

SEQUENCE LISTING

<110> Bamboo Therapeutics, Inc.
Samulski, Richard J.

<120> MODIFIED FRIEDREICH ATAXIA GENES AND VECTORS FOR GENE THERAPY

<130> PC45291A

<150> 62/251,288

<151> 2015-11-05

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<160> 33

<170> PatentIn version 3.5

<210> 1

<211> 210

<212> PRT

<213> Artificial Sequence

<220>

<223> Amino acid sequence of human wild type frataxin

<400> 1

Met Trp Thr Leu Gly Arg Arg Ala Val Ala Thr Gly Leu Leu Ala Ser
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Pro Ser Pro Ala Gln Ala Gln Thr Leu Thr Arg Val Pro Arg Pro Ala
20 25 30

Glu Leu Ala Pro Leu Cys Gly Arg Arg Gly Leu Arg Thr Asp Ile Asp
35 40 45

Ala Thr Cys Pro Arg Arg Ala Ser Ser Asn Gln Arg Gly Leu Asn Gln
50 55 60

Ile Trp Asn Val Lys Lys Gln Ser Val Tyr Leu Met Asn Leu Arg Lys
65 70 75 80

Ser Gly Thr Leu Gly His Pro Gly Ser Leu Asp Glu Thr Thr Tyr Glu
85 90 95

Arg Leu Ala Glu Glu Thr Leu Asp Ser Leu Ala Glu Phe Phe Glu Asp

100

105

110

Leu Ala Asp Lys Pro Tyr Thr Phe Glu Asp Tyr Asp Val Ser Phe Gly
 115 120 125

Ser Gly Val Leu Thr Val Lys Leu Gly Gly Asp Leu Gly Thr Tyr Val
 130 135 140

Ile Asn Lys Gln Thr Pro Asn Lys Gln Ile Trp Leu Ser Ser Pro Ser
 145 150 155 160

Ser Gly Pro Lys Arg Tyr Asp Trp Thr Gly Lys Asn Trp Val Tyr Ser
 165 170 175

His Asp Gly Val Ser Leu His Glu Leu Leu Ala Ala Glu Leu Thr Lys
 180 185 190

Ala Leu Lys Thr Lys Leu Asp Leu Ser Ser Leu Ala Tyr Ser Gly Lys
 195 200 205

Asp Ala
 210

<210> 2
 <211> 630
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleotide sequence encoding wild type frataxin

<400> 2
 atgtggactc tcgggcgccg cgcagtagcc ggcctcctgg cgtcaccag cccagcccag 60
 gccagaccc tcaccgggt cccgcggccg gcagagttgg cccactctg cggccgccgt 120
 ggcctgcgca ccgacatcga tgcgacctgc acgccccgcc gcgcaagttc gaaccaacgt 180
 ggcctcaacc agatttggaa tgtcaaaaag cagagtgtct atttgatgaa tttgaggaaa 240
 tctggaactt tgggccaccc aggctctcta gatgagacca cctatgaaag actagcagag 300
 gaaacgctgg actcttttagc agagtttttt gaagaccttg cagacaagcc atacacgttt 360
 gaggactatg atgtctcctt tgggagtggt gtcttaactg tcaaactggg tggagatcta 420

ggaacctatg tgatcaacaa gcagacgcca aacaagcaaa tctggctatc ttctccatcc	480
agtggaccta agcgttatga ctggactggg aaaaactggg tgtactccca cgacggcgtg	540
tccctccatg agctgctggc cgagagctc actaaagcct taaaaaccaa actggacttg	600
tcttccttgg cctattccgg aaaagatgct	630

<210> 3
 <211> 630
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> IDT2 optimized nucleotide sequence encoding frataxin

<400> 3	
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gcgcagaccc ttactagggt gccgcggccc gcggagctgg cgccactctg cggtcgccgc	120
ggtctgagaa cggacattga tgccacttgt acacctcgga gggccagctc caaccaaagg	180
ggccttaatc aaatttggaa cgtgaagaag cagtccgtct acctgatgaa ctttcggaag	240
tcagggaccc tgggccaccc gggaagcttg gatgaaacaa cttacgaaag gttggcggag	300
gagaccttgg attctcttgc agagttcttc gaagacctgg ctgataagcc ttacaccttt	360
gaggactacg atgtgtcttt tggatctgga gtgctgaccg ttaaactggg cggggatctg	420
ggcacctacg tgattaacaa gcaaactcca aacaagcaga tctggctttc aagccccagt	480
agcgggccaa aacgctacga ttggaccgga aagaattggg ttacagcca cgatggcgtt	540
tcactgcacg agcttctggc agcagaactg acaaaagcac tcaagacgaa gctcgacttg	600
tcatccttgg catactccgg aaaggatgcc	630

<210> 4
 <211> 630
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> JCAT Optimized Nucleotide sequence encoding frataxin

<400> 4	
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gcccagaccc tgaccgcgt gccccgcccc gccgagctgg cccccctgtg cggccgccgc	120

ggcctgcgca ccgacatcga cgccacctgc accccccgcc gcgccagcag caaccagcgc	180
ggcctgaacc agatctggaa cgtgaagaag cagagcgtgt acctgatgaa cctgcgcaag	240
agcggcaccc tggggccacc cggcagcctg gacgagacca cctacgagcg cctggccgag	300
gagaccctgg acagcctggc cgagttcttc gaggacctgg ccgacaagcc ctacaccttc	360
gaggactacg acgtgagctt cggcagcggc gtgctgaccg tgaagctggg cggcgacctg	420
ggcacctacg tgatcaacaa gcagaccccc aacaagcaga tctggctatc tagccccagc	480
agcggcccca agcgctacga ctggaccggc aagaactggg tgtacagcca cgacggcgtg	540
agcctgcacg agctgctggc cgccgagctg accaaggccc tgaagaccaa gctggacctg	600
agcagcctgg cctacagcgg caaggacgcc	630

<210> 5
 <211> 630
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> GeneArt optimized nucleotide sequence encoding frataxin

<400> 5	
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gcccagaccc tgaccagagt gcctagacct gccgaactgg cccctctgtg tggcagaaga	120
ggcctgagaa ccgacatcga cgccacctgt acccccagaa gggccagcag caatcagcgg	180
ggcctgaatc agatctggaa cgtgaagaaa cagagcgtgt acctgatgaa cctgagaaaag	240
agcggcaccc tggggccacc tggaagcctg gatgagacaa cctacgagcg gctggccgag	300
gaaaccctgg attccctggc cgagttcttc gaggacctgg ccgacaagcc ctacaccttc	360
gaggattacg acgtgtcctt cggcagcggc gtgctgacag tgaagctggg cggagatctg	420
ggcacctacg tgatcaacaa gcagaccccc aacaaacaga tctggctatc tagccccagc	480
agcggcccca agagatacga ttggaccggc aagaactggg tgtacagcca cgacggcgtg	540
tccctgcatg agctgctggc tgccgagctg accaaggccc tgaaaacaaa gctggacctg	600
tccagcctgg cctacagcgg caaggatgcc	630

<210> 6
 <211> 630
 <212> DNA

<213> Artificial Sequence

<220>

<223> Genscript (control) optimized Nucleotide sequence encoding frataxin

<400> 6

atgtggacac tgggccggag agccgtcgct gggctgctgg catcaccatc cccgcacag	60
gcacagaccc tgacaagagt ccctcggcca gcagagctgg cccactgtg cgggcggaga	120
ggactgcgaa ccgacatcga tgctacttgt accccaaggc gagcaagctc caaccagcga	180
gggctgaacc agatttggaa tgtgaagaaa cagtctgtct acctgatgaa tctgagaaag	240
agcggcactc tgggacaccc tggcagcctg gacgagacca cctacgagcg gctggccgag	300
gaaaccctgg attccctggc cgagttcttt gaagacctgg ctgataagcc atacaccttc	360
gaagactatg acgtgagctt cggcagcggc gtgctgacag tcaaactggg cggggacctg	420
ggaacatacg tgatcaacaa gcagactcct aacaagcaga tttggctgtc tagtccttca	480
agcggcccta agaggtacga ctggacaggg aaaaactggg tgtatagtca cgatggcgctc	540
tcactgcatg agctgctggc cgctgaactg actaaagccc tgaaaactaa actggacctg	600
tcttccctgg catactctgg caaggacgcc	630

<210> 7

<211> 630

<212> DNA

<213> Artificial Sequence

<220>

<223> Genscript (low CpG) nucleotide sequence encoding frataxin

<400> 7

atgtggactc tgggccggag agcagtggca ggactgctgg caagtccatc acctgctcag	60
gcacagactc tgacaagagt cccaagacct gcagagctgg ctccactgtg cgggaggcgc	120
ggactgagaa cagacatcga tgctacatgt actcctcgac gggcaagctc caaccagcga	180
gggctgaacc agatttggaa tgtgaagaaa cagtccgtct acctgatgaa tctgaggaag	240
tcaggcaccc tggggcaccc aggaagtctg gacgagacca catatgaacg gctggctgag	300
gaaacactgg attctctggc cgagttcttt gaagacctgg ctgataagcc ctacacattc	360
gaagactatg atgtgagctt tggatccggc gtgctgactg tcaaactggg cggggacctg	420
ggcacttacg tgatcaacaa gcagaccct aacaagcaga tttggctgtc tagtccttca	480

agcggaccaa agcggtagca ctggaccggc aaaaactggg tgtattctca cgatggggtc	540
agtctgcatg agctgctggc cgctgaactg accaaggccc tgaagacaaa actggacctg	600
tcctctctgg catatagcgg aaaagatgcc	630

<210> 8
 <211> 630
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> IDT3 optimized Nucleotide sequence encoding frataxin

<400> 8	
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gctcagacac tcacccgagt cccaagaccc gcagagctgg cccctctgtg cgggcgccga	120
ggccttcgca ccgatatcga tgctacatgc acgccacgca gagctagctc aaatcagagg	180
ggactcaacc agatatggaa tgtcaagaag caaagcgtgt atctcatgaa cctccgaaa	240
agcggcaccc tgggacatcc cgggtctctc gacgagacca cttatgaaag actggcagag	300
gagactcttg acagtctggc ggagttcttc gaagacctcg ctgacaagcc atataccttc	360
gaagattacg acgtctcctt cggctctggg gtgctgactg tcaagcttgg cggcgacctg	420
gggacctacg tgatcaacaa gcagactcca aacaagcaaa tctggctatc tagtccaagc	480
tccggacca agagatacga ttggacaggc aagaattggg ttactccca cgacgggggtg	540
tccctccatg agctgctggc cgagagctg acgaaggccc tgaagaccaa gctggatctc	600
tcctccctgg catacagtgg taaggacgct	630

<210> 9
 <211> 630
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> IDT5 optimized Nucleotide sequence encoding frataxin

<400> 9	
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gcgcagactc tgactagggt gccgcggcct gccgagttgg cccccctgtg cggtaggaga	120
ggcctgcgca cagacatcga tgccacttgc acaccccggc gggccagctc taaccaaagg	180

ggcctgaatc aaatttggaa cgtcaaaaaa cagtctgtat atctgatgaa tctccgaaa	240
tctggaacgc tcgggcatcc cggatctctt gacgagacca cctacgagcg actggccgag	300
gaaacccttg acagcctggc agaattcttt gaggatctgg ctgataaacc ctataccttt	360
gaagattacg atgtgagttt tggtagcggg gtactgactg ttaagctggg cggtgatctc	420
ggtacgtatg ttatcaataa acaaaccccc aataaacaga tttggctctc ctccccatcc	480
tctgggccta agcgctatga ctggacagga aagaattggg tctattcaca cgacggagtc	540
agtttgcacg agctcctcgc cggcagagtt accaaggccc ttaagactaa gctcgacctg	600
tcaagcctcg cttactctgg taaggacgct	630

<210> 10
 <211> 630
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleotide sequence encoding frataxin

<400> 10	
atgtggactc tcgggcgccg cgcagtagcc ggcctcctgg cgtcaccag cccggcccag	60
gcccagaccc tcacccgggt cccgcggccg gcagagttgg cccactctg cggccgccgt	120
ggcctgcgca ccgacatcga tgcgacctgc acgccccgcc gcgcaagttc gaaccaacgt	180
ggcctcaacc agatttggaa tgtcaaaaag cagagtgtct atttgatgaa tttgaggaaa	240
tctggaactt tgggccaccc aggctctcta gatgagacca cctatgaaag actagcagag	300
gaaacgctgg actcttttagc agagtttttt gaagaccttg cagacaagcc atacacgttt	360
gaggactatg atgtctcctt tgggagtggg gtcttaactg tcaaactggg tggagatcta	420
ggaacctatg tgatcaacaa gcagacgcca aacaagcaaa tctggctatc ttctccatcc	480
agtggacctc agcgttatga ctggactggg aaaaactggg tgtactcca cgacggcgtg	540
tccctccatg agctgctggc cgcagagctc actaaagcct taaaaaccaa actggacttg	600
tcttccttgg cctattccgg aaaagatgct	630

<210> 11
 <211> 630
 <212> DNA
 <213> Artificial Sequence

<220>

<223> IDT-1 optimized Nucleotide sequence encoding frataxin

<400> 11

atgtggactc tgggtaggcg agcggtaggcc ggcctgttgg catctcctag tcctgcacaa	60
gctcaaacgc tgactagagt ccctcggcca gcagaactgg cgccactttg cggccggcgc	120
ggtcttcgca ctgatattga tgccacttgc acaccccggc ggcctccag taatcagcgg	180
ggacttaatc aaatttggaa tgtgaagaag cagtctgtgt atcttatgaa tctgcggaag	240
agcgggaccc tgggccaccc tggtagcctt gatgaaacca cctatgagcg cctggccgaa	300
gagacactgg acagtcttgc cgagtttttt gaggatctgg ccgacaaacc ttatactttt	360
gaggactatg acgtgtcctt tggatctggg gtattgaccg taaaactcgg gggagacctt	420
gggacgtatg taataaataa gcagacccca aacaagcaga tctggctatc ttctccaagt	480
agtggtccta agagatatga ttggacgggc aagaactggg tctattcca tgatggcgtc	540
tctttgcatg aactccttgc agcagagctg accaaggcct tgaagaccaa attggatctc	600
agcagcctcg cctatagtgg caaagatgca	630

<210> 12

<211> 630

<212> DNA

<213> Artificial Sequence

<220>

<223> IDT-4 optimized Nucleotide sequence encoding frataxin

<400> 12

atgtggactc tgggccggcg ggccgtagct ggcttgctgg ctagcccaag tccgcccag	60
gctcagactc tcaccagggt acccaggccc gcagagcttg ctccactctg cggacgcagg	120
ggtctgcgaa ccgatatcga cgcaacttgc acgccgcgga gggcctcttc aaaccagaga	180
ggactcaatc aaatttggaa tgtaaagaaa cagagcgtgt atctcatgaa cctccgaaag	240
agtgggactc ttgggcaccc cggctccctg gacgagacta cttacgagcg cctggccgaa	300
gaaaccttgg attccctggc ggagtttttt gaagacttgg cagacaagcc ttataccttc	360
gaggattacg acgtgagttt tggctctggg gttcttacag tcaagctcgg tggcgacctt	420
ggcacttatg taattaacaa gcagacacct aacaagcaga tctggctttc tagtccgtct	480
tccggtccca aaaggtacga ttggactgga aagaactggg tctacagtca cgacggtgtc	540

tccctgcacg aattgcttgc ggcagagctg actaaggcgc tcaaaacaaa actggatctg	600
tccagccttg cctatagcgg gaaggacgca	630

<210> 13
 <211> 2211
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleotide sequence encoding chimeric AAV2.5 Vector Capsid VP1

<400> 13	
atggctgccg atggttatct tccagattgg ctcgaggaca ctctctctga aggaataaga	60
cagtgggtgga agctcaaacc tggcccacca ccaccaaagc ccgcagagcg gcataaggac	120
gacagcaggg gtcttgtgct tcctgggtac aagtacctcg gacccttcaa cggactcgac	180
aaggagagc cggatcaacga ggcagacgcc gcggccctcg agcacgacaa agcctacgac	240
cggcagctcg acagcggaga caaccgtac ctcaagtaca accacgccga cgcggagttt	300
caggagcgcc ttaaagaaga tacgtctttt gggggcaacc tcggacgagc agtcttccag	360
gcgaaaaaga gggttcttga acctctgggc ctggttgagg aacctgttaa gacggctccg	420
ggaaaaaaga ggccggtaga gcactctcct gtggagccag actcctctc gggaaccgga	480
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aatac gatgg ctacaggcag tggcgcacca atggcagaca ataacgaggg cgccgacgga	660
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gttcttccag gcatggctctg gcaggacaga gatgtgtacc ttcaggggcc catctgggca	1860
aagattccac acacggacgg acattttcac ccctctcccc tcatgggtgg attcggactt	1920
aaacaccctc ctccacagat tctcatcaag aacaccccgg tacctgcgaa tccttcgacc	1980
accttcagtg cggcaaagtt tgcttccttc atcacacagt actccacggg acaggtcagc	2040
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tacacttcca actacgcaa gtctgtcaat gtggacttta ctgtggacaa taatggcgtg	2160
tattcagagc ctcgccccat tggcaccaga tacctgactc gtaatctgta a	2211

<210> 14

<211> 2211

<212> DNA

<213> Artificial Sequence

<220>

<223> Nucleotide sequence encoding wildtypeAAV1 capsid (VP1)

<400> 14

atggctgccg atggttatct tccagattgg ctcaggaca acctctctga gggcattcgc	60
gagtgggtggg acttgaaacc tggagccccg aagcccaaag ccaaccagca aaagcaggac	120
gacggccggg gtctgggtgt tcctggctac aagtacctcg gacccttcaa cggactcgac	180
aaggggggagc ccgtcaacgc ggcggacgca gcggccctcg agcacgacaa ggcctacgac	240
cagcagctca aagcgggtga caatccgtac ctgcggtata accacgccga cgccgagttt	300

caggagcgtc tgcaagaaga tacgtctttt gggggcaacc tcgggcgagc agtcttccag	360
gccaagaagc gggttctcga acctctcggt ctggttgagg aaggcgctaa gacggctcct	420
ggaaagaaac gtccggtaga gcagtcgcca caagagccag actcctcctc gggcatcggc	480
aagacaggcc agcagcccg taaaaagaga ctcaattttg gtcagactgg cgactcagag	540
tcagtccccg atccacaacc tctcggagaa cctccagcaa ccccgctgc tgtgggacct	600
actacaatgg cttcaggcgg tggcgcacca atggcagaca ataacgaagg cgccgacgga	660
gtgggtaatg cctcaggaaa ttggcattgc gattccacat ggctgggcga cagagtcac	720
accaccagca cccgcacctg ggccttgccc acctacaata accacctcta caagcaaadc	780
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gggtattttg atttcaacag attccactgc cacttttcac cacgtgactg gcagcgactc	900
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caatacctgt attacctgaa cagaactcaa aatcagtccg gaagtgccca aaacaaggac	1380
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ggcactgcta tggcctcaca caaagacgac gaagacaagt tctttcccat gagcgggtgc	1620
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acagacgaag aggaaattaa agccactaac cctgtggcca ccgaaagatt tgggaccgtg	1740
gcagtcaatt tccagagcag cagcacagac cctgcgaccg gagatgtgca tgctatggga	1800
gcattacctg gcatggtgtg gcaagataga gacgtgtacc tgcagggtcc catttgggcc	1860
aaaattcctc acacagatgg acactttcac ccgtctcctc ttatgggcgg ctttggactc	1920

aagaacccgc ctcctcagat cctcatcaaa aacacgcctg ttcctgcgaa tcctccggcg	1980
gagttttcag ctacaaagtt tgcttcattc atcacccaat actccacagg acaagtgagt	2040
gtggaaattg aatgggagct gcagaaagaa aacagcaagc gctggaatcc cgaagtgcag	2100
tacacatcca attatgcaaa atctgccaac gttgatttta ctgtggacaa caatggactt	2160
tatactgagc ctcgccccat tggcaccctg taccttacc gtcccctgta a	2211

<210> 15
 <211> 2208
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleotide sequence encoding modified AAV1.1 capsid VP1

<400> 15	
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gagtggtaggg acttgaaacc tggagccccg aagcccaaag ccaaccagca aaagcaggac	120
gacggccggg gtctgggtgt tcctggctac aagtacctcg gacccttcaa cggactcgac	180
aaggggggagc ccgtcaacgc ggcggacgca gcggccctcg agcacgacaa ggcctacgac	240
cagcagctca aagcgggtga caatccgtac ctgcggtata accacgccga cgccgagttt	300
caggagcgtc tgcaagaaga tacgtctttt gggggcaacc tcgggcgagc agtctttccag	360
gccaagaagc gggttctcga acctctcggg ctggttgagg aaggcgctaa gacggctcct	420
ggaaagaaac gtccggtaga gcagtcgcca caagagccag actcctctc gggcatcggc	480
aagacaggcc agcagccgc taaaaagaga ctcaattttg gtcagactgg cgactcagag	540
tcagtccccg atccacaacc tctcggagaa cctccagcaa ccccgctgc tgtgggacct	600
actacaatgg cttcaggcgg tggcgcacca atggcagaca ataacgaagg cgccgacgga	660
gtgggtaatg cctcaggaaa ttggcattgc gattccacat ggctgggcga cagagtcac	720
accaccagca cccgcacctg ggccttgccc acctacaata accacctcta caagcaaadc	780
tccagtgttt caggggcccag caacgacaac cactacttcg gctacagcac cccctggggg	840
tattttgatt tcaacagatt cactgccac ttttcaccac gtgactggca gcgactcatc	900
aacaacaatt ggggattccg gcccaagaga ctcaacttca aactcttcaa catccaagtc	960
aaggaggtca cgacgaatga tggcgtcaca accatcgcta ataaccttac cagcacggtt	1020

caagtcttct cggactcgga gtaccagctt ccgtacgtcc tcggctctgc gcaccagggc	1080
tgcctccctc cgttcccggc ggacgtgttc atgattccgc aatacggcta cctgacgctc	1140
aacaatggca gccaaagccgt gggacgttca tccttttact gcctggaata tttcccttct	1200
cagatgctga gaacgggcaa caactttacc ttcagctaca cctttgagga agtgcctttc	1260
cacagcagct acgcgcacag ccagagcctg gaccggctga tgaatcctct catcgaccaa	1320
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ccctgttatc ggcagcagcg cgtttctaaa aaaaaacag acaacaacaa cagcaatttt	1500
acctggactg gtgcttcaaa atataacctc aatgggcgtg aatccatcat caaccctggc	1560
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ttacctggca tgggtgtggca agatagagac gtgtacctgc aggggtcccat ttgggccaaa	1860
attcctcaca cagatggaca ctttcacccg tctcctctta tgggcggctt tggactcaag	1920
aacccgcctc ctgagatcct catcaaaaac acgcctgttc ctgcgaatcc tccggcggag	1980
ttttcagcta caaagtttgc ttcatctatc acccaatact ccacaggaca agtgagtgtg	2040
gaaattgaat gggagctgca gaaagaaaac agcaagcgct ggaatcccga agtgcagtac	2100
acatccaatt atgcaaaatc tgccaacgtt gattttactg tggacaacaa tggactttat	2160
actgagcctc gcccattgg caccgttac cttaccgctc ccctgtaa	2208

<210> 16
 <211> 2211
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleotide sequence encoding wildtype AAV6 capsid (VP1)

<400> 16	
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gagtgggtggg acttgaaacc tggagccccg aaacccaaag ccaaccagca aaagcaggac	120

gacggccggg gtctggtgct tcctggctac aagtacctcg gacccttcaa cggactcgac	180
aaggggggagc ccgtcaacgc ggcgggatgca gcggccctcg agcacgacaa ggcctacgac	240
cagcagctca aagcgggtga caatccgtac ctgcggtata accacgccga cgccgagttt	300
caggagcgtc tgcaagaaga tacgtctttt gggggcaacc tcgggcgagc agtcttccag	360
gccaagaaga gggttctcga accttttggg ctggttgagg aaggtgctaa gacggctcct	420
ggaaagaaac gtccggtaga gcagtcgcca caagagccag actcctcctc gggcattggc	480
aagacaggcc agcagccgc taaaaagaga ctcaattttg gtcagactgg cgactcagag	540
tcagtccccg acccacaacc tctcggagaa cctccagcaa ccccgctgc tgtgggacct	600
actacaatgg cttcaggcgg tggcgcacca atggcagaca ataacgaagg cgccgacgga	660
gtgggtaatg cctcaggaaa ttggcattgc gattccacat ggctgggcga cagagtcac	720
accaccagca cccgaacatg ggccttgccc acctataaca accacctcta caagcaaadc	780
tccagtgtt caacgggggc cagcaacgac aaccactact tcggctacag cccccctgg	840
gggtattttg atttcaacag attccactgc catttctcac cacgtgactg gcagcgactc	900
atcaacaaca attgggggatt ccggcccaag agactcaact tcaagctctt caacatccaa	960
gtcaaggagg tcacgacgaa tgatggcgtc acgaccatcg ctaataacct taccagcacg	1020
gttcaagtct tctcggactc ggagtaccag ttgccgtacg tcctcggctc tgcgcaccag	1080
ggctgcctcc ctccgttccc ggcggacgtg ttcattgattc cgagctacgg ctacctaacg	1140
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tcgcagatgc tgagaacggg caataacttt accttcagct acaccttcga ggacgtgcct	1260
ttccacagca gctacgcga cagccagagc ctggaccggc tgatgaatcc tctcatcgac	1320
cagtacctgt attacctgaa cagaactcag aatcagtcgg gaagtgccca aaacaaggac	1380
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ggcactgcta tggcctcaca caaagacgac aaagacaagt tctttcccat gagcgggtgc	1620
atgatttttg gaaaggagag cgccggagct tcaaactg cattggacaa tgtcatgatc	1680
acagacgaag aggaaatcaa agccactaac cccgtggcca ccgaaagatt tgggactgtg	1740

gcagtcaatc tccagagcag cagcacagac cctgcgaccg gagatgtgca tgttatggga	1800
gccttacctg gaatggtgtg gcaagacaga gacgtatacc tgcagggtcc tatttgggcc	1860
aaaattcctc acacggatgg acactttcac ccgtctcctc tcatgggcgg ctttggactt	1920
aagcacccgc ctctcagat cctcatcaaa aacacgcctg ttcctgcgaa tcctccggca	1980
gagttttcgg ctacaaagtt tgcttcattc atcaccaggt attccacagg acaagtgagc	2040
gtggagattg aatgggagct gcagaaagaa aacagcaaac gctggaatcc cgaagtgcag	2100
tatacatcta actatgcaaa atctgccaac gttgatttca ctgtggacaa caatggactt	2160
tatactgagc ctgccccat tggcacccgt tacctcacc gtcccctgta a	2211

<210> 17
 <211> 2205
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleotide sequence encoding modified AAV6.1 capsid VP1

<400> 17	
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agtgggtggga cttgaaacct ggagccccga aacccaaagc caaccagcaa aagcaggacg	120
acggccgggg tdggtgcttc ctggctacaa gtacctcgga cccttcaacg gactcgacaa	180
gggggagccc gtcaacgcgg cggatgcagc ggccctcgag cacgacaagg cctacgacca	240
gcagctcaaa gcgggtgaca atccgtacct gcggtataac cacgccgacg ccgagtttca	300
ggagcgtctg caagaagata cgtcttttgg gggcaacctc gggcgagcag tcttccaggc	360
caagaagagg gttctcgaac cttttggt dg gttgaggaag gtgctaagac ggctcctgga	420
aagaaacgtc cggtagagca gtcgccacaa gagccagact cctcctcggg cattggcaag	480
acaggccagc agcccgctaa aaagagactc aattttgggtc agactggcga ctcagagtca	540
gtccccgacc cacaacctct cggagaacct ccagcaaccc ccgtgctgt gggacctact	600
acaatggctt caggcggtgg cgcaccaatg gcagacaata acgaaggcgc cgacggagtg	660
ggtaatgcct caggaaattg gcattgcgat tccacatggc tgggcgacag agtcatcacc	720
accagcacc gaacatgggc cttgcccacc tataacaacc acctctacaa gcaaatctcc	780
agtgcctcag gggccagcaa cgacaaccac tacttcggct acagcacc ccctgggggtat	840

tttgatttca acagattcca ctgccatttc tcaccacgtg actggcagcg actcatcaac	900
aacaattggg gattccggcc caagagactc aacttcaagc tcttcaacat ccaagtcaag	960
gaggtcacga cgaatgatgg cgtcacgacc atcgctaata accttaccag cacggttcaa	1020
gtcttctcgg actcggagta ccagttgccg tacgtcctcg gctctgcgca ccagggtgc	1080
ctccctccgt tcccggcgga cgtgttcatg attccgcagt acggctacct aacgctcaac	1140
aatggcagcc aggcagtggg acggtcattc ttttactgcc tggaatattt cccatcgcag	1200
atgctgagaa cgggcaataa ctttaccttc agctacacct tcgaggacgt gcctttccac	1260
agcagctacg cgcacagcca gagcctggac cggctgatga atcctctcat cgaccagtac	1320
ctgtattacc tgaacagaac tcagaatcag tccggaagtg cccaaaacaa ggacttgctg	1380
tttagccggg ggtctccagc tggcatgtct gttcagccca aaaactggct acctggaccc	1440
tgttaccggc agcagcgcgt ttctaaaaca aaaacagaca acaacaacag caactttacc	1500
tggactggtg cttcaaaata taaccttaat gggcgtgaat ctataatcaa ccctggcact	1560
gctatggcct cacacaaaga cgacaaagac aagttctttc ccatgagcgg tgtcatgatt	1620
tttggaaagg agagcgccgg agcttcaaac actgcattgg acaatgtcat gatcacagac	1680
gaagaggaaa tcaaagccac taaccccggtg gccaccgaaa gatttgggac tgtggcagtc	1740
aatctccaga gcagcagcac agaccctgcg accggagatg tgcattgttat gggagcctta	1800
cctggaatgg tgtggcaaga cagagacgta tacctgcagg gtcctatttg ggccaaaatt	1860
cctcacacgg atggacactt tcacccgtct cctctcatgg gcggcttttg acttaagcac	1920
ccgcctctc agatcctcat caaaaacacg cctgttcctg cgaatcctcc ggcagagttt	1980
tcggctacaa agtttgcttc attcatcacc cagtattcca caggacaagt gagcgtggag	2040
attgaatggg agctgcagaa agaaaacagc aaacgctgga atcccgaagt gcagtataca	2100
tctaactatg caaaatctgc caacgttgat ttcactgtgg acaacaatgg actttatact	2160
gagcctcgcc ccattggcac ccgttacctc acccgctccc tgtaa	2205

<210> 18
 <211> 2208
 <212> DNA
 <213> Artificial Sequence

<220>

<223> Nucleotide sequence encoding modified AAV6.3.1 capsid VP1

<400> 18

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gagtgggtggg acttgaaacc tggagccccg aaacccaaag ccaaccagca aaagcaggac	120
gacggccggg gtctgggtgct tcctggctac aagtacctcg gacccttcaa cggactcgac	180
aagggggagc ccgtcaacgc ggcggatgca gcggccctcg agcacgacaa ggcctacgac	240
cagcagctca aagcgggtga caatccgtac ctgcggtata accacgccga cgccgagttt	300
caggagcgtc tgcaagaaga tacgtctttt gggggcaacc tcgggcgagc agtcttccag	360
gccaagaaga gggttctcga accttttggg ctggttgagg aaggtgctaa gacggctcct	420
ggaaagaaac gtccggtaga gcagtcgcca caagagccag actcctcctc gggcattggc	480
aagacaggcc agcagcccg taaaaagaga ctcaattttg gtcagactgg cgactcagag	540
tcagtccccg acccacaacc tctcggagaa cctccagcaa ccccgctgc tgtgggacct	600
actacaatgg cttcaggcgg tggcgacca atggcagaca ataacgaagg cgccgacgga	660
gtgggtaatg cctcaggaaa ttggcattgc gattccacat ggctgggcga cagagtcac	720
accaccagca cccgaacatg ggccttgccc acctataaca accacctcta caagcaaadc	780
tccagtgtt caggggccag caacgacaac cactacttcg gctacagcac cccctggggg	840
tattttgatt tcaacagatt cactgcat ttctcaccac gtgactggca gcgactcatc	900
aacaacaatt ggggattccg gcccaagaga ctcaacttca agctcttcaa catccaagtc	960
aaggaggta cgcgaatga tggcgtcacg accatcgcta ataaccttac cagcacggtt	1020
caagtcttct cggactcgga gtaccagttg ccgtacgtcc tcggctctgc gcaccagggc	1080
tgctccctc cgttcccggc ggacgtgttc atgattccgc agtacggcta cctaacgctc	1140
aacaatggca gccaggcagt gggacggta tccttttact gcctggaata tttcccatcg	1200
cagatgctga gaacgggcaa taactttacc tttagctaca ctttcgagga cgtgcctttc	1260
cacagcagct acgcgcacag ccagagcctg gaccggctga tgaatcctct catcgaccag	1320
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ctgtttagcc ggggggtctc agctggcatg tctgttcagc ccaaaaactg gctacctgga	1440
ccctgttacc ggcagcagcg cgtttctaaa acaaaaacag acaacaaca cagcaacttt	1500
acctggactg gtgcttcaaa atataacctt aatgggcgtg aatctataat caaccctggc	1560

actgctatgg cctcacacaa agacgacgaa gacaagttct ttcccatgag cgggtgtcatg	1620
atTTTTtgGaa aggagagcgc cggagcttca aacactgcat tggacaatgt catgatcaca	1680
gacgaagagg aaatcaaagc cactaacccc gtggccaccg aaagatttgg gactgtggca	1740
gtcaatctcc agagcagcag cacagaccct gcgaccggag atgtgcatgt tatgggagcc	1800
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attcctcaca cggatggaca ctttcacccg tctcctctca tgggcggctt tggacttaag	1920
cacccgcctc ctcatatcct catcaaaaac acgcctgttc ctgcgaatcc tccggcagag	1980
ttttcggcta caaagtttgc ttcattcatc acccagtatt ccacaggaca agtgagcgtg	2040
gagattgaat gggagctgca gaaagaaaac agcaaacgct ggaatcccga agtgcagtat	2100
acatctaact atgcaaaatc tgccaacgtt gatttcactg tggacaacaa tggactttat	2160
actgagcctc gccccattgg cacccgttac ctcaccgctc ccctgtaa	2208

<210> 19

<211> 983

<212> DNA

<213> Artificial Sequence

<220>

<223> Nucleotide sequence encoding human wild type frataxin (WT FXN)
for cloning into pTRs-KS-CBh-EGFP-BGH scAAV vector

<400> 19

tagaagaccg gtcgccacca tgtggactct cgggcgccgc gcagtagccg gcctcctggc	60
gtcaccagc ccagcccagg cccagaccct caccgggtc ccgcggccgg cagagttggc	120
cccactctgc ggccgccgtg gcctgcgcac cgacatcgat gcgacctgca cccccgccg	180
cgcaagtctg aaccaacgtg gcctcaacca gatttggaa gtcaaaaagc agagtgtcta	240
tttgatgaat ttgaggaaat ctggaacttt gggccacca ggctctctag atgagaccac	300
ctatgaaaga ctagcagagg aaacgctgga ctcttttagca gagttttttg aagaccttgc	360
agacaagcca tacacgtttg aggactatga tgtctccttt gggagtgggtg tcttaactgt	420
caaactgggt ggagatctag gaacctatgt gatcaacaag cagacgcaa acaagcaa	480
ctggctatct tctccatcca gtggacctaa gcgttatgac tggactggga aaaactgggt	540
gtactccac gacggcgtgt ccctccatga gctgctggcc gcagagctca ctaaagcctt	600

aaaaacaaa ctggacttgt cttccttggc ctattccgga aaagatgctt gacgagcggc	660
cgctcctagg agcagtatcg atcccagccc acttttcccc aatacgacta gtactcgact	720
gtgccttcta gttgccagcc atctgttggt tgcccctccc ccgtgccttc cttgaccctg	780
gaagggtgcca ctcccactgt cctttcctaa taaaatgagg aaattgcatc gcattgtctg	840
agtaggtgtc attctattct ggggggtggg gtggggcagg acagcaaggg ggaggattgg	900
gaagacaaca gcaggcatgc tggggatgcg gtgggctcta tggcttctga ggcggaaaga	960
accagctttg gacgctctt aag	983

<210> 20

<211> 983

<212> DNA

<213> Artificial Sequence

<220>

<223> IDT1 Codon optimized nucleotide sequence encoding FXN for cloning into pTRs-KS-CBh-EGFP-BGH scAAV vector

<400> 20

tagaagaccg gtcgccacca tgtggactct gggtaggcga gcggtggccg gcctgttggc	60
atctcctagt cctgcacaag ctcaaacgct gactagagtc cctcggccag cagaactggc	120
gccactttgc ggccggcgcg gtcttcgcac tgatattgat gccacttgca caccgcggcg	180
cgcctccagt aatcagcggg gacttaatca aatttgaat gtgaagaagc agtctgtgta	240
tcttatgaat ctgcggaaga gcgggaccct gggccaccct ggtagccttg atgaaaccac	300
ctatgagcgc ctggccgaag agacactgga cagtcttgcc gagttttttg aggatctggc	360
cgacaaacct tatacttttg aggactatga cgtgtccttt ggatctggtg tattgaccgt	420
aaaactcggg ggagaccttg ggacgtatgt aataaataag cagaccccaa acaagcagat	480
ctggctcagc tctccaagta gtggtcctaa gagatatgat tggacgggca agaactgggt	540
ctattcccat gatggcgtct ctttgcata actccttgca gcagagctga ccaaggcctt	600
gaagacaaa ttggatctca gcagcctcgc ctatagtggc aaagatgcat agcgagcggc	660
cgctcctagg agcagtatcg atcccagccc acttttcccc aatacgacta gtactcgact	720
gtgccttcta gttgccagcc atctgttggt tgcccctccc ccgtgccttc cttgaccctg	780
gaagggtgcca ctcccactgt cctttcctaa taaaatgagg aaattgcatc gcattgtctg	840
agtaggtgtc attctattct ggggggtggg gtggggcagg acagcaaggg ggaggattgg	900

gaagacaaca gcaggcatgc tggggatgcg gtgggctcta tggcttctga ggcggaaaga	960
accagctttg gacgctctt aag	983

<210> 21
 <211> 983
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Codon optimized nucleotide sequence encoding FXN IDT3 (low expresser) for cloning into pTRs-KS-CBh-EGFP-BGH scAAV vector

<400> 21	
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atcaccatcc ccagcccagg ctgagacact caccgagtc ccaagaccg cagagctggc	120
ccctctgtgc gggcgccgag gccttcgcac cgatatcgat gctacatgca cgccacgcag	180
agctagctca aatcagaggg gactcaacca gatatggaat gtcaagaagc aaagcgtgta	240
tctcatgaac ctccggaaaa gcggcaccct gggacatccc gggctctctcg acgagaccac	300
ttatgaaaga ctggcagagg agactcttga cagtctggcg gagttcttcg aagacctcgc	360
tgacaagcca tataccttcg aagattacga cgtctccttc ggctctgggg tgctgactgt	420
caagcttggc ggcgacctgg ggacctacgt gatcaacaag cagactccaa acaagcaa	480
ctggctcagc agtccaagct ccggacccaa gagatacgat tggacaggca agaattgggt	540
ttactccac gacgggggtgt ccctccatga gctgctggcc gctgagctga cgaaggccct	600
gaagaccaag ctggatctct cctccctggc atacagtggg aaggacgctt gacgagcggc	660
cgctcctagg agcagtatcg atcccagccc acttttcccc aatacgacta gtactcgact	720
gtgccttcta gttgccagcc atctgttggt tgcccctccc ccgtgccttc cttgaccctg	780
gaaggtgcca ctcccactgt ctttcctaa taaaatgagg aaattgcatc gcattgtctg	840
agtaggtgtc attctattct ggggggtggg gtggggcagg acagcaaggg ggaggattgg	900
gaagacaaca gcaggcatgc tggggatgcg gtgggctcta tggcttctga ggcggaaaga	960
accagctttg gacgctctt aag	983

<210> 22
 <211> 983
 <212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized nucleotide sequence encoding FXN IDT4 for cloning into pTRs-KS-CBh-EGFP-BGH scAAV vector

<400> 22

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tagcccaagt cccgccagg ctcagactct caccagggtta cccaggcccg cagagcttgc      120
tccactctgc ggacgcaggg gtctgcgaac cgatatcgac gcaacttgca cgccgcggag      180
ggcctcttca aaccagagag gactcaatca aatttggaa gttaaagaaac agagcgtgta      240
tctcatgaac ctccgaaaga gtgggactct tgggcacccc ggctccctgg acgagactac      300
ttacgagcgc ctggccgaag aaaccttgga ttccctggcg gagttttttg aagacttggc      360
agacaagcct tataccttcg aggattacga cgtgagtttt ggctctggtg ttcttacagt      420
caagctcggg ggcgaccttg gcacttatgt aattaacaag cagacaccta acaagcagat      480
ctggctttct agtccgtctt ccggtcccaa aaggtacgat tggactggaa agaactgggt      540
ctacagtcac gacggtgtct ccctgcacga attgcttgcg gctgagctga ctaaggcgct      600
caaaacaaaa ctggatctgt ccagccttgc ctatagcggg aaggacgcat gacgagcggc      660
cgctcctagg agcagtatcg atcccagccc acttttcccc aatacgacta gtactcgact      720
gtgccttcta gttgccagcc atctgttggt tggccctccc ccgtgccttc cttgaccctg      780
gaaggtgcca ctcccactgt cttttcctaa taaaatgagg aaattgcatc gcattgtctg      840
agtaggtgtc attctattct ggggggtggg gtggggcagg acagcaaggg ggaggattgg      900
gaagacaaca gcaggcatgc tggggatgcg gtgggctcta tggcttctga ggcggaaaga      960
accagctttg gacgcgtctt aag                                           983
```

<210> 23

<211> 983

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized nucleotide sequence encoding FXN GenScript for cloning into pTRs-KS-CBh-EGFP-BGH scAAV vector

<400> 23

```
tagaagaccg gtcgccacca tgtggacact gggccggaga gccgtcgctg ggctgctggc      60
```

atcaccatcc cccgcacagg cacagaccct gacaagagtc cctcggccag cagagctggc	120
cccactgtgc gggcggagag gactgcgaac cgacatcgat gctacttgta cccaaggcg	180
agcaagctcc aaccagcgag ggctgaacca gatttggaaat gtgaagaaac agtctgtcta	240
cctgatgaat ctgagaaaga gcggcactct gggacaccct ggcagcctgg acgagaccac	300
ctacgagcgg ctggccgagg aaaccctgga ttccctggcc gagttctttg aagacctggc	360
tgataagcca tacaccttcg aagactatga cgtgagcttc ggcagcggcg tgctgacagt	420
caaaactgggc ggggacctgg gaacatacgt gatcaacaag cagactccta acaagcagat	480
ttggctgtct agtccctcaa gcggccctaa gaggtacgac tggacaggga aaaactgggt	540
gtatagtcac gatggcgtct cactgcatga gctgctggcc gctgaactga ctaaagccct	600
gaaaactaaa ctggacctgt cttccctggc atactctggc aaggacgcct gacgagcggc	660
cgctcctagg agcagtatcg atcccagccc acttttcccc aatacgacta gtactcgact	720
gtgccttcta gttgccagcc atctgttggt tgcccctccc ccgtgccttc cttgacctg	780
gaaggtgcca ctcccactgt cttttcctaa taaaatgagg aaattgcatc gcattgtctg	840
agtaggtgtc attctattct ggggggtggg gtggggcagg acagcaaggg ggaggattgg	900
gaagacaaca gcaggcatgc tggggatgcg gtgggctcta tggcttctga ggcggaaaga	960
accagctttg gacgcgtctt aag	983

<210> 24

<211> 983

<212> DNA

<213> Artificial Sequence

<220>

<223> Codon-optimized nucleotide sequence encoding FXN GenScript (low CpG) for cloning into pTRs-KS-CBh-EGFP-BGH scAAV vector

<400> 24

tagaagaccg gtcgccacca tgtggactct gggccggaga gcagtggcag gactgctggc	60
aagtccatca cctgctcagg cacagactct gacaagagtc ccaagacctg cagagctggc	120
tccactgtgc gggaggcgcg gactgagaac agacatcgat gctacatgta ctctcgacg	180
ggcaagctcc aaccagcgag ggctgaacca gatttggaaat gtgaagaaac agtccgtcta	240
cctgatgaat ctgaggaagt caggcaccct ggggcaccca ggaagtctgg acgagaccac	300
atatgaacgg ctggctgagg aaacactgga ttctctggcc gagttctttg aagacctggc	360

tgataagccc tacacattcg aagactatga tgtgagcttt ggatccggcg tgctgactgt	420
caaaactgggc ggggacctgg gcacttacgt gatcaacaag cagacccta acaagcagat	480
ttggctgtct agtccttcaa gcggaccaa gcggtacgac tggaccggca aaaactgggt	540
gtattctcac gatggggtca gtctgcatga gctgctggcc gctgaactga ccaaggccct	600
gaagacaaaa ctggacctgt cctctctggc atatagcgga aaagatgcct gacgagcggc	660
cgctcctagg agcagtatcg atcccagccc acttttcccc aatacgacta gtactcgact	720
gtgccttcta gttgccagcc atctgttggt tgcccctccc ccgtgccttc cttgaccctg	780
gaagggtcca ctcccactgt cctttcctaa taaaatgagg aaattgcatc gcattgtctg	840
agtaggtgtc attctattct ggggggtggg gtggggcagg acagcaaggg ggaggattgg	900
gaagacaaca gcaggcatgc tggggatgcg gtgggctcta tggcttctga ggcggaaaga	960
accagctttg gacgcgtctt aag	983

<210> 25
 <211> 20
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleic acid sequence encoding collagen stabilizing sequence

<400> 25	
cccagccac ttttcccaa	20

<210> 26
 <211> 797
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleic acid sequence of CBh promoter

<400> 26	
tacataactt acggtaaatg gccgcctgg ctgaccgcc aacgacccc gccattgac	60
gtcaatagta acgccaatag ggactttcca ttgacgtcaa tgggtggagt atttacggta	120
aactgcccac ttggcagtac atcaagtgt tcatatgcc agtacgccc ctattgacgt	180
caatgacggg aaatggcccg cctggcattg tgcccagtac atgaccttat gggactttcc	240
tacttggcag tacatctacg tattagtcac cgctattacc atggtcgagg tgagccccac	300

gttctgcttc actctcccca tctccccccc ctccccaccc ccaattttgt atttatztat	360
ttttaatta ttttgtgcag cgatgggggc gggggggggg ggggggcgcg cgccaggcgg	420
ggcggggcgg ggcgaggggc ggggcggggc gaggcggaga ggtgcggcgg cagccaatca	480
gagcggcgcg ctccgaaagt ttccttttat ggcgaggcgg cggcggcggc ggccctataa	540
aaagcgaagc gcgcggcggg cgggagtcgc tgcgacgctg ccttcgcccc gtgccccgct	600
ccgccgccgc ctgcgccgc ccgccccggc tctgactgac cgcgttactc ccacaggtga	660
gcgggcggga cggcccttct cctccgggct gtaattagct gagcaagagg taagggttta	720
agggatggtt ggttggtggg gtattaatgt ttaattacct ggagcacctg cctgaaatca	780
ctttttttca ggttgga	797

<210> 27
 <211> 254
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleic acid sequence of bGHpoly A signal sequence

<400> 27	
ctcgactgtg ccttctagtt gccagccatc tgttgtttgc ccctccccg tgccttcctt	60
gaccttgga ggtgccactc ccactgtcct ttcctaataa aatgaggaaa ttgcatcgca	120
ttgtctgagt aggtgtcatt ctattctggg ggggtggggtg gggcaggaca gcaaggggga	180
ggattgggaa gacaacagca ggcatgctgg ggatgcggtg ggctctatgg cttctgaggc	240
ggaaagaacc agct	254

<210> 28
 <211> 2208
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Nucleotide sequence encoding AAV2i8 capsid (VP1)

<400> 28	
atggctgccg atggttatct tccagattgg ctgaggaca ctctctctga aggaataaga	60
cagtggtgga agctcaaacc tggcccacca ccaccaaagc ccgcagagcg gcataaggac	120
gacagcaggg gtcttgtgct tcctgggtac aagtacctcg gacccttcaa cggactcgac	180

aagggagagc cgggtcaacga ggcagacgcc gcggccctcg agcacgacaa agcctacgac	240
cggcagctcg acagcggaga caacccgtac ctcaagtaca accacgccga cgcggagttt	300
caggagcggc ttaaagaaga tacgtctttt gggggcaacc tcggacgagc agtcttccag	360
gcgaaaaaga gggttcttga acctctgggc ctggttgagg aacctgttaa gacggctccg	420
ggaaaaaaga ggccggtaga gcactctcct gtggagccag actcctcctc gggaaccgga	480
aaggcgggcc agcagcctgc aagaaaaaga ttgaattttg gtcagactgg agacgcagac	540
tcagtacctg acccccagcc tctcggacag ccaccagcag cccctcttg tctgggaact	600
aatacgatgg ctacaggcag tggcgcacca atggcagaca ataacgaggg cgccgacgga	660
gtgggtaatt cctcgggaaa ttggcattgc gattccacat ggatgggcga cagagtcac	720
accaccagca cccgaacctg ggccctgccc acctacaaca accacctcta caaacaatt	780
tccagccaat caggagcctc gaacgacaat cactactttg gctacagcac cccttggggg	840
tattttgact tcaacagatt ccactgccac ttttcaccac gtgactggca aagactcatc	900
aacaacaact ggggattccg acccaagaga ctcaacttca agctctttaa cattcaagtc	960
aaagaggcca cgcagaatga cggtagcagc acgattgcc aataaccttac cagcacggtt	1020
cagggtgttta ctgactcgga gtaccagctc ccgtacgtcc tcggctcggc gcatcaagga	1080
tgcttccgc cgttcccagc agacgtcttc atgggtgccac agtatggata cctcacctg	1140
aacaacggga gtcaggcagt aggacgctct tcattttact gcctggagta ctttccttct	1200
cagatgctgc gtaccggaaa caactttacc ttcagctaca cttttgagga cgttcctttc	1260
cacagcagct acgctcacag ccagagtctg gaccgtctca tgaatcctct catcgaccag	1320
tacctgtatt acttgagcag acaaacact ccaagtggaa ccaccacgca gtcaaggctt	1380
cagttttctg tggccggacc cagtaacatg gctgtccagg gaaggaaactg gcttcctgga	1440
ccctgttacc gccagcagcg agtatcaaag acatctgcgg ataacaaca cagtgaattt	1500
gcttggactg gagctaccaa gtaccacctc aatggcagag actctctggt gaatccgggc	1560
ccggccatgg caagccacaa ggacgatgaa gaaaagtttt ttcctcagag cggggttctc	1620
atctttggga agcaaggctc agagaaaaca aatgtggaca ttgaaaagg catgattaca	1680
gacgaagagg aaatcaggac aaccaatccc gtggctacgg agcagtatgg ttctgtatct	1740
accaacctcc agcaacagaa cacagcacca gctaccgcag atgtcaacac acaaggcgtt	1800

cttccaggca tggctctggca ggacagagat gtgtaccttc aggggcccac ctgggcaaag 1860
 attccacaca cggacggaca ttttcacccc tctcccctca tgggtggatt cggacttaaa 1920
 caccctcctc cacagattct catcaagaac accccggtac ctgcgaatcc ttcgaccacc 1980
 ttcagtgcgg caaagtttgc ttccttcac acacagtact ccacgggaca ggtcagcgtg 2040
 gagatcgagt gggagctgca gaaggaaaac agcaaacgct ggaatcccga aattcagtac 2100
 acttccaact acaacaagtc tgттаатgtg gactttactg tggacactaa tggcgtgtat 2160
 tcagagcctc gccccattgg caccagatac ctgactcgta atctgtaa 2208

<210> 29
 <211> 735
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Amino acid sequence of AAV2i8 capsid (VP1)

<400> 29

Met Ala Ala Asp Gly Tyr Leu Pro Asp Trp Leu Glu Asp Thr Leu Ser
 1 5 10 15

Glu Gly Ile Arg Gln Trp Trp Lys Leu Lys Pro Gly Pro Pro Pro Pro
 20 25 30

Lys Pro Ala Glu Arg His Lys Asp Asp Ser Arg Gly Leu Val Leu Pro
 35 40 45

Gly Tyr Lys Tyr Leu Gly Pro Phe Asn Gly Leu Asp Lys Gly Glu Pro
 50 55 60

Val Asn Glu Ala Asp Ala Ala Ala Leu Glu His Asp Lys Ala Tyr Asp
 65 70 75 80

Arg Gln Leu Asp Ser Gly Asp Asn Pro Tyr Leu Lys Tyr Asn His Ala
 85 90 95

Asp Ala Glu Phe Gln Glu Arg Leu Lys Glu Asp Thr Ser Phe Gly Gly
 100 105 110

Asn Leu Gly Arg Ala Val Phe Gln Ala Lys Lys Arg Val Leu Glu Pro
115 120 125

Leu Gly Leu Val Glu Glu Pro Val Lys Thr Ala Pro Gly Lys Lys Arg
130 135 140

Pro Val Glu His Ser Pro Val Glu Pro Asp Ser Ser Ser Gly Thr Gly
145 150 155 160

Lys Ala Gly Gln Gln Pro Ala Arg Lys Arg Leu Asn Phe Gly Gln Thr
165 170 175

Gly Asp Ala Asp Ser Val Pro Asp Pro Gln Pro Leu Gly Gln Pro Pro
180 185 190

Ala Ala Pro Ser Gly Leu Gly Thr Asn Thr Met Ala Thr Gly Ser Gly
195 200 205

Ala Pro Met Ala Asp Asn Asn Glu Gly Ala Asp Gly Val Gly Asn Ser
210 215 220

Ser Gly Asn Trp His Cys Asp Ser Thr Trp Met Gly Asp Arg Val Ile
225 230 235 240

Thr Thr Ser Thr Arg Thr Trp Ala Leu Pro Thr Tyr Asn Asn His Leu
245 250 255

Tyr Lys Gln Ile Ser Ser Gln Ser Gly Ala Ser Asn Asp Asn His Tyr
260 265 270

Phe Gly Tyr Ser Thr Pro Trp Gly Tyr Phe Asp Phe Asn Arg Phe His
275 280 285

Cys His Phe Ser Pro Arg Asp Trp Gln Arg Leu Ile Asn Asn Asn Trp
290 295 300

Gly Phe Arg Pro Lys Arg Leu Asn Phe Lys Leu Phe Asn Ile Gln Val
305 310 315 320

Lys Glu Val Thr Gln Asn Asp Gly Thr Thr Thr Ile Ala Asn Asn Leu
325 330 335

Thr Ser Thr Val Gln Val Phe Thr Asp Ser Glu Tyr Gln Leu Pro Tyr
340 345 350

Val Leu Gly Ser Ala His Gln Gly Cys Leu Pro Pro Phe Pro Ala Asp
355 360 365

Val Phe Met Val Pro Gln Tyr Gly Tyr Leu Thr Leu Asn Asn Gly Ser
370 375 380

Gln Ala Val Gly Arg Ser Ser Phe Tyr Cys Leu Glu Tyr Phe Pro Ser
385 390 395 400

Gln Met Leu Arg Thr Gly Asn Asn Phe Thr Phe Ser Tyr Thr Phe Glu
405 410 415

Asp Val Pro Phe His Ser Ser Tyr Ala His Ser Gln Ser Leu Asp Arg
420 425 430

Leu Met Asn Pro Leu Ile Asp Gln Tyr Leu Tyr Tyr Leu Ser Arg Thr
435 440 445

Asn Thr Pro Ser Gly Thr Thr Thr Gln Ser Arg Leu Gln Phe Ser Val
450 455 460

Ala Gly Pro Ser Asn Met Ala Val Gln Gly Arg Asn Trp Leu Pro Gly
465 470 475 480

Pro Cys Tyr Arg Gln Gln Arg Val Ser Lys Thr Ser Ala Asp Asn Asn
485 490 495

Asn Ser Glu Phe Ala Trp Thr Gly Ala Thr Lys Tyr His Leu Asn Gly
500 505 510

Arg Asp Ser Leu Val Asn Pro Gly Pro Ala Met Ala Ser His Lys Asp
515 520 525

Asp Glu Glu Lys Phe Phe Pro Gln Ser Gly Val Leu Ile Phe Gly Lys
530 535 540

Gln Gly Ser Glu Lys Thr Asn Val Asp Ile Glu Lys Val Met Ile Thr
545 550 555 560

Asp Glu Glu Glu Ile Arg Thr Thr Asn Pro Val Ala Thr Glu Gln Tyr
565 570 575

Gly Ser Val Ser Thr Asn Leu Gln Gln Gln Asn Thr Ala Pro Ala Thr
580 585 590

Ala Asp Val Asn Thr Gln Gly Val Leu Pro Gly Met Val Trp Gln Asp
595 600 605

Arg Asp Val Tyr Leu Gln Gly Pro Ile Trp Ala Lys Ile Pro His Thr
610 615 620

Asp Gly His Phe His Pro Ser Pro Leu Met Gly Gly Phe Gly Leu Lys
625 630 635 640

His Pro Pro Pro Gln Ile Leu Ile Lys Asn Thr Pro Val Pro Ala Asn
645 650 655

Pro Ser Thr Thr Phe Ser Ala Ala Lys Phe Ala Ser Phe Ile Thr Gln
660 665 670

Tyr Ser Thr Gly Gln Val Ser Val Glu Ile Glu Trp Glu Leu Gln Lys
675 680 685

Glu Asn Ser Lys Arg Trp Asn Pro Glu Ile Gln Tyr Thr Ser Asn Tyr
690 695 700

Asn Lys Ser Val Asn Val Asp Phe Thr Val Asp Thr Asn Gly Val Tyr
705 710 715 720

Ser Glu Pro Arg Pro Ile Gly Thr Arg Tyr Leu Thr Arg Asn Leu
725 730 735

<210> 30

<211> 2208

<212> DNA

<213> Artificial Sequence

<220>

<223> Nucleic acid encoding AAV2-TT capsid (VP1)

<400> 30

atggctgccg atggttatct tccagattgg ctcgaggaca ctctctctga aggaataaga	60
cagtgggtgga agctcaaacc tggcccacca ccaccaaagc ccgcagagcg gcataaggac	120
gacagcaggg gtcttgtgct tcctgggtac aagtacctcg gacccttcaa cggactcgac	180
aagggagagc cgggtcaacga ggacagcgcc gcggccctcg agcacgacaa agcctacgac	240
cggcagctcg acagcggaga caacccttac ctcaagtaca accacgccga cgcggagttt	300
caggagcgcc ttaaagaaga tacgtctttt gggggcaacc tcggacgagc agtcttccag	360
gcgaaaaaga ggattcttga acctctgggc ctggttgagg aacctgttaa gacggctccg	420
ggaaaaaaga ggccggtaga gcactctcct gcggagccag actcctcctc gggaaccgga	480
aagtcgggcc agcagcctgc aagaaaaaga ttgaattttg gtcagactgg agacgcagac	540
tcagtacctg acccccagcc tctcggacag ccaccagcag cccctcttgg tctgggaact	600
aatacgatgg cttcaggcag tggcgcacca atggcagaca ataacgaggg cgccgacgga	660
gtgggtaatt cctcgggaaa ttggcattgc gattccacat ggatgggcga cagagtcac	720
accaccagca cccgaacctg ggccctgccc acctacaaca accacctcta caaacaatt	780
tccagccaat caggagcctc gaacgacaat cactactttg gctacagcac cccttggggg	840
tattttgact tcaacagatt ccactgccac ttttcaccac gtgactggca aagactcatc	900
aacaacaact ggggattccg acccaagaga ctacgcttca agctctttta cattcaagtc	960
aaagaggcca cgagaatga cggtagcagc acgattgcca ataaccttac cagcacgggt	1020
cagggtgttta ctgactcgga gtaccagctc ccgtacgtcc tcggctcggc gcatcaagga	1080
tgctccccgc cgttcccagc agacgtcttc atgggtgccac agtatggata cctcacctg	1140
aacaacggga gtcaggcagt aggacgctct tcatttttact gcctggagta ctttccttct	1200
cagatgctgc gtaccggaac caactttacc ttacagctaca cttttgagga cgttccttct	1260
cacagcagct acgctcacag ccagagtctg gaccgtctca tgaatcctct catcgaccag	1320
tacctgtatt acttgagcag aacaaacact ccaagtggaa ccaccacgat gtcaaggctt	1380
cagttttctc aggccggagc gagtgacatt cgggaccagt ctaggaactg gcttcctgga	1440
ccctgttacc gccagcagcg agtatcaaag acagctgcgg ataacaacaa cagtgattac	1500
tcgtggactg gagctaccaa gtaccacctc aatggcagag actctctggt gaatccgggc	1560

```

ccggccatgg caagccacaa ggacgatgaa gaaaagtatt ttcctcagag cggggttctc      1620
atctttggga agcaagactc aggaaaaaca aatgtggaca ttgaaaaggt catgattaca      1680
gacgaagagg aaatcaggac aaccaatccc gtggctacgg agcagtatgg ttctgtatct      1740
accaacctcc agagcggcaa cacacaagca gctacctcag atgtcaacac acaaggcggt      1800
cttccaggca tgggtctggca ggacagagat gtgtaccttc aggggccccat ctgggcaaag      1860
attccacaca cggacggaca ttttcacccc tctcccctca tgggtggatt cggacttaaa      1920
caccctcttc cacagattct catcaagaac accccggtac ctgcgaatcc ttcgaccacc      1980
ttcagtgcgg caaagtttgc ttccttcatc acacagtact ccacgggaca ggtcagcgtg      2040
gagatcgagt gggagctgca gaaggaaaac agcaaacgct ggaatcccga aattcagtac      2100
acttccaact acaacaagtc tgттаatgtg gactttactg tggacactaa tggcgtgtat      2160
tcagagcctc gccccattgg caccagatac ctgactcgta atctgtaa                    2208

```

```

<210> 31
<211> 735
<212> PRT
<213> Artificial Sequence

```

```

<220>
<223> Amino acid sequence of AAV2-TT capsid (VP1)

```

```

<400> 31

```

```

Met Ala Ala Asp Gly Tyr Leu Pro Asp Trp Leu Glu Asp Thr Leu Ser
1           5           10           15

```

```

Glu Gly Ile Arg Gln Trp Trp Lys Leu Lys Pro Gly Pro Pro Pro Pro
          20           25           30

```

```

Lys Pro Ala Glu Arg His Lys Asp Asp Ser Arg Gly Leu Val Leu Pro
          35           40           45

```

```

Gly Tyr Lys Tyr Leu Gly Pro Phe Asn Gly Leu Asp Lys Gly Glu Pro
          50           55           60

```

```

Val Asn Glu Ala Asp Ala Ala Ala Leu Glu His Asp Lys Ala Tyr Asp
          65           70           75           80

```

Arg Gln Leu Asp Ser Gly Asp Asn Pro Tyr Leu Lys Tyr Asn His Ala
85 90 95

Asp Ala Glu Phe Gln Glu Arg Leu Lys Glu Asp Thr Ser Phe Gly Gly
100 105 110

Asn Leu Gly Arg Ala Val Phe Gln Ala Lys Lys Arg Ile Leu Glu Pro
115 120 125

Leu Gly Leu Val Glu Glu Pro Val Lys Thr Ala Pro Gly Lys Lys Arg
130 135 140

Pro Val Glu His Ser Pro Ala Glu Pro Asp Ser Ser Ser Gly Thr Gly
145 150 155 160

Lys Ser Gly Gln Gln Pro Ala Arg Lys Arg Leu Asn Phe Gly Gln Thr
165 170 175

Gly Asp Ala Asp Ser Val Pro Asp Pro Gln Pro Leu Gly Gln Pro Pro
180 185 190

Ala Ala Pro Ser Gly Leu Gly Thr Asn Thr Met Ala Ser Gly Ser Gly
195 200 205

Ala Pro Met Ala Asp Asn Asn Glu Gly Ala Asp Gly Val Gly Asn Ser
210 215 220

Ser Gly Asn Trp His Cys Asp Ser Thr Trp Met Gly Asp Arg Val Ile
225 230 235 240

Thr Thr Ser Thr Arg Thr Trp Ala Leu Pro Thr Tyr Asn Asn His Leu
245 250 255

Tyr Lys Gln Ile Ser Ser Gln Ser Gly Ala Ser Asn Asp Asn His Tyr
260 265 270

Phe Gly Tyr Ser Thr Pro Trp Gly Tyr Phe Asp Phe Asn Arg Phe His
275 280 285

Cys His Phe Ser Pro Arg Asp Trp Gln Arg Leu Ile Asn Asn Asn Trp
290 295 300

Gly Phe Arg Pro Lys Arg Leu Ser Phe Lys Leu Phe Asn Ile Gln Val
305 310 315 320

Lys Glu Val Thr Gln Asn Asp Gly Thr Thr Thr Ile Ala Asn Asn Leu
325 330 335

Thr Ser Thr Val Gln Val Phe Thr Asp Ser Glu Tyr Gln Leu Pro Tyr
340 345 350

Val Leu Gly Ser Ala His Gln Gly Cys Leu Pro Pro Phe Pro Ala Asp
355 360 365

Val Phe Met Val Pro Gln Tyr Gly Tyr Leu Thr Leu Asn Asn Gly Ser
370 375 380

Gln Ala Val Gly Arg Ser Ser Phe Tyr Cys Leu Glu Tyr Phe Pro Ser
385 390 395 400

Gln Met Leu Arg Thr Gly Asn Asn Phe Thr Phe Ser Tyr Thr Phe Glu
405 410 415

Asp Val Pro Phe His Ser Ser Tyr Ala His Ser Gln Ser Leu Asp Arg
420 425 430

Leu Met Asn Pro Leu Ile Asp Gln Tyr Leu Tyr Tyr Leu Ser Arg Thr
435 440 445

Asn Thr Pro Ser Gly Thr Thr Thr Met Ser Arg Leu Gln Phe Ser Gln
450 455 460

Ala Gly Ala Ser Asp Ile Arg Asp Gln Ser Arg Asn Trp Leu Pro Gly
465 470 475 480

Pro Cys Tyr Arg Gln Gln Arg Val Ser Lys Thr Ala Ala Asp Asn Asn
485 490 495

Asn Ser Asp Tyr Ser Trp Thr Gly Ala Thr Lys Tyr His Leu Asn Gly
500 505 510

Arg Asp Ser Leu Val Asn Pro Gly Pro Ala Met Ala Ser His Lys Asp
515 520 525

Asp Glu Glu Lys Tyr Phe Pro Gln Ser Gly Val Leu Ile Phe Gly Lys
530 535 540

Gln Asp Ser Gly Lys Thr Asn Val Asp Ile Glu Lys Val Met Ile Thr
545 550 555 560

Asp Glu Glu Glu Ile Arg Thr Thr Asn Pro Val Ala Thr Glu Gln Tyr
565 570 575

Gly Ser Val Ser Thr Asn Leu Gln Ser Gly Asn Thr Gln Ala Ala Thr
580 585 590

Ser Asp Val Asn Thr Gln Gly Val Leu Pro Gly Met Val Trp Gln Asp
595 600 605

Arg Asp Val Tyr Leu Gln Gly Pro Ile Trp Ala Lys Ile Pro His Thr
610 615 620

Asp Gly His Phe His Pro Ser Pro Leu Met Gly Gly Phe Gly Leu Lys
625 630 635 640

His Pro Pro Pro Gln Ile Leu Ile Lys Asn Thr Pro Val Pro Ala Asn
645 650 655

Pro Ser Thr Thr Phe Ser Ala Ala Lys Phe Ala Ser Phe Ile Thr Gln
660 665 670

Tyr Ser Thr Gly Gln Val Ser Val Glu Ile Glu Trp Glu Leu Gln Lys
675 680 685

Glu Asn Ser Lys Arg Trp Asn Pro Glu Ile Gln Tyr Thr Ser Asn Tyr
690 695 700

Asn Lys Ser Val Asn Val Asp Phe Thr Val Asp Thr Asn Gly Val Tyr
705 710 715 720

Ser Glu Pro Arg Pro Ile Gly Thr Arg Tyr Leu Thr Arg Asn Leu
725 730 735

<210> 32
<211> 2208
<212> DNA
<213> Artificial Sequence

<220>
<223> Nucleic acid encoding AAV2-TT-S312N capsid (VP1)

<400> 32
atggctgccg atggttatct tccagattgg ctcgaggaca ctctctctga aggaataaga 60
cagtgggtgga agctcaaacc tggcccacca ccaccaaagc ccgcagagcg gcataaggac 120
gacagcaggg gtcttgtgct tcctgggtac aagtacctcg gacccttcaa cggactcgac 180
aagggagagc cgggtcaacga ggcagacgcc gcggccctcg agcacgacaa agcctacgac 240
cggcagctcg acagcggaga caaccgtac ctcaagtaca accacgccga cgcggagttt 300
caggagcgcc ttaaagaaga tacgtctttt gggggcaacc tcggacgagc agtcttccag 360
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ggaaaaaaga ggccggtaga gcactctcct gcggagccag actcctcctc gggaaccgga 480
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Lys	Pro	Ala	Glu	Arg	His	Lys	Asp	Asp	Ser	Arg	Gly	Leu	Val	Leu	Pro
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Gly Tyr Lys Tyr Leu Gly Pro Phe Asn Gly Leu Asp Lys Gly Glu Pro
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Val Asn Glu Ala Asp Ala Ala Ala Leu Glu His Asp Lys Ala Tyr Asp
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Arg Gln Leu Asp Ser Gly Asp Asn Pro Tyr Leu Lys Tyr Asn His Ala
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Asp Ala Glu Phe Gln Glu Arg Leu Lys Glu Asp Thr Ser Phe Gly Gly
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Asn Leu Gly Arg Ala Val Phe Gln Ala Lys Lys Arg Ile Leu Glu Pro
115 120 125

Leu Gly Leu Val Glu Glu Pro Val Lys Thr Ala Pro Gly Lys Lys Arg
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Pro Val Glu His Ser Pro Ala Glu Pro Asp Ser Ser Ser Gly Thr Gly
145 150 155 160

Lys Ser Gly Gln Gln Pro Ala Arg Lys Arg Leu Asn Phe Gly Gln Thr
165 170 175

Gly Asp Ala Asp Ser Val Pro Asp Pro Gln Pro Leu Gly Gln Pro Pro
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Ala Ala Pro Ser Gly Leu Gly Thr Asn Thr Met Ala Ser Gly Ser Gly
195 200 205

Ala Pro Met Ala Asp Asn Asn Glu Gly Ala Asp Gly Val Gly Asn Ser
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Ser Gly Asn Trp His Cys Asp Ser Thr Trp Met Gly Asp Arg Val Ile
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Thr Thr Ser Thr Arg Thr Trp Ala Leu Pro Thr Tyr Asn Asn His Leu
245 250 255

Tyr Lys Gln Ile Ser Ser Gln Ser Gly Ala Ser Asn Asp Asn His Tyr
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Phe Gly Tyr Ser Thr Pro Trp Gly Tyr Phe Asp Phe Asn Arg Phe His
275 280 285

Cys His Phe Ser Pro Arg Asp Trp Gln Arg Leu Ile Asn Asn Asn Trp
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Gly Phe Arg Pro Lys Arg Leu Asn Phe Lys Leu Phe Asn Ile Gln Val
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Lys Glu Val Thr Gln Asn Asp Gly Thr Thr Thr Ile Ala Asn Asn Leu
325 330 335

Thr Ser Thr Val Gln Val Phe Thr Asp Ser Glu Tyr Gln Leu Pro Tyr
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Val Leu Gly Ser Ala His Gln Gly Cys Leu Pro Pro Phe Pro Ala Asp
355 360 365

Val Phe Met Val Pro Gln Tyr Gly Tyr Leu Thr Leu Asn Asn Gly Ser
370 375 380

Gln Ala Val Gly Arg Ser Ser Phe Tyr Cys Leu Glu Tyr Phe Pro Ser
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Gln Met Leu Arg Thr Gly Asn Asn Phe Thr Phe Ser Tyr Thr Phe Glu
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Asp Val Pro Phe His Ser Ser Tyr Ala His Ser Gln Ser Leu Asp Arg
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Leu Met Asn Pro Leu Ile Asp Gln Tyr Leu Tyr Tyr Leu Ser Arg Thr
435 440 445

Asn Thr Pro Ser Gly Thr Thr Thr Met Ser Arg Leu Gln Phe Ser Gln
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Ala Gly Ala Ser Asp Ile Arg Asp Gln Ser Arg Asn Trp Leu Pro Gly
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Pro Cys Tyr Arg Gln Gln Arg Val Ser Lys Thr Ala Ala Asp Asn Asn
485 490 495

Asn Ser Asp Tyr Ser Trp Thr Gly Ala Thr Lys Tyr His Leu Asn Gly
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Arg Asp Ser Leu Val Asn Pro Gly Pro Ala Met Ala Ser His Lys Asp
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Asp Glu Glu Lys Tyr Phe Pro Gln Ser Gly Val Leu Ile Phe Gly Lys
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Gln Asp Ser Gly Lys Thr Asn Val Asp Ile Glu Lys Val Met Ile Thr
545 550 555 560

Asp Glu Glu Glu Ile Arg Thr Thr Asn Pro Val Ala Thr Glu Gln Tyr
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Gly Ser Val Ser Thr Asn Leu Gln Ser Gly Asn Thr Gln Ala Ala Thr
580 585 590

Ser Asp Val Asn Thr Gln Gly Val Leu Pro Gly Met Val Trp Gln Asp
595 600 605

Arg Asp Val Tyr Leu Gln Gly Pro Ile Trp Ala Lys Ile Pro His Thr
610 615 620

Asp Gly His Phe His Pro Ser Pro Leu Met Gly Gly Phe Gly Leu Lys
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His Pro Pro Pro Gln Ile Leu Ile Lys Asn Thr Pro Val Pro Ala Asn
645 650 655

Pro Ser Thr Thr Phe Ser Ala Ala Lys Phe Ala Ser Phe Ile Thr Gln
660 665 670

Tyr Ser Thr Gly Gln Val Ser Val Glu Ile Glu Trp Glu Leu Gln Lys
675 680 685

Glu Asn Ser Lys Arg Trp Asn Pro Glu Ile Gln Tyr Thr Ser Asn Tyr
690 695 700

Asn Lys Ser Val Asn Val Asp Phe Thr Val Asp Thr Asn Gly Val Tyr
705 710 715 720

Ser Glu Pro Arg Pro Ile Gly Thr Arg Tyr Leu Thr Arg Asn Leu
725 730 735