTCAGCGTCGT |
| | **DNADisk-12** | AAACATGAAAGTATTAAGAGGAGTATAGCAGTGCCGTCGAGAGGG |
| | **DNADisk-13** | CATTCCACAGACAGCCCTCAGCCCAATAGGAA |
| | **DNADisk-14** | TGACAGGAGGGCTGACTCAGAGCCACCACCC |
| | **DNADisk-15** | TGTATTTCAGCGGAGTGAGAATA |
| | **DNADisk-16** | TCAGAGCAGAATGGGACGATTGGGAGTGTACTGGTAAT |
| | **DNADisk-17** | AAGTTACTTAATGAATTTACCGTTCCA |
| | **DNADisk-18** | AATAAATCCTCATTAAAGCCCGCCACCAGAAC |
| | **DNADisk-19** | TTTGCGGGCCCACGCATAACC |
| | **DNADisk-20** | GAAAGGAACAACTAAAGGAGTTT |
| | **DNADisk-21** | AGTTTTACCAGGCGGATACCGGAATACGTACTCAGGAGGTTTAGT |
| | **DNADisk-22** | CAGTTAATGCCCCCTGCCTCGTCATACATGGC |
| | **DNADisk-23** | GAGCCACCACCCTCATAGAACCGCACACTG |
| | **DNADisk-24** | GCTTGACCAGCCGGACAGCCTCAGCAGCGAAAGACAGCATCGGAA |
| | **DNADisk-25** | TTTGCGGGCCCACGCATAACC |

| | | |
|---|---|---|
| | **DNADisk-26** | GAAAGGAACAACTAAAGGAGTTT |
| | **DNADisk-27** | AGTTTTACCAGGCGGATACCGGAATACGTACTCAGGAGGTTT AGT |
| | **DNADisk-28** | CAGTTAATGCCCCCTGCCTCGTCATACATGGC |
| | **DNADisk-29** | GAGCCACCACCCTCATAGAACCGCACACTG |
| | **DNADisk-30** | GCTTGACCAGCCGGACAGCCTCAGCAGCGAAAGACAGCATC GGAA |
| | **DNADisk-31** | GATATATTCGGTCAGGTGAATTTCTTAAACAG |
| | **DNADisk-32** | TTTTGATGATACAGCCTTGATATTCACAAACA |
| | **DNADisk-33** | GTAAATGAATTTTCTGGTCTTTCCAGACGTTA |
| | **DNADisk-34** | CCCATGTACCGTACACCCTCA |
| | **DNADisk-35** | CTCCAAAAGGAGCCTTATCTCCAAAAAAAAGG |
| | **DNADisk-36** | CGAGGGTAGATCAAAATCAAGCCACCAAGAACCGC |
| | **DNADisk-37** | ACCGCCACCCTCAGAACCGCCACCCTCTTTATCACGGTGTC AGGG |
| | **DNADisk-38** | AGAGAAGGATTAGGTAACAGTGCCCGTATAAA |
| | **DNADisk-39** | CACCACCAGAGCCGCCTCCCT |

***Supplementary Table 23: Staple strand sequences for the DNA brick DNA design.***

| | ***Name*** | ***Sequence*** |
|---|---|---|
| **staple strands** | **DNAbrick-1** | AACCGTTGCGAAGCTCTTTT |
| | **DNAbrick-2** | AAATTAAAAGGTAGCGTCGCCATTCCTGTAGCCTCACACCTT TT |
| | **DNAbrick-3** | TTTTCGGGTAACCCAGCAAATCCGATCAAGGCCCCGTCTTTA TG |
| | **DNAbrick-4** | TTAGAGTCGTGGGAGATGCTCGCGGGTGTGCC |
| | **DNAbrick-5** | AGGGTGAGATCGTGGTCCCTAACCTCGTGGTA |
| | **DNAbrick-6** | TCATCCCTCTGCCACCCCGTGCTCGGGTGACC |
| | **DNAbrick-7** | CATGTAGTCCAGGAATTAGTTAGGGCAGGTAC |
| | **DNAbrick-8** | GTGGGAATCAATATTCCAAATGGAGAAAGAAT |
| | **DNAbrick-9** | TTTTAAGCGTCTCAAGAGCATTTT |
| | **DNAbrick-10** | ATGAACCGTTAATATAATCAAGGTGCACCCTT |
| | **DNAbrick-11** | GGGACTGGGTCGCGCACCGTTTTTTCGAG |
| | **DNAbrick-12** | GTTTTGACCGCATAGAATCGCAGTCCTCTTAG |
| | **DNAbrick-13** | ACAGTCTAGTGGACCGTTTATATGATGGTGGA |
| | **DNAbrick-14** | CCGCCGACGCCCAACACATCCGCTTGGTCGTC |
| | **DNAbrick-15** | GTGTACCTTCGCCCAGGTCAGCCGGTGCGCTG |
| | **DNAbrick-16** | TTTTCTAAGGGTCGTCATTAATGTCTTCTATCAGATAAGCATG ACTACGATCTTTT |

| | |
|---|---|
| **DNAbrick-17** | TTTTAACTTAAACCAAGTACCATGAATGGCACCCAACGTCTAAG |
| **DNAbrick-18** | CGTTCCTTAGTTTACGTCTGTACCAAGAGCAA |
| **DNAbrick-19** | CTTCTGCAGGGACACTTCGACATCGGCCAGGT |
| **DNAbrick-20** | CCCCTAGACTCATATAGTGGAGCGCATCATGT |
| **DNAbrick-21** | TTTTGAACTACACAGCGCTAGAGCTTTT |
| **DNAbrick-22** | CTAATCTAGAACGCGCTAAACGAGTTCCAGTGGATCGAAAAATTCATC |
| **DNAbrick-23** | TGGTTGGGGCAAACGTCGCCGTCGGTAAATCC |
| **DNAbrick-24** | CACAGGTTTACTTTTCTGACCCGCAAGCAGTAGGTATATTGCCGACTC |
| **DNAbrick-25** | CGGGGGATTGAACTTCGCGAGT |
| **DNAbrick-26** | CGGAGCTGGTGCCCTAGACACTCTCTCAGAAG |
| **DNAbrick-27** | TAACGTAGCGCGTAGTGAGTCGTTGCTCAGCC |
| **DNAbrick-28** | GAAAGTCGCCTACAGTATACGGTTCAATACTATTCTGAGACATGAATTAAAC |
| **DNAbrick-29** | CTCATCCTCGTGATAAGCTAACAATTATTGTCGAGCTTCGCAACGGTTCGACCCTTTTT |
| **DNAbrick-30** | ATGGTGAAACAAAGTCGGCCGTCGAAAAGCGC |
| **DNAbrick-31** | TGTCTCGGCAGCGTACACCGGCTTCGCAAGTGTATTAGGCTTTT |
| **DNAbrick-32** | GACTACTTAGGAATCATGTTTGCGCATGGGTA |
| **DNAbrick-33** | TTTTACCAAGGAGGATCTTCTTTT |
| **DNAbrick-34** | GGCAGCAAGTCATGAACTGATACACTGTCACGTCGGGATGAGCCATCC |
| **DNAbrick-35** | CTAACACTTCTGGTATGTTTACGAACGACACC |
| **DNAbrick-36** | CGTCTAAACGAGATTGTGGTATTAAGTCATGT |
| **DNAbrick-37** | TAGTAGTACAGCCTCGTAACTGTATGCACCCA |
| **DNAbrick-38** | ACCCAATGTACAGGTCAAGTAGTGTTCTGATT |
| **DNAbrick-39** | CATCCACCGTTACCCTTCCGGTGACCGGCATA |
| **DNAbrick-40** | TTCCAACAAGACGTTAACAAACGAGTAGGCCGCATTGGGGCGTGTTTT |
| **DNAbrick-41** | GAGTGACATCGTCCACTAAGTTGACGGTTGAAGGCTCAGATTGAACCGTTTT |
| **DNAbrick-42** | CCTGAGACACACTTGAGCATCCAAATCGAAACGTATGTAACTTTGTGC |
| **DNAbrick-43** | AATGGCGACTTGCGACTCATGGGGACGCACATAATATACCATCCTTTT |
| **DNAbrick-44** | TTTAATTTGCTACAGGAACCTGTGACTCGCGAAGTCCGGC |
| **DNAbrick-45** | ATCCCCCGCTTCTGAGAGAGTGTCGAGTCGGCATTGTAGACGCTACCT |
| **DNAbrick-46** | TTTTCGCATTGTTTCATTTGCTGGGTTATTTT |
| **DNAbrick-47** | GTATCGGCGGCACACCCAGGGTCGACTACGCG |

| | |
|---|---|
| **DNAbrick-48** | CTACGTTATAGGGCACGGTTAGGGTTGTACTC |
| **DNAbrick-49** | CGGGGCCTTACCACGACAGCTCCGAGAATAGT |
| **DNAbrick-50** | ATTGAACCGTATACTGGAGCACGGCATAAAGA |
| **DNAbrick-51** | TTTTGGTCACCCTAGGTTTT |
| **DNAbrick-52** | TTTTTCTCCCACGACTCTAAATTCCTGGAACGACTCTTATCACG |
| **DNAbrick-53** | CGACGGCCGGCTGAGCACTACATGACCACGAT |
| **DNAbrick-54** | CTCACCCTGAATATTGCATGTCTCGCGCTTTT |
| **DNAbrick-55** | AAGCCGGTGTTTAATTATTCCCACGGTGGCAG |
| **DNAbrick-56** | AGGGATGAAGACGCTTGCCTAATACACTTGCG |
| **DNAbrick-57** | GTCAAAACGGATGGCTCATCCCGTTTT |
| **DNAbrick-58** | CCTAACTACGGTCCACACTGCGATCGAGGCTG |
| **DNAbrick-59** | AGGATGAGGACTTTGTACCTTGATGTACCTGC |
| **DNAbrick-60** | TCCATTTGAAGGGTGCTTCACCATTGATTCCT |
| **DNAbrick-61** | AAGTAGTCGTACGCTGAACGGTGCATTCTTTC |
| **DNAbrick-62** | TTTTCTTGCTCGAAAACCGAGACATCCTTTTT |
| **DNAbrick-63** | TCGTAAACCTAAGAGGTAGACTGTTATATTAA |
| **DNAbrick-64** | CGGTTCATTGTTGGGCCGCAAACAGGTGTCGT |
| **DNAbrick-65** | TAATACCATACCCATGGTCGGCGGGCGACCCA |
| **DNAbrick-66** | GTCCCTTTATTTATTGGAAGATCCACATGACT |
| **DNAbrick-67** | TACTACTAATACCAGACGGCTGACTCCACCATCATATAAACTTAGACG |
| **DNAbrick-68** | AGCGGATGCAGCGCACAGTGTTAGGACCTGTA |
| **DNAbrick-69** | CATTGGGTCAATCTCGATCTGATAGACGACCA |
| **DNAbrick-70** | TTTTGTAGTCATGCTTTTTAGACGAAGTAGTTCTTTT |
| **DNAbrick-71** | TTTTATGGTACTTGGCGTAAACTTACAGTTATACTAAGTACCAATTTT |
| **DNAbrick-72** | TCACCGGATGGGTGCAAAGGAACGCTGGGCGA |
| **DNAbrick-73** | AGGTACACAGTGTCCCCACTACTTTATGCCGG |
| **DNAbrick-74** | TTACATACAATCAGAATGCAGAAGGAAGACAT |
| **DNAbrick-75** | TAATGACGACCCTTAGAGATCCGGGCACAAAG |
| **DNAbrick-76** | GGTACAGATTTAAGTTGATTGCAATAACGTCT |
| **DNAbrick-77** | TGTTGGAAAGGGTAACCGCTCCACTTGCTCTT |
| **DNAbrick-78** | GATGTCGAACATGATGGGTGGATGGTGGACGATGTCACTCTTCAACCG |
| **DNAbrick-79** | TTTTGCTTGCTCTTGGATGCTTTT |
| **DNAbrick-80** | TTTTGCGCGTTCTCGTTTGTCAGCCACGCCCCAATGTTTTTACC |

| | | |
|---|---|---|
| | **DNAbrick-81** | GGAGACTTCGGCCTACTAGATTAGTATATGAG |
| | **DNAbrick-82** | TCTAGGGGACGTTTGCTCAACTTAGGATTTACTCTGAGCCTTTT |
| | **DNAbrick-83** | CGGTTCAACGACGGCGGATGAATTGTGAGATTGCAGGAGA |
| | **DNAbrick-84** | TTTTTTCATGACTTGCTGCCTCTATGCGTGTATCAGTTTT |
| | **DNAbrick-85** | TTTTAGTGTGTCTCAGGGTTTCGATTAGCGCTGACCTGGCC |
| | **DNAbrick-86** | CCTTTTGTGCCGGAACAATGCGAAGGTTTT |
| | **DNAbrick-87** | GCACGAACTACTTCCGGATCTTTTT |
| | **DNAbrick-88** | TTGCAATCAAGACCTTCGTTTGGTACTTAGTA |
| | **DNAbrick-89** | TAATCTCACGGTAAAAAAAGTCTCCTCTCCTGC |
| | **DNAbrick-90** | GGCGGGTCAGAAAAGTA |
| | **DNAbrick-91** | TGCAGGCCGACAATAATTGTTAGC |
| | **DNAbrick-92** | ATGAGTCGCAAGTCTACAATATGTGCGTGCCGATACGAGTACAA |
| | **DNAbrick-93** | TAGCCAATAAATAAA |
| | **DNAbrick-94** | GTGTGAGTGATCGGA |
| | **DNAbrick-95** | CCCAACCATGTAGTTC |
| | **DNAbrick-96** | TTTCGATCCACTGGA |
| | **DNAbrick-97** | TTGGGTGCCGTGACAG |

***Supplementary Table 24: Primers used for asymmetric PCR.***

| ***DNA nanostructures*** | ***PCR Product length*** | ***Fwd primer*** | ***Rev primer*** |
|---|---|---|---|
| **wHex 31 bp** | 751 | GGCGCAACTATCGGTATCA | CTCATTAAAGCCAGAATGGAAAGC |
| **pHex; scHDT6; scDDT6 small** | 882 | CGGTCTGGTTCGCTTTGA | CCAGCGATTATACCAAGCGC |
| **wHex 42 bp** | 1008 | GGCGCAACTATCGGTATCA | GACTGTAGCGCGTTTTCATCG |
| **DNA disk** | 1136 | CTACCCTCGTTCCGATGCT | GACTGTAGCGCGTTTTCATCG |
| **bpHex 31 bp** | 1229 | GCACTGACCCCGTTAAAACTTA | GACTTGCGGGAGGTTTTGAAG |
| **bpHex 42bp** | 1512 | GCCTCAACCTCCTGTCAAT | CAACGCTCAACAGTAGGGC |
| **Hex; twistedHex** | 1521 | GGGCTTGCTATCCCTGAAAAT | GACTTGCGGGAGGTTTTGAAG |
| **bpHex 52bp** | 1872 | CTTTGCCTTGCCTGTATGATTT | CCACCCTCATTTTCAGGGATAG |
| **bPHex 63bp** | 2268 | CCCTGGCGTTACCCAACTTA | GTAGCAACGGCTACAGAGGC |

| | | | |
|---|---|---|---|
| **tHex1** | 2462 | CCCTGGCGTTACCCAACTTA | TAATTGTATCGGTTTATCAGCTTGC |
| **tHex2** | 3400 | CCCTGGCGTTACCCAACTTA | GACTGTAGCGCGTTTTCATCG |

***Supplementary Table 25: Primers used for ssDNA production using T7 exonuclease digestion.***

| ***DNA nanostructures*** | ***PCR Product length*** | ***Fwd primer*** | ***Rev primer*** |
|---|---|---|---|
| **wHex 31bp** | 751 | G*G*C*G*C*AACTATCGGTATCA | CTCATTAAAGCCAGAATGGAAAGC |
| **bpHex 31bp** | 1229 | G*C*A*C*T*GACCCCGTTAAAACTTA | GACTTGCGGGAGGTTTTGAAG |
| **bpHex 42bp** | 1512 | G*C*C*T*C*AACCTCCTGTCAAT | CAACGCTCAACAGTAGGGC |
| **Hex; twisted Hex** | 1521 | G*G*G*C*T*TGCTATCCCTGAAAAT | GACTTGCGGGAGGTTTTGAAG |
| **bpHex 52bp** | 1872 | C*T*T*T*G*CCTTGCCTGTATGATTT | CCACCCTCATTTTCAGGGATAG |
| **bpHex 63bp** | 2268 | C*C*C*T*G*GCGTTACCCAACTTA | GTAGCAACGGCTACAGAGGC |
| **tHex1** | 2462 | C*C*C*T*G*GCGTTACCCAACTTA | TAATTGTATCGGTTTATCAGCTTGC |
| **tHex2** | 3400 | C*C*C*T*G*GCGTTACCCAACTTA | GACTGTAGCGCGTTTTCATCG |

***Supplementary Table 26: Scaffold sequence for wHex 31 bp.***

| ***751 nt scaffold for*** | ***wHex 31bp*** |
|---|---|
| ggcgcaactatcggtatcaagctgtttaagaaattcacctcgaaagcaagctgataaaccgatacaattaaaggctccttttg<br>gagccttttttttggagattttcaacgtgaaaaaattattattcgcaattcctttagttgttcctttctattctcactccgctgaaactgtt<br>gaaagttgtttagcaaaatcccatacagaaaattcatttactaacgtctggaaagacgacaaaacttttagatcgttacgctaa<br>ctatgagggctgtctgtggaatgctacaggcgttgtagtttgtactggtgacgaaactcagtgttacggtacatgggttcctattg<br>ggcttgctatccctgaaaatgagggtggtggctctgagggtggcggttctgagggtggcggttctgagggtggcggtactaa<br>acctcctgagtacggtgatacacctattccgggctatacttatatcaaccctctcgacggcacttatccgcctggtactgagca<br>aaaccccgctaatcctaatccttctcttgaggagtctcagcctcttaatactttcatgtttcagaataataggttccgaaataggc<br>aggggcattaactgtttatacgggcactgttactcaaggcactgaccccgttaaaacttattaccagtacactcctgtatcatc<br>aaaagccatgtatgacgcttactggaacggtaaattcagagactgcgctttccattctggctttaatgag | |

***Supplementary Table 27: Scaffold sequence for pHex, scHDT6 and scDDT6-small.***

| ***882 nt scaffold for*** | scHDT6 and scDDT6 small |
|---|---|
| cggtctggttcgctttgaagctcgaattaaaacgcgatatttgaagtctttcgggcttcctcttaatctttttgatgcaatccgctttg<br>cttctgactataatagtcagggtaaagacctgatttttgatttatggtcattctcgttttctgaactgtttaaagcatttgaggggggatt<br>caatgaatatttatgacgattccgcagtattggacgctatccagtctaaacattttactattacccccctctggcaaaacttcttttgc<br>aaaagcctctcgctattttggtttttatcgtcgtctggtaaacgagggttatgatagtgttgctcttactatgcctcgtaattccttttgg<br>cgttatgtatctgcattagttgaatgtggtattcctaaatctcaactgatgaatctttctacctgtaataatgttgttccgttagttcgttt<br>tattaacgtagatttttcttcccaacgtcctgactggtataatgagccagttcttaaaatcgcataaggtaattcacaatgattaa<br>agttgaaattaaaccatctcaagcccaatttactactcgttctggtgtttctcgtcagggcaagccttattcactgaatgagcag<br>ctttgttacgttgatttgggtaatgaatatccggttcttgtcaagattactcttgatgaaggtcagccagcctatgcgcctggtctgt | |

| |
|---|
| acaccgttcatctgtcctctttcaaagttggtcagttcggttcccttatgattgaccgtctgcgcctcgttccggctaagtaacatg<br>gagcaggtcgcggatttcgacacaatttatcaggcgatgatacaaatctccgttgtactttgtttcgcgcttggtataatcgctgg |

***Supplementary Table 28: Scaffold sequence for wHex 42 bp.***

| ***1008 nt scaffold for*** wHex 42bp |
|---|
| ggcgcaactatcggtatcaagctgtttaagaaattcacctcgaaagcaagctgataaaccgatacaattaaaggctccttttg<br>gagccttttttttggagattttcaacgtgaaaaaattattattcgcaattcctttagttgttcctttctattctcactccgctgaaactgtt<br>gaaagttgtttagcaaaatcccatacagaaaattcatttactaacgtctggaaagacgacaaaacttagatcgttacgctaa<br>ctatgagggctgtctgtggaatgctacaggcgttgtagtttgtactggtgacgaaactcagtgttacggtacatgggttcctattg<br>ggcttgctatccctgaaaatgagggtggtggctctgagggtggcggttctgagggtggcggttctgagggtggcggtactaa<br>acctcctgagtacggtgatacacctattccgggctatacttatatcaaccctctcgacggcacttatccgcctggtactgagca<br>aaaccccgctaatcctaatccttctcttgaggagtctcagcctcttaatactttcatgtttcagaataataggttccgaaataggc<br>aggggcattaactgtttatacgggcactgttactcaaggcactgaccccgttaaaacttattaccagtacactcctgtatcatc<br>aaaagccatgtatgacgcttactggaacggtaaattcagagactgcgctttccattctggctttaatgaggatttatttgtttgtga<br>atatcaaggccaatcgtctgacctgcctcaacctcctgtcaatgctggcggcggctctggtggtggttctggtggcggctctga<br>gggtggtggctctgagggtggcggttctgagggtggcggctctgagggaggcggttccggtggtggctctggttccggtgatt<br>ttgattatgaaaagatggcaaacgctaataagggggctatgaccgaaaatgccgatgaaaacgcgctacagtc |

***Supplementary Table 29: Scaffold sequence for the DNA disk.***

| ***1136 nt scaffold for*** DNA disk |
|---|
| ctaccctcgttccgatgctgtctttcgctgctgagggtgacgatcccgcaaaagcggcctttaactccctgcaagcctcagcg<br>accgaatatatcggttatgcgtgggcgatggttgttgtcattgtcggcgcaactatcggtatcaagctgtttaagaaattcacctc<br>gaaagcaagctgataaaccgatacaattaaaggctccttttggagccttttttttggagattttcaacgtgaaaaaattattattc<br>gcaattcctttagttgttcctttctattctcactccgctgaaactgttgaaagttgtttagcaaaatcccatacagaaaattcatttac<br>taacgtctggaaagacgacaaaacttttagatcgttacgctaactatgagggctgtctgtggaatgctacaggcgttgtagtttg<br>tactggtgacgaaactcagtgttacggtacatgggttcctattgggcttgctatccctgaaaatgagggtggtggctctgaggg<br>tggcggttctgagggtggcggttctgagggtggcggctactaaacctcctgagtacggtgatacacctattccgggctatactta<br>tatcaaccctctcgacggcacttatccgcctggtactgagcaaaaccccgctaatcctaatccttctcttgaggagtctcagcc<br>tcttaatactttcatgtttcagaataataggttccgaaataggcagggggcattaactgtttatacgggcactgttactcaaggc<br>actgaccccgttaaaacttattaccagtacactcctgtatcatcaaaagccatgtatgacgcttactggaacggtaaattcag<br>agactgcgctttccattctggctttaatgaggatttatttgtttgtgaatatcaaggccaatcgtctgacctgcctcaacctcctgtc<br>aatgctggcggcggctctggtggtggttctggtggcggctctgagggtggtggctctgagggtggcggttctgagggtggcg<br>gctctgagggaggcggttccggtggtggctctggttccggtgattttgattatgaaaagatggcaaacgctaataaggggct<br>atgaccgaaaatgccgatgaaaacgcgctacagtc |

***Supplementary Table 30: Scaffold sequence for bpHex 31 bp.***

| ***1229 nt scaffold for*** bpHex 31bp |
|---|
| gcactgaccccgttaaaacttattaccagtacactcctgtatcatcaaaagccatgtatgacgcttactggaacggtaaattca<br>gagactgcgctttccattctggctttaatgaggatttatttgtttgtgaatatcaaggccaatcgtctgacctgcctcaacctcctgt<br>caatgctggcggcggctctggtggtggttctggtggcggctctgagggtggtggctctgagggtggcggttctgagggtggc<br>ggctctgagggaggcggttccggtggtggctctggttccggtgattttgattatgaaaagatggcaaacgctaataaggggg<br>ctatgaccgaaaatgccgatgaaaacgcgctacagtctgacgctaaaggcaaacttgattctgtcgctactgattacggtgc<br>tgctatcgatggtttcattggtgacgtttccggccttgctaatggtaatggtgctactggtgattttgctggctctaattcccaaatgg<br>ctcaagtcggtgacggtgataattcacctttaatgaataatttccgtcaatatttaccttccctccctcaatcggttgaatgtcgcc<br>cttttgtctttggcgctggtaaaccatatgaattttctattgattgtgacaaaataaacttattccgtggtgtctttgcgtttcttttatatg<br>ttgccacctttatgtatgtattttctacgtttgctaacatactgcgtaataaggagtcttaatcatgccagttcttttgggtattccgttat<br>tattgcgtttcctcggtttccttctggtaactttgttcggctatctgcttacttttcttaaaaagggcttcggtaagatagctattgctattt<br>cattgtttcttgctcttattattgggcttaactcaattcttgtgggttatctctctgatattagcgctcaattaccctctgactttgttcagg<br>gtgttcagttaattctcccgtctaatgcgcttccctgtttttatgttattctctctgtaaaggctgctatttttcatttttgacgttaaacaaa |

| |
|---|
| aaatcgtttcttatttggattgggataaataatatggctgtttattttgtaactggcaaattaggctctggaaagacgctcgttagc gttggtaagattcaggataaaattgtagctgggtgcaaaatagcaactaatcttgatttaaggcttcaaaacctcccgcaagt c |

***Supplementary Table 31: Scaffold sequence for bpHex 42 bp and Hex DNA designs.***

| ***1512 nt scaffold for*** bpHex 42 bp and Hex |
|---|
| cctcaacctcctgtcaatgctggcggcggctctggtggtggttctggtggcggctctgagggtggtggctctgagggtggcgg ttctgagggtggcggctctgagggaggcggttccggtggtggctctggttccggtgattttgattatgaaaagatggcaaacg ctaataaggggggctatgaccgaaaatgccgatgaaaacgcgctacagtctgacgctaaaggcaaacttgattctgtcgcta ctgattacggtgctgctatcgatggtttcattggtgacgtttccggccttgctaatggtaatggtgctactggtgattttgctggctct aattcccaaatggctcaagtcggtgacggtgataattcacctttaatgaataatttccgtcaatatttaccttccctccctcaatcg gttgaatgtcgccctttttgtctttggcgctggtaaaccatatgaattttctattgattgtgacaaaataaacttattccgtggtgtctttt gcgtttcttttatatgttgccacctttatgtatgtattttctacgtttgctaacatactgcgtaataaggagtcttaatcatgccagttcttt tgggtattccgttattattgcgtttcctcggtttccttctggtaactttgttcggctatctgcttacttttcttaaaaagggcttcggtaag atagctattgctatttcattgtttcttgctcttattattgggcttaactcaattcttgtgggttatctctctgatattagcgctcaattaccct ctgactttgttcagggtgttcagttaattctcccgtctaatgcgcttccctgtttttatgttattctctctgtaaaggctgctatttttcatttttt gacgttaaacaaaaaatcgtttcttatttggattgggataaataatatggctgtttatttttgtaactggcaaattaggctctggaaa gacgctcgttagcgttggtaagattcaggataaaattgtagctgggtgcaaaatagcaactaatcttgatttaaggcttcaaaa cctcccgcaagtcgggaggttcgctaaaacgcctcgcgttcttagaataccggataagccttctatatctgatttgcttgctattg ggcgcggtaatgattcctacgatgaaaataaaaacggcttgcttgttctcgatgagtgcggtacttggtttaatacccgttcttg gaatgataaggaaagacagccgattattgattggtttctacatgctcgtaaattaggatgggatattatttttcttgttcaggactt atctattgttgataaacaggcgcgttctgcattagctgaacatgttgtttattgtcgtcgtctggacagaattactttacctttgtcg gtactttatattctcttattactggctcgaaaatgcctctgcctaaattacatgttggcgttgttaaatatggcgattctcaattaagc cctactgttgagcgttg |

***Supplementary Table 32: Scaffold sequence for the twistedHex DNA nanostructure***

| ***1521 nt scaffold for*** twistedHex |
|---|
| gggcttgctatccctgaaaatgagggtggtggctctgagggtggcggttctgagggtggcggttctgagggtggcggtacta aacctcctgagtacggtgatacacctattccgggctatacttatatcaaccctctcgacggcacttatccgcctggtactgagc aaaaccccgctaatcctaatccttctcttgaggagtctcagcctcttaatactttcatgtttcagaataatagggttccgaaatagg caggggcattaactgtttatacgggcactgttactcaaggcactgaccccgttaaaacttattaccagtacactcctgtatcat caaaagccatgtatgacgcttactggaacggtaaattcagagactgcgctttccattctggctttaatgaggatttatttgtttgtg aatatcaaggccaatcgtctgacctgcctcaacctcctgtcaatgctggcggcggctctggtggtggttctggtggcggctctg agggtggtggctctgagggtggcggttctgagggtggcggctctgagggaggcggttccggtggtggctctggttccggtga ttttgattatgaaaagatggcaaacgctaataagggggctatgaccgaaaatgccgatgaaaacgcgctacagtctgacg ctaaaggcaaacttgattctgtcgctactgattacggtgctgctatcgatggtttcattggtgacgtttccggccttgctaatggta atggtgctactggtgattttgctggctctaattcccaaatggctcaagtcggtgacggtgataattcacctttaatgaataatttcc gtcaatatttaccttccctccctcaatcggttgaatgtcgccctttttgtctttggcgctggtaaaccatatgaattttctattgattgtg acaaaataaacttattccgtggtgtctttgcgtttcttttatatgttgccacctttatgtatgtattttctacgtttgctaacatactgcgta ataaggagtcttaatcatgccagttcttttgggtattccgttattattgcgtttcctcggtttccttctggtaactttgttcggctatctgct tacttttcttaaaaagggcttcggtaagatagctattgctatttcattgtttcttgctcttattattgggcttaactcaattcttgtgggtta tctctctgatattagcgctcaattaccctctgactttgttcagggtgttcagttaattctcccgtctaatgcgcttccctgtttttatgttat tctctctgtaaaggctgctatttttcatttttgacgttaaacaaaaaatcgtttcttatttggattgggataaataatatggctgtttatttt gtaactggcaaattaggctctggaaagacgctcgttagcgttggtaagattcaggataaaattgtagctgggtgcaaaatag caactaatcttgatttaaggcttcaaaacctcccgcaagtc |

***Supplementary Table 33: Scaffold sequence for the tiny Toroid.***

| ***1536 nt scaffold for*** Tiny Toroid |
|---|
| gacgggttgttactcgctcacatttaatgttgatgaaagctggctacaggaaggccagacgcgaattatttttgatggcgttcct<br>attggttaaaaaatgagctgatttaacaaaaatttaatgcgaattttaacaaaatattaacgtttacaatttaaatatttgcttatac<br>aatcttcctgtttttggggcttttctgattatcaaccggggtacatatgattgacatgctagttttacgattaccgttcatcgattctctt<br>gtttgctccagactctcaggcaatgacctgatagcctttgtagatctctcaaaaatagctaccctctccggcattaatttatcagc<br>tagaacggttgaatatcatattgatggtgatttgactgtctccggcctttctcaccctttgaatctttacctacacattactcaggc<br>attgcatttaaaatatatgagggttctaaaaatttttatccttgcgttgaaataaaggcttctcccgcaaaagtattacagggtcat<br>aatgtttttggtacaaccgatttagctttatgctctgaggctttattgcttaattttgctaattctttgccttgcctgtatgatttattggatg<br>ttaatgctactactattagtagaattgatgccacctttcagctcgcgccccaaatgaaaatatagctaaacaggttattgacca<br>tttgcgaaatgtatctaatggtcaaactaaatctactcgttcgcagaattgggaatcaactgttatatggaatgaaacttccaga<br>caccgtactttagttgcatatttaaaacatgttgagctacagcattatattcagcaattaagctctaagccatccgcaaaaatga<br>cctcttatcaaaaggagcaattaaaggtactctctaatcctgacctgttggagtttgcttccggtctggttcgctttgaagctcga<br>attaaaacgcgatatttgaagtctttcgggcttcctcttaatctttttgatgcaatccgctttgcttctgactataatagtcagggtaa<br>agacctgatttttgatttatggtcattctcgttttctgaactgtttaaagcatttgaggggattcaatgaatatttatgacgattccgc<br>agtattggacgctatccagtctaaacattttactattacccccctctggcaaaacttcttttgcaaaagcctctcgctattttggttttta<br>tcgtcgtctggtaaacgagggttatgatagtgttgctcttactatgcctcgtaattccttttggcgttatgtatctgcattagttgaatg<br>tggtattcctaaatctcaactgatgaatctttctacctgtaataatgttgttccgttagttcgttttattaacgtagatttttcttcccaac<br>gtcctgactggtataatgagccagttcttaaaatcgcataaggtaattcacaatgattaaagttgaaattaaaccatctcaagc<br>ccaatttactactcgttctggtgtttctcgtcagggcaagc |

***Supplementary Table 34: Scaffold sequence for bHexp 52 bp.***

| ***1872 nt scaffold for*** bpHex 52 bp |
|---|
| ctttgccttgcctgtatgatttattggatgttaatgctactactattagtagaattgatgccacctttcagctcgcgccccaaatga<br>aaatatagctaaacaggttattgaccatttgcgaaatgtatctaatggtcaaactaaatctactcgttcgcagaattgggaatc<br>aactgttatatggaatgaaacttccagacaccgtactttagttgcatatttaaaacatgttgagctacagcattatattcagcaat<br>taagctctaagccatccgcaaaaatgacctcttatcaaaaggagcaattaaaggtactctctaatcctgacctgttggagtttg<br>cttccggtctggttcgctttgaagctcgaattaaaacgcgatatttgaagtctttcgggcttcctcttaatcttttgatgcaatccgc<br>tttgcttctgactataatagtcagggtaaagacctgatttttgatttatggtcattctcgttttctgaactgtttaaagcatttgagggg<br>gattcaatgaatatttatgacgattccgcagtattggacgctatccagtctaaacattttactattacccccctctggcaaaacttct<br>tttgcaaaagcctctcgctattttggtttttatcgtcgtctggtaaacgagggttatgatagtgttgctcttactatgcctcgtaattcct<br>tttggcgttatgtatctgcattagttgaatgtggtattcctaaatctcaactgatgaatctttctacctgtaataatgttgttccgttagtt<br>cgttttattaacgtagatttttcttcccaacgtcctgactggtataatgagccagttcttaaaatcgcataaggtaattcacaatgat<br>taaagttgaaattaaaccatctcaagcccaatttactactcgttctggtgtttctcgtcagggcaagccttattcactgaatgagc<br>agctttgttacgttgatttgggtaatgaatatccggttcttgtcaagattactcttgatgaaggtcagccagcctatgcgcctggtct<br>gtacaccgttcatctgtcctctttcaaagttggtcagttcggttcccttatgattgaccgtctgcgcctcgttccggctaagtaacat<br>ggagcaggtcgcggatttcgacacaatttatcaggcgatgatacaaatctccgttgtactttgtttcgcgcttggtataatcgctg<br>ggggtcaaagatgagtgttttagtgtattcttttgcctctttcgttttaggttggtgccttcgtagtggcattacgtattttacccgtttaa<br>tggaaacttcctcatgaaaaagtctttagtcctcaaagcctctgtagccgttgctaccctcgttccgatgctgtctttcgctgctga<br>gggtgacgatcccgcaaaagcggcctttaactccctgcaagcctcagcgaccgaatatatcggttatgcgtgggcgatggtt<br>gttgtcattgtcggcgcaactatcggtatcaagctgtttaagaaattcacctcgaaagcaagctgataaaccgatacaattaa<br>aggctccttttggagccttttttttggagattttcaacgtgaaaaaattattattcgcaattcctttagttgttcctttctattctcactccg<br>ctgaaactgttgaaagttgtttagcaaaatcccatacagaaaattcatttactaacgtctggaaagacgacaaaactttagat<br>cgttacgctaactatgagggctgtctgtggaatgctacaggcgttgtagtttgtactggtgacgaaactcagtgttacggtacat<br>gggttcctattgggcttgctatccctgaaaatgagggtgg |

***Supplementary Table 35: Scaffold sequence for bpHex 63 bp.***

| ***2268 nt scaffold for*** bpHex 63bp |
|---|
| ccctggcgttacccaacttaatcgccttgcagcacatccccctttcgccagctggcgtaatagcgaagaggcccgcaccga<br>tcgcccttcccaacagttgcgcagcctgaatggcgaatggcgctttgcctggtttccggcaccagaagcggtgccggaaag<br>ctggctggagtgcgatcttcctgaggccgatactgtcgtcgtcccctcaaactggcagatgcacggttacgatgcgcccatct<br>acaccaacgtgacctatcccattacggtcaatccgccgtttgttcccacggagaatccgacgggttgttactcgctcacattta<br>atgttgatgaaagctggctacaggaaggccagacgcgaattatttttgatggcgttcctattggttaaaaaatgagctgattta<br>acaaaaatttaatgcgaattttaacaaaatattaacgtttacaatttaaatatttgcttatacaatcttcctgtttttggggcttttctga<br>ttatcaaccggggtacatatgattgacatgctagttttacgattaccgttcatcgattctcttgtttgctccagactctcaggcaatg<br>acctgatagcctttgtagatctctcaaaaatagctaccctctccggcattaatttatcagctagaacggttgaatatcatattgat<br>ggtgatttgactgtctccggcctttctcacccttttgaatctttacctacacattactcaggcattgcatttaaaatatatgagggttc<br>taaaaatttttatccttgcgttgaaataaaggcttctcccgcaaaagtattacagggtcataatgtttttggtacaaccgatttagc<br>tttatgctctgaggctttattgcttaattttgctaattctttgccttgcctgtatgatttattggatgttaatgctactactattagtagaatt<br>gatgccacctttcagctcgcgccccaaatgaaaatatagctaaacaggttattgaccatttgcgaaatgtatctaatggtcaa<br>actaaatctactcgttcgcagaattgggaatcaactgttatatggaatgaaacttccagacaccgtactttagttgcatatttaa<br>aacatgttgagctacagcattatattcagcaattaagctctaagccatccgcaaaaatgacctcttatcaaaaggagcaatta<br>aaggtactctctaatcctgacctgttggagtttgcttccggtctggttcgctttgaagctcgaattaaaacgcgatatttgaagtctt<br>tcgggcttcctcttaatctttttgatgcaatccgctttgcttctgactataatagtcagggtaaagacctgatttttgatttatggtcatt<br>ctcgttttctgaactgtttaaagcatttgaggggggattcaatgaatatttatgacgattccgcagtattggacgctatccagtctaa<br>acattttactattacccccctctggcaaaacttcttttgcaaaagcctctcgctattttggtttttatcgtcgtctggtaaacgagggtt<br>atgatagtgttgctcttactatgcctcgtaattccttttggcgttatgtatctgcattagttgaatgtggtattcctaaatctcaactgat<br>gaatctttctacctgtaataatgttgttccgttagttcgttttattaacgtagatttttcttcccaacgtcctgactggtataatgagcca<br>gttcttaaaatcgcataaggtaattcacaatgattaaagttgaaattaaaccatctcaagcccaatttactactcgttctggtgttt<br>ctcgtcagggcaagccttattcactgaatgagcagctttgttacgttgatttgggtaatgaatatccggttcttgtcaagattactct<br>tgatgaaggtcagccagcctatgcgcctggtctgtacaccgttcatctgtcctctttcaaagttggtcagttcggttcccttatgatt<br>gaccgtctgcgcctcgttccggctaagtaacatggagcaggtcgcggatttcgacacaatttatcaggcgatgatacaaatc<br>tccgttgtactttgtttcgcgcttggtataatcgctgggggtcaaagatgagtgttttagtgtattcttttgcctctttcgttttaggttggt<br>gccttcgtagtggcattacgtattttacccgtttaatggaaacttcctcatgaaaaagtctttagtcctcaaagcctctgtagccgt<br>tgctac |

***Supplementary Table 36: Scaffold sequence for tHex-1 DNA design.***

| ***2462 nt scaffold for*** tHex1 |
|---|
| ccctggcgttacccaacttaatcgccttgcagcacatccccctttcgccagctggcgtaatagcgaagaggcccgcaccga<br>tcgcccttcccaacagttgcgcagcctgaatggcgaatggcgctttgcctggtttccggcaccagaagcggtgccggaaag<br>ctggctggagtgcgatcttcctgaggccgatactgtcgtcgtcccctcaaactggcagatgcacggttacgatgcgcccatct<br>acaccaacgtgacctatcccattacggtcaatccgccgtttgttcccacggagaatccgacgggttgttactcgctcacattta<br>atgttgatgaaagctggctacaggaaggccagacgcgaattatttttgatggcgttcctattggttaaaaaatgagctgattta<br>acaaaaatttaatgcgaattttaacaaaatattaacgtttacaatttaaatatttgcttatacaatcttcctgtttttggggcttttctga<br>ttatcaaccggggtacatatgattgacatgctagttttacgattaccgttcatcgattctcttgtttgctccagactctcaggcaatg<br>acctgatagcctttgtagatctctcaaaaatagctaccctctccggcattaatttatcagctagaacggttgaatatcatattgat<br>ggtgatttgactgtctccggcctttctcacccttttgaatctttacctacacattactcaggcattgcatttaaaatatatgagggttc<br>taaaaatttttatccttgcgttgaaataaaggcttctcccgcaaaagtattacagggtcataatgtttttggtacaaccgatttagc<br>tttatgctctgaggctttattgcttaattttgctaattctttgccttgcctgtatgatttattggatgttaatgctactactattagtagaatt<br>gatgccacctttcagctcgcgccccaaatgaaaatatagctaaacaggttattgaccatttgcgaaatgtatctaatggtcaa<br>actaaatctactcgttcgcagaattgggaatcaactgttatatggaatgaaacttccagacaccgtactttagttgcatatttaa<br>aacatgttgagctacagcattatattcagcaattaagctctaagccatccgcaaaaatgacctcttatcaaaaggagcaatta<br>aaggtactctctaatcctgacctgttggagtttgcttccggtctggttcgctttgaagctcgaattaaaacgcgatatttgaagtctt<br>tcgggcttcctcttaatctttttgatgcaatccgctttgcttctgactataatagtcagggtaaagacctgatttttgatttatggtcatt<br>ctcgttttctgaactgtttaaagcatttgaggggggattcaatgaatatttatgacgattccgcagtattggacgctatccagtctaa<br>acattttactattacccccctctggcaaaacttcttttgcaaaagcctctcgctattttggtttttatcgtcgtctggtaaacgagggtt<br>atgatagtgttgctcttactatgcctcgtaattccttttggcgttatgtatctgcattagttgaatgtggtattcctaaatctcaactgat |

gaatctttctacctgtaataatgttgttccgttagttcgttttattaacgtagatttttcttcccaacgtcctgactggtataatgagcca
gttcttaaaatcgcataaggtaattcacaatgattaaagttgaaattaaaccatctcaagcccaatttactactcgttctggtgttt
ctcgtcagggcaagccttattcactgaatgagcagctttgttacgttgatttgggtaatgaatatccggttcttgtcaagattactct
tgatgaaggtcagccagcctatgcgcctggtctgtacaccgttcatctgtcctctttcaaagttggtcagttcggttcccttatgatt
gaccgtctgcgcctcgttccggctaagtaacatggagcaggtcgcggatttcgacacaatttatcaggcgatgatacaaatc
tccgttgtactttgtttcgcgcttggtataatcgctgggggtcaaagatgagtgttttagtgtattcttttgcctctttcgttttaggttggt
gccttcgtagtggcattacgtattttacccgtttaatggaaacttcctcatgaaaaagtctttagtcctcaaagcctctgtagccgt
tgctaccctcgttccgatgctgtctttcgctgctgagggtgacgatcccgcaaaagcggcctttaactccctgcaagcctcagc
gaccgaatatatcggttatgcgtgggcgatggttgttgtcattgtcggcgcaactatcggtatcaagctgtttaagaaattcacc
tcgaaagcaagctgataaaccgatacatta

***Supplementary Table 37: Scaffold sequence for tHex-1 DNA nanostructure.***

| ***3400 nt scaffold for*** tHex2 |
|---|
| ccctggcgttacccaacttaatcgccttgcagcacatccccctttcgccagctggcgtaatagcgaagaggcccgcaccga<br>tcgcccttcccaacagttgcgcagcctgaatggcgaatggcgctttgcctggtttccggcaccagaagcggtgccggaaag<br>ctggctggagtgcgatcttcctgaggccgatactgtcgtcgtcccctcaaactggcagatgcacggttacgatgcgcccatct<br>acaccaacgtgacctatcccattacggtcaatccgccgtttgttcccacggagaatccgacgggttgttactcgctcacattta<br>atgttgatgaaagctggctacaggaaggccagacgcgaattatttttgatggcgttcctattggttaaaaaatgagctgattta<br>acaaaaatttaatgcgaattttaacaaaatattaacgtttacaatttaaatatttgcttatacaatcttcctgtttttggggcttttctga<br>ttatcaaccggggtacatatgattgacatgctagttttacgattaccgttcatcgattctcttgtttgctccagactctcaggcaatg<br>acctgatagcctttgtagatctctcaaaaatagctaccctctccggcattaatttatcagctagaacggttgaatatcatattgat<br>ggtgatttgactgtctccggcctttctcacccttttgaatctttacctacacattactcaggcattgcatttaaaatatatgagggttc<br>taaaaatttttatccttgcgttgaaataaaggcttctcccgcaaaagtattacagggtcataatgtttttggtacaaccgatttagc<br>tttatgctctgaggctttattgcttaattttgctaattctttgccttgcctgtatgatttattggatgttaatgctactactattagtagaatt<br>gatgccacctttcagctcgcgccccaaatgaaaatatagctaaacaggttattgaccatttgcgaaatgtatctaatggtcaa<br>actaaatctactcgttcgcagaattgggaatcaactgttatatggaatgaaacttccagacaccgtactttagttgcatatttaa<br>aacatgttgagctacagcattatattcagcaattaagctctaagccatccgcaaaaatgacctcttatcaaaaggagcaatta<br>aaggtactctctaatcctgacctgttggagtttgcttccggtctggttcgctttgaagctcgaattaaaacgcgatatttgaagtctt<br>tcgggcttcctcttaatctttttgatgcaatccgctttgcttctgactataatagtcagggtaaagacctgatttttgatttatggtcatt<br>ctcgttttctgaactgtttaaagcatttgaggggattcaatgaatatttatgacgattccgcagtattggacgctatccagtctaa<br>acattttactattacccccctctggcaaaacttcttttgcaaaagcctctcgctattttggtttttatcgtcgtctggtaaacgagggtt<br>atgatagtgttgctcttactatgcctcgtaattccttttggcgttatgtatctgcattagttgaatgtggtattcctaaatctcaactgat<br>gaatctttctacctgtaataatgttgttccgttagttcgttttattaacgtagattttcttcccaacgtcctgactggtataatgagcca<br>gttcttaaaatcgcataaggtaattcacaatgattaaagttgaaattaaaccatctcaagcccaatttactactcgttctggtgttt<br>ctcgtcagggcaagccttattcactgaatgagcagctttgttacgttgatttgggtaatgaatatccggttcttgtcaagattactct<br>tgatgaaggtcagccagcctatgcgcctggtctgtacaccgttcatctgtcctctttcaaagttggtcagttcggttcccttatgatt<br>gaccgtctgcgcctcgttccggctaagtaacatggagcaggtcgcggatttcgacacaatttatcaggcgatgatacaaatc<br>tccgttgtactttgtttcgcgcttggtataatcgctgggggtcaaagatgagtgttttagtgtattcttttgcctctttcgttttaggttggt<br>gccttcgtagtggcattacgtattttacccgtttaatggaaacttcctcatgaaaaagtctttagtcctcaaagcctctgtagccgt<br>tgctaccctcgttccgatgctgtctttcgctgctgagggtgacgatcccgcaaaagcggcctttaactccctgcaagcctcagc<br>gaccgaatatatcggttatgcgtgggcgatggttgttgtcattgtcggcgcaactatcggtatcaagctgtttaagaaattcacc<br>tcgaaagcaagctgataaaccgatacaattaaaggctccttttggagccttttttttggagattttcaacgtgaaaaaattattatt<br>cgcaattcctttagttgttcctttctattctcactccgctgaaactgttgaaagttgtttagcaaaatcccatacagaaaattcattta<br>ctaacgtctggaaagacgacaaaacttagatcgttacgctaactatgagggctgtctgtggaatgctacaggcgttgtagttt<br>gtactggtgacgaaactcagtgttacggtacatgggttcctattgggcttgctatccctgaaaatgagggtggtggctctgagg<br>gtggcggttctgagggtggcggttctgagggtggcggtactaaacctcctgagtacggtgatacacctattccgggctatactt<br>atatcaaccctctcgacggcacttatccgcctggtactgagcaaaaccccgctaatcctaatccttctcttgaggagtctcagc<br>ctcttaatactttcatgtttcagaataataggttccgaaataggcaggggcattaactgtttatacgggcactgttactcaagg<br>cactgaccccgttaaaacttattaccagtacactcctgtatcatcaaaagccatgtatgacgcttactggaacggtaaattcag<br>agactgcgctttccattctggctttaatgaggatttatttgtttgtgaatatcaaggccaatcgtctgacctgcctcaacctcctgtc<br>aatgctggcggcggctctggtggtggttctggtggcggctctgagggtggtggctctgagggtggcggttctgagggtggcg |

gctctgagggaggcggttccggtggtggctctggttccggtgattttgattatgaaaagatggcaaacgctaataaggggggct
atgaccgaaaatgccgatgaaaacgcgctacagtc

***Supplementary Table 38: Sequence of the M13mp18 ssDNA vector, which was used as template for all ssDNA productions and as scaffold for the scDDT6-tall and the mHex, and partially for the tHex-1 and tHex-2.***

***M13mp18 ssDNA vector***

tgatagacggtttttcgccctttgacgttggagtccacgttctttaatagtggactcttgttccaaactggaacaacactcaaccct
atctcgggctattcttttgatttataagggattttgccgatttcggaaccaccatcaaacaggattttcgcctgctggggcaaacc
agcgtggaccgcttgctgcaactctctcagggccaggcggtgaagggcaatcagctgttgcccgtctcactggtgaaaaga
aaaaccaccctggcgcc
caatacgcaaaccgcctctccccgcgcgttggccgattcattaatgcagctggcacgacaggtttcccgactggaaagcgg
gcagtgagcgcaacgcaattaatgtgagttagctcactcattaggcaccccaggctttacactttatgcttccggctcgtatgtt
gtgtggaattgtgagcggataacaatttcacacaggaaacagctatgaccatgattacgaattcgagctcggtacccgggg
atcc
tctagagtcgacctgcaggcatgcaagcttggcactggccgtcgttttacaacgtcgtgactgggaaaaccctggcgttacc
caacttaatcgccttgcagcacatccccctttcgccagctggcgtaatagcgaagaggcccgcaccgatcgcccttcccaa
cagttgcgcagcctgaatggcgaatggcgctttgcctggtttccggcaccagaagcggtgccggaaagctggctggagtg
cgatcttcctgaggccgatactgtcgtcgtcccctcaaactggcagatgcacggttacgatgcgcccatctacaccaacgtg
acctatcccattacggtcaatccgccgtttgttcccacggagaatccgacgggttgttactcgctcacatttaatgttgatgaaa
gctggctacaggaaggccagacgcgaattatttttgatggcgttcctattggttaaaaaatgagctgatttaacaaaaatttaat
gcgaattttaacaaaatattaacgtttacaatttaaatatttgcttatacaatcttcctgtttttggggcttttctgattatcaaccggg
gtacatatgattgacatgctagttttacgattaccgttcatcgattctcttgtttgctccagactctcaggcaatgacctgatagcct
ttgtagatct
ctcaaaaatagctaccctctccggcattaatttatcagctagaacggttgaatatcatattgatggtgatttgactgtctccggcc
tttctcacccttttgaatctttacctacacattactcaggcattgcatttaaaatatatgagggttctaaaaatttttatccttgcgttga
aataaaggcttctcccgcaaaagtattacagggtcataatgtttttggtacaaccgatttagctttatgctctgaggctttattgctt
aattttgctaattctttgccttgcctgtatgatttattggatgttaatgctactactattagtagaattgatgccacctttcagctcgcg
ccccaaatgaaaatatagctaaacaggttattgaccatttgcgaaatgtatctaatggtcaaactaaatctactcgttcgcagaa
attgggaatcaactgttatatggaatgaaacttccagacaccgtactttagttgcatatttaaaacatgttgagctacagcattat
attcagcaattaagctctaagccatccgcaaaaatgacctcttatcaaaaggagcaattaaaggtactctctaatcctgacct
gttggagtttgcttccggtctggttcgctttgaagctcgaattaaaacgcgatatttgaagtctttcgggcttcctcttaatctttttgat
gcaatccgctttgcttctgactataatagtcagggtaaagacctgatttttgatttatggtcattctcgttttctgaactgtttaaagc
atttgaggggattcaatgaatatttatgacgattccgcagtattggacgctatccagtctaaacatttactattacccccctctgg
caaaacttcttttgcaaaagcctctcgctattttggtttttatcgtcgtctggtaaacgagggttatgatagtgttgctcttactatgcc
tcgtaattccttttggcgttatgtatctgcattagttgaatgtggtattcctaaatctcaactgatgaatctttctacctgtaataatgtt
gttccgttagttcgttttattaacgtagatttttcttcccaacgtcctgactggtataatgagccagttcttaaaatcgcataaggtaa
ttcacaatgattaaagttgaaattaaaccatctcaagcccaatttactactcgttctggtgtttctcgtcagggcaagccttattca
ctgaatgagcagctttgttacgttgatttgggtaatgaatatccggttcttgtcaagattactcttgatgaaggtcagccagcctat
gcgcctggtctgtacaccgttcatctgtcctctttcaaagttggtcagttcggttcccttatgattgaccgtctgcgcctcgttccgg
ctaagtaacatggagcaggtcgcggatttcgacacaatttatcaggcgatgatacaaatctccgttgtactttgtttcgcgcttg
gtataatcgctgggggtcaaagatgagtgttttagtgtattcttttgcctctttcgttttaggttggtgccttcgtagtggcattacgtat
tttacccgtttaatggaaacttcctcatgaaaaagtctttagtcctcaaagcctctgtagccgttgctaccctcgttccgatgctgt
ctttcgctgctgagggtgacgatcccgcaaaagcggcctttaactccctgcaagcctcagcgaccgaatatatcggttatgc
gtgggcgatggttgttgtcattgtcggcgcaactatcggtatcaagctgtttaagaaattcacctcgaaagcaagctgataaa
ccgatacaattaaaggctccttttggagccttttttttggagattttcaacgtgaaaaaattattattcgcaattcctttagttgttcctt
tctattctcactccgctgaaactgttgaaagttgtttagcaaaatcccatacagaaaattcatttactaacgtctggaaagacga
caaaactttagatcgttacgctaactatgagggctgtctgtggaatgctacaggcgttgtagtttgtactggtgacgaaactca
gtgttacggtacatgggttcctattgggcttgctatccctgaaaatgagggtggtggctctgagggtggcggttctgagggtgg
cggttctgagggtggcggtactaaacctcctgagtacggtgatacacctattccgggctatacttatatcaaccctctcgacgg
cacttatccgcctggtactgagcaaaaccccgctaatcctaatccttctcttgaggagtctcagcctcttaatactttcatgtttca
gaataataggttccgaaataggcaggggcattaactgtttatacgggcactgttactcaaggcactgaccccgttaaaactt
attaccagtacactcctgtatcatcaaaagccatgtatgacgcttactggaacggtaaattcagagactgcgctttccattctg
gctttaatgaggatttatttgtttgtgaatatcaaggccaatcgtctgacctgcctcaacctcctgtcaatgctggcggcggctct

ggtggtggttctggtggcggctctgagggtggtggctctgagggtggcggttctgagggtggcggctctgagggaggcggtt
ccggtggtggctctggttccggtgattttgattatgaaaagatggcaaacgctaataagggggctatgaccgaaaatgccga
tgaaaacgcgctacagtctgacgctaaaggcaaacttgattctgtcgctactgattacggtgctgctatcgatggtttcattggt
gacgtttccggccttgctaatggtaatggtgctactggtgattttgctggctctaattcccaaatggctcaagtcggtgacggtga
taattcacctttaatgaataatttccgtcaatatttaccttccctccctcaatcggttgaatgtcgccctttgtctttggcgctggtaa
accatatgaattttctattgattgtgacaaaataaacttattccgtggtgtctttgcgtttcttttatatgttgccacctttatgtatgtattt
tctacgtttgctaacatactgcgtaataaggagtcttaatcatgccagttcttttgggtattccgttattattgcgtttcctcggtttcctt
ctggtaactttgttcggctatctgcttacttttcttaaaaagggcttcggtaagatagctattgctatttcattgtttcttgctcttattatt
gggcttaactcaattcttgtgggttatctctctgatattagcgctcaattaccctctgactttgttcagggtgttcagttaattctcccg
tctaatgcgcttccctgtttttatgttattctctctgtaaaggctgctattttcatttttgacgttaaacaaaaaatcgtttcttatttggatt
gggataaataatatggctgtttattttgtaactggcaaattaggctctggaaagacgctcgttagcgttggtaagattcaggata
aaattgtagctgggtgcaaaatagcaactaatcttgatttaaggcttcaaaacctcccgcaagtc
gggaggttcgctaaaacgcctcgcgttcttagaataccggataagccttctatatctgatttgcttgctattgggcgcggtaatg
attcctacgatgaaaataaaaacggcttgcttgttctcgatgagtgcggtacttggtttaatacccgttcttggaatgataagga
aagacagccgattattgattggtttctacatgctcgtaaattaggatgggatattatttttcttgttcaggacttatctattgttgataa
acaggcgcgttctgcattagctgaacatgttgtttattgtcgtcgtctggacagaattacttttacctttgtcggtactttatattctctt
attactggctcgaaaatgcctctgcctaaattacatgttggcgttgttaaatatggcgattctcaattaagccctactgttgagcgt
tg
gctttatactggtaagaatttgtataacgcatatgatactaaacaggctttttctagtaattatgattccggtgtttattcttatttaacg
ccttatttatcacacggtcggtatttcaaaccattaaatttaggtcagaagatgaaattaactaaaatatatttgaaaaagttttct
cgcgttctttgtcttgcgattggatttgcatcagcatttacatatagttatataacccaacctaagccggaggttaaaaaggtagt
ctctcagacctatgattttgataaattcactattgactcttctcagcgtcttaatctaagctatcgctatgttttcaaggattctaagg
gaaaattaattaatagcgacgatttacagaagcaaggttattcactcacatatattgatttatgtactgtttccattaaaaaaggt
aattcaaatgaaattgttaaatgtaattaattttgttttcttgatgtttgtttcatcatcttcttttgctcaggtaattgaaatgaataattc
gcctctgcgcgattttgtaacttggtattcaaagcaatcaggcgaatccgttattgtttctcccgatgtaaaaggtactgttactgt
atattcatctgacgttaaacctgaaaatctacgcaatttctttatttctgttttacgtgcaaataattttgatatggtaggttctaaccc
ttccattattcagaagtataatccaaacaatcaggattatattgatgaattgccatcatctgataatcaggaatatgatgataatt
ccgctccttctggtggtttctttgttccgcaaaatgataatgttactcaaacttttaaaattaataacgttcgggcaaaggatttaat
acgagttgtcgaattgtttgtaaagtctaatacttctaaatcctcaaatgtattatctattgacggctctaatctattagttgttagtgc
tcctaaagatattttagataaccttcctcaattcctttcaactgttgatttgccaactgaccagatattgattgagggtttgatatttg
aggttcagcaaggtgatgctttagatttttcatttgctgctggctctcagcgtggcactgttgcaggcggtgttaatactgaccgc
ctcacctctgttttatcttctgctggtggttcgttcggtatttttaatggcgatgttttagggctatcagttcgcgcattaaagactaata
gccattcaaaaatattgtctgtgccacgtattcttacgctttcaggtcagaagggttctatctctgttggccagaatgtccctttatt
actggtcgtgtgactggtgaatctgccaatgtaaataatccatttcagacgattgagcgtcaaaatgtaggtatttccatgagc
gtttttcctgttgcaatggctggcggtaatattgttctggatattaccagcaaggccgatagtttgagttcttctactcaggcaagt
gatgttattactaatcaaagaagtattgctacaacggttaatttgcgtgatggacagactcttttactcggtggcctcactgattat
aaaaacacttctcaggattctggcgtaccgttcctgtctaaaatccctttaatcggcctcctgtttagctcccgctctgattctaac
gaggaaagcacgttatacgtgctcgtcaaagcaaccatagtacgcgccctgtagcggcgcattaagcgcggcgggtgtg
gtggttacgcgcagcgtgaccgctacacttgccagcgccctagcgcccgctcctttcgctttcttcccttcctttctcgccacgtt
cgccggctttccccgtcaagctctaaatcgggggctcccttagggttccgatttagtgctttacggcacctcgaccccaaaaa
acttgatttgggtgatggttcacgtagtgggccatcgccc