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Supplementary Figures

Supplementary Figure 1. The sequence alignment of natural-type (Query) and modified (codon optimized) DNA for nucleocapsid (NP) gene of Ebola virus for accession number MG572235.1.

*The specific-coloured symbols stand for (*): Transversion change, (#): Transition change and (|): Unchanged nucleotide.

ALIGNMENT

```
           M   D   S   R   P   Q   K   V   W   M   T   P   S   L   T   E   S   D   M   D
Query      ATG GAT TCT CGT CCT CAG AAA GTC TGG ATG ACG CCG AGT CTC ACT GAA TCT GAC ATG GAT
           ||| ||# ||| ||| ||* ||| ||| ||# ||| ||| ||* ||| **| ||* ||# ||| ||| ||| ||| ||#
Optimized  ATG GAC TCT CGT CCG CAG AAA GTT TGG ATG ACC CCG TCT CTG ACC GAA TCT GAC ATG GAC

           Y   H   K   I   L   T   A   G   L   S   V   Q   Q   G   I   V   R   Q   R   V
Query      TAC CAC AAG ATC TTG ACA GCA GGT CTG TCC GTT CAA CAG GGG ATT GTT CGG CAA AGA GTC
           ||| ||| ||# ||| #|| ||* ||# ||| ||| ||# ||| ||# ||| ||* ||# ||| ||* ||# *|* ||#
Optimized  TAC CAC AAA ATC CTG ACC GCG GGT CTG TCT GTT CAG CAG GGT ATC GTT CGT CAG CGT GTT

           I   P   V   Y   Q   V   N   N   L   E   E   I   C   Q   L   I   I   Q   A   F
Query      ATC CCA GTG TAT CAA GTA AAC AAT CTT GAG GAG ATT TGC CAA CTT ATC ATA CAG GCC TTT
           ||| ||# ||* ||# ||# ||* ||| ||# ||* ||# ||# ||# ||| ||# ||* ||| ||* ||| ||* ||#
Optimized  ATC CCG GTT TAC CAG GTT AAC AAC CTG GAA GAA ATC TGC CAG CTG ATC ATC CAG GCG TTC

           E   A   G   V   D   F   Q   E   S   A   D   S   F   L   L   M   L   C   L   H
Query      GAA GCA GGT GTT GAT TTT CAA GAG AGT GCG GAC AGT TTC CTT CTC ATG CTT TGT CTT CAT
           ||| ||# ||| ||| ||# ||# ||# ||# **| ||| ||| **| ||| ||* ||* ||| ||* ||# ||* ||#
Optimized  GAA GCG GGT GTT GAC TTC CAG GAA TCT GCG GAC TCT TTC CTG CTG ATG CTG TGC CTG CAC

           H   A   Y   Q   G   D   Y   K   L   F   L   E   S   G   A   V   K   Y   L   E
Query      CAT GCG TAC CAG GGA GAT TAC AAA CTT TTC TTG GAA AGT GGC GCA GTC AAG TAT TTG GAA
           ||# ||| ||| ||| ||* ||# ||| ||| ||* ||| #|| ||| **| ||# ||# ||# ||# ||# #|| |||
Optimized  CAC GCG TAC CAG GGT GAC TAC AAA CTG TTC CTG GAA TCT GGT GCG GTT AAA TAC CTG GAA

           G   H   G   F   R   F   E   V   K   K   R   D   G   V   K   R   L   E   E   L
Query      GGG CAC GGG TTC CGT TTT GAA GTC AAG AAG CGT GAT GGA GTG AAG CGC CTT GAG GAA TTG
           ||* ||| ||* ||| ||| ||# ||| ||# ||# ||# ||| ||# ||* ||* ||# ||# ||* ||# ||| #||
Optimized  GGT CAC GGT TTC CGT TTC GAA GTT AAA AAA CGT GAC GGT GTT AAA CGT CTG GAA GAA CTG

           L   P   A   V   S   S   G   K   N   I   K   R   T   L   A   A   M   P   E   E
Query      CTG CCA GCA GTA TCT AGT GGA AAA AAC ATT AAG AGA ACA CTT GCT GCC ATG CCG GAA GAG
           ||| ||# ||# ||* ||| **| ||* ||| ||| ||# ||# *|* ||* ||* ||* ||* ||| ||| ||| ||#
Optimized  CTG CCG GCG GTT TCT TCT GGT AAA AAC ATC AAA CGT ACC CTG GCG GCG ATG CCG GAA GAA

           E   T   T   E   A   N   A   G   Q   F   L   S   F   A   S   L   F   L   P   K
Query      GAG ACA ACT GAA GCT AAT GCC GGT CAG TTT CTC TCC TTT GCA AGT CTA TTC CTT CCG AAA
           ||# ||* ||# ||| ||* ||# ||* ||| ||| ||# ||* ||# ||# ||# **| ||# ||| ||* ||| |||
Optimized  GAA ACC ACC GAA GCG AAC GCG GGT CAG TTC CTG TCT TTC GCG TCT CTG TTC CTG CCG AAA
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          L   V   V   G   E   K   A   C   L   E   K   V   Q   R   Q   I   Q   V   H   A
Query     TTG GTA GTA GGA GAA AAG GCT TGT CTT GAG AAG GTT CAA AGG CAA ATT CAA GTA CAT GCA
          #|| ||* ||* ||* ||| ||# ||* ||# ||* ||# ||# ||| ||# *|* ||# ||# ||# ||* ||# ||#
Optimized CTG GTT GTT GGT GAA AAA GCG TGC CTG GAA AAA GTT CAG CGT CAG ATC CAG GTT CAC GCG

          E   Q   G   L   I   Q   Y   P   T   A   W   Q   S   V   G   H   M   M   V   I
Query     GAG CAA GGA CTG ATA CAA TAT CCA ACA GCT TGG CAA TCA GTA GGA CAC ATG ATG GTG ATT
          ||# ||# ||* ||| ||* ||# ||# ||# ||* ||* ||| ||# ||* ||* ||* ||| ||| ||| ||* ||#
Optimized GAA CAG GGT CTG ATC CAG TAC CCG ACC GCG TGG CAG TCT GTT GGT CAC ATG ATG GTT ATC

          F   R   L   M   R   T   N   F   L   I   K   F   L   L   I   H   Q   G   M   H
Query     TTC CGT TTG ATG CGA ACA AAT TTT TTG ATC AAA TTT CTC CTA ATA CAC CAA GGG ATG CAC
          ||| ||| #|| ||| ||* ||* ||# ||# #|| ||| ||| ||# ||* ||# ||* ||| ||# ||* ||| |||
Optimized TTC CGT CTG ATG CGT ACC AAC TTC CTG ATC AAA TTC CTG CTG ATC CAC CAG GGT ATG CAC

          M   V   A   G   H   D   A   N   D   A   V   I   S   N   S   V   A   Q   A   R
Query     ATG GTT GCC GGG CAT GAT GCC AAC GAC GCT GTG ATT TCA AAT TCA GTG GCT CAA GCT CGT
          ||| ||| ||* ||* ||# ||# ||* ||| ||| ||* ||* ||# ||* ||# ||* ||* ||* ||# ||* |||
Optimized ATG GTT GCG GGT CAC GAC GCG AAC GAC GCG GTT ATC TCT AAC TCT GTT GCG CAG GCG CGT

          F   S   G   L   L   I   V   K   T   V   L   D   H   I   L   Q   K   T   E   R
Query     TTT TCA GGT TTA TTG ATT GTC AAA ACA GTA CTT GAT CAT ATC CTA CAA AAG ACA GAA CGC
          ||# ||* ||| #|# #|| ||# ||# ||| ||* ||* ||* ||# ||# ||| ||# ||# ||# ||* ||| ||#
Optimized TTC TCT GGT CTG CTG ATC GTT AAA ACC GTT CTG GAC CAC ATC CTG CAG AAA ACC GAA CGT

          G   V   R   L   H   P   L   A   R   T   A   K   V   K   N   E   V   N   S   F
Query     GGA GTT CGT CTC CAT CCT CTT GCA AGG ACC GCC AAG GTA AAA AAT GAG GTG AAC TCC TTT
          ||* ||| ||| ||* ||# ||* ||* ||# *|* ||| ||* ||# ||* ||| ||# ||# ||* ||| ||# ||#
Optimized GGT GTT CGT CTG CAC CCG CTG GCG CGT ACC GCG AAA GTT AAA AAC GAA GTT AAC TCT TTC

          K   A   A   L   S   S   L   A   K   H   G   E   Y   A   P   F   A   R   L   L
Query     AAG GCT GCA CTC AGC TCC CTG GCC AAG CAT GGA GAG TAT GCT CCT TTC GCC CGA CTT TTG
          ||# ||* ||# ||* **# ||# ||| ||* ||# ||# ||* ||# ||# ||* ||* ||| ||* ||* ||* #||
Optimized AAA GCG GCG CTG TCT TCT CTG GCG AAA CAC GGT GAA TAC GCG CCG TTC GCG CGT CTG CTG

          N   L   S   G   V   N   N   L   E   H   G   L   F   P   Q   L   S   A   I   A
Query     AAC CTT TCT GGA GTA AAT AAT CTT GAG CAT GGT CTT TTC CCT CAA CTA TCA GCA ATT GCA
          ||| ||* ||| ||* ||* ||# ||# ||* ||# ||# ||| ||* ||| ||* ||# ||# ||* ||# ||# ||#
Optimized AAC CTG TCT GGT GTT AAC AAC CTG GAA CAC GGT CTG TTC CCG CAG CTG TCT GCG ATC GCG
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          L   G   V   A   T   A   H   G   S   T   L   A   G   V   N   V   G   E   Q   Y
Query     CTC GGA GTC GCC ACA GCA CAC GGG AGT ACC CTC GCA GGA GTA AAT GTT GGA GAA CAG TAT
          ||* ||* ||# ||* ||* ||# ||| ||* **| ||| ||* ||# ||* ||* ||# ||| ||* ||| ||| ||#
Optimized CTG GGT GTT GCG ACC GCG CAC GGT TCT ACC CTG GCG GGT GTT AAC GTT GGT GAA CAG TAC

          Q   Q   L   R   E   A   A   T   E   A   E   K   Q   L   Q   Q   Y   A   E   S
Query     CAA CAA CTC AGA GAG GCT GCC ACT GAG GCT GAG AAG CAA CTC CAA CAA TAC GCA GAG TCT
          ||# ||# ||* *|* ||# ||* ||* ||# ||# ||* ||# ||# ||# ||* ||# ||# ||| ||# ||# |||
Optimized CAG CAG CTG CGT GAA GCG GCG ACC GAA GCG GAA AAA CAG CTG CAG CAG TAC GCG GAA TCT

          R   E   L   D   H   L   G   L   D   D   Q   E   K   K   I   L   M   N   F   H
Query     CGC GAA CTT GAC CAT CTT GGA CTT GAT GAT CAG GAA AAG AAA ATT CTT ATG AAC TTC CAT
          ||# ||| ||* ||| ||# ||* ||* ||* ||# ||# ||| ||| ||# ||| ||# ||* ||| ||| ||| ||#
Optimized CGT GAA CTG GAC CAC CTG GGT CTG GAC GAC CAG GAA AAA AAA ATC CTG ATG AAC TTC CAC

          Q   K   K   N   E   I   S   F   Q   Q   T   N   A   M   V   T   L   R   K   E
Query     CAG AAA AAG AAC GAA ATC AGC TTC CAG CAA ACA AAC GCT ATG GTA ACT CTA AGA AAA GAG
          ||| ||| ||# ||| ||| ||| **# ||| ||| ||# ||* ||| ||* ||| ||* ||# ||# *|* ||| ||#
Optimized CAG AAA AAA AAC GAA ATC TCT TTC CAG CAG ACC AAC GCG ATG GTT ACC CTG CGT AAA GAA

          R   L   A   K   L   T   E   A   I   T   A   A   S   L   P   K   T   S   G   H
Query     CGC CTG GCC AAG CTG ACG GAA GCT ATC ACT GCT GCG TCA CTG CCC AAA ACA AGT GGA CAT
          ||# ||| ||* ||# ||| ||* ||| ||* ||| ||# ||* ||| ||* ||| ||* ||| ||* **| ||* ||#
Optimized CGT CTG GCG AAA CTG ACC GAA GCG ATC ACC GCG GCG TCT CTG CCG AAA ACC TCT GGT CAC

          Y   D   D   D   D   D   I   P   F   P   G   P   I   N   D   D   D   N   P   G
Query     TAC GAT GAT GAT GAC GAC ATT CCC TTT CCA GGA CCC ATC AAT GAT GAC GAC AAT CCT GGC
          ||| ||# ||# ||# ||| ||| ||# ||* ||# ||# ||* ||* ||| ||# ||# ||| ||| ||# ||* ||#
Optimized TAC GAC GAC GAC GAC GAC ATC CCG TTC CCG GGT CCG ATC AAC GAC GAC GAC AAC CCG GGT

          H   Q   D   D   D   P   T   D   S   Q   D   T   T   I   P   D   V   V   V   D
Query     CAT CAA GAT GAT GAT CCA ACT GAC TCA CAA GAT ACG ACC ATT CCT GAT GTG GTG GTT GAT
          ||# ||# ||# ||# ||# ||# ||# ||| ||* ||# ||# ||* ||| ||# ||* ||# ||* ||* ||| ||#
Optimized CAC CAG GAC GAC GAC CCG ACC GAC TCT CAG GAC ACC ACC ATC CCG GAC GTT GTT GTT GAC

          P   D   D   G   S   Y   G   E   Y   Q   S   Y   S   E   N   G   M   N   A   P
Query     CCC GAT GAT GGA AGC TAC GGC GAA TAC CAG AGT TAC TCG GAA AAC GGC ATG AAT GCA CCA
          ||* ||# ||# ||* **# ||| ||# ||| ||| ||| **| ||| ||* ||| ||| ||# ||| ||# ||# ||#
Optimized CCG GAC GAC GGT TCT TAC GGT GAA TAC CAG TCT TAC TCT GAA AAC GGT ATG AAC GCG CCG
```

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          D   D   L   V   L   F   D   L   D   E   D   D   E   D   T   K   P   V   P   N
Query     GAT GAC TTG GTC CTA TTC GAT CTA GAC GAG GAC GAT GAG GAC ACT AAG CCA GTG CCT AAT
          ||# ||| #|| ||# ||# ||| ||# ||# ||| ||# ||| ||# ||# ||| ||# ||# ||# ||* ||* ||#
Optimized GAC GAC CTG GTT CTG TTC GAC CTG GAC GAA GAC GAC GAA GAC ACC AAA CCG GTT CCG AAC

          R   S   T   K   G   G   Q   Q   K   N   S   Q   K   G   Q   H   T   E   G   R
Query     AGA TCA ACC AAG GGT GGA CAA CAG AAA AAC AGT CAA AAG GGC CAG CAT ACA GAG GGC AGA
          *|* ||* ||| ||# ||| ||* ||# ||| ||| ||| **| ||# ||# ||# ||| ||# ||* ||# ||# *|*
Optimized CGT TCT ACC AAA GGT GGT CAG CAG AAA AAC TCT CAG AAA GGT CAG CAC ACC GAA GGT CGT

          Q   T   Q   S   R   P   T   Q   N   V   P   G   P   H   R   T   I   H   H   A
Query     CAG ACA CAA TCC AGG CCA ACT CAA AAT GTC CCA GGC CCT CAC AGA ACA ATC CAC CAC GCC
          ||| ||* ||# ||# *|* ||# ||# ||# ||# ||# ||# ||# ||* ||| *|* ||* ||| ||| ||| ||*
Optimized CAG ACC CAG TCT CGT CCG ACC CAG AAC GTT CCG GGT CCG CAC CGT ACC ATC CAC CAC GCG

          S   A   P   L   T   D   N   D   R   R   N   E   P   S   G   S   T   S   P   R
Query     AGT GCT CCA CTC ACG GAT AAT GAC AGA AGA AAT GAA CCC TCC GGC TCA ACC AGC CCT CGC
          **| ||* ||# ||* ||* ||# ||# ||| *|* *|* ||# ||| ||* ||# ||# ||* ||| **# ||* ||#
Optimized TCT GCG CCG CTG ACC GAC AAC GAC CGT CGT AAC GAA CCG TCT GGT TCT ACC TCT CCG CGT

          M   L   T   P   I   N   E   E   A   D   P   L   D   D   A   D   D   E   T   S
Query     ATG CTG ACA CCA ATC AAC GAA GAG GCA GAC CCA CTG GAC GAT GCC GAC GAC GAG ACG TCT
          ||| ||| ||* ||# ||| ||| ||| ||# ||# ||| ||# ||| ||| ||# ||* ||| ||| ||# ||* |||
Optimized ATG CTG ACC CCG ATC AAC GAA GAA GCG GAC CCG CTG GAC GAC GCG GAC GAC GAA ACC TCT

          S   L   P   P   L   E   S   D   D   E   E   Q   D   R   D   G   T   S   N   R
Query     AGC CTT CCG CCC CTG GAG TCA GAC GAT GAA GAA CAG GAC AGG GAC GGA ACT TCC AAC CGC
          **# ||* ||| ||* ||| ||# ||* ||| ||# ||| ||| ||| ||| *|* ||| ||* ||# ||# ||| ||#
Optimized TCT CTG CCG CCG CTG GAA TCT GAC GAC GAA GAA CAG GAC CGT GAC GGT ACC TCT AAC CGT

          T   P   T   V   A   P   P   A   P   V   Y   R   D   H   S   E   K   R   E   L
Query     ACA CCC ACT GTC GCC CCA CCG GCT CCC GTA TAC AGA GAT CAC TCT GAA AAG AGA GAA CTC
          ||* ||* ||# ||# ||* ||# ||| ||* ||* ||* ||| *|* ||# ||| ||| ||| ||# *|* ||| ||*
Optimized ACC CCG ACC GTT GCG CCG CCG GCG CCG GTT TAC CGT GAC CAC TCT GAA AAA CGT GAA CTG

          P   Q   D   E   Q   Q   D   Q   D   H   T   Q   E   A   R   N   Q   D   S   D
Query     CCG CAA GAT GAG CAA CAA GAT CAG GAC CAC ACT CAA GAG GCC AGG AAC CAG GAC AGT GAC
          ||| ||# ||# ||# ||# ||# ||# ||| ||| ||| ||# ||# ||# ||* *|* ||| ||| ||| **| |||
Optimized CCG CAG GAC GAA CAG CAG GAC CAG GAC CAC ACC CAG GAA GCG CGT AAC CAG GAC TCT GAC
```

```
          N   T   Q   P   E   H   S   F   E   E   M   Y   R   H   I   L   R   S   Q   G
Query     AAC ACC CAG CCA GAA CAC TCT TTT GAG GAG ATG TAT CGC CAC ATT CTA AGA TCA CAG GGG
          ||| ||| ||| ||# ||| ||| ||| ||# ||# ||# ||| ||# ||# ||| ||# ||# *|* ||* ||| ||*
Optimized AAC ACC CAG CCG GAA CAC TCT TTC GAA GAA ATG TAC CGT CAC ATC CTG CGT TCT CAG GGT

          P   F   D   A   V   L   Y   Y   H   M   M   K   D   E   P   V   V   F   S   T
Query     CCA TTT GAT GCT GTT TTG TAT TAT CAT ATG ATG AAG GAT GAG CCT GTA GTT TTC AGT ACC
          ||# ||# ||# ||* ||| #|| ||# ||# ||# ||| ||| ||# ||# ||# ||* ||* ||| ||| **| |||
Optimized CCG TTC GAC GCG GTT CTG TAC TAC CAC ATG ATG AAA GAC GAA CCG GTT GTT TTC TCT ACC

          S   D   G   K   E   Y   T   Y   P   D   S   L   E   E   E   Y   P   P   W   L
Query     AGT GAT GGC AAA GAG TAC ACG TAT CCA GAC TCC CTT GAA GAG GAA TAT CCA CCA TGG CTC
          **| ||# ||# ||| ||# ||| ||* ||# ||# ||| ||# ||* ||| ||# ||| ||# ||# ||# ||| ||*
Optimized TCT GAC GGT AAA GAA TAC ACC TAC CCG GAC TCT CTG GAA GAA GAA TAC CCG CCG TGG CTG

          T   E   K   E   A   M   N   E   E   N   R   F   V   T   L   D   G   Q   Q   F
Query     ACT GAA AAA GAG GCT ATG AAT GAA GAG AAT AGA TTT GTT ACA TTG GAT GGT CAA CAA TTT
          ||# ||| ||| ||# ||* ||| ||# ||| ||# ||# *|* ||# ||| ||* #|| ||# ||| ||# ||# ||#
Optimized ACC GAA AAA GAA GCG ATG AAC GAA GAA AAC CGT TTC GTT ACC CTG GAC GGT CAG CAG TTC

          Y   W   P   V   M   N   H   K   N   K   F   M   A   I   L   Q   H   H   Q   .
Query     TAT TGG CCG GTA ATG AAT CAC AAG AAT AAA TTC ATG GCA ATC CTG CAA CAT CAT CAG TGA
          ||# ||| ||| ||* ||| ||# ||| ||# ||# ||| ||| ||| ||# ||| ||| ||# ||# ||# ||| |||
Optimized TAC TGG CCG GTT ATG AAC CAC AAA AAC AAA TTC ATG GCG ATC CTG CAG CAC CAC CAG TGA
```

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Supplementary Figure 2. The sequence alignment of natural-type (Query) and modified (codon optimized) DNA for VP35 gene of Ebola virus for accession number MG572235.1.

*The specific-coloured symbols stand for (*): Transversion change, (#): Transition change and (|): Unchanged nucleotide.

ALIGNMENT

```
            M   T   T   R   T   K   G   R   G   H   T   A   A   T   T   Q   N   D   R   M
Query       ATG ACA ACC AGA ACA AAG GGC AGG GGC CAC ACT GCG GCC ACG ACT CAA AAC GAC AGA ATG
            ||| ||* ||| *|* ||* ||# ||# *|* ||# ||| ||# ||| ||* ||* ||# ||# ||| ||| *|* |||
Optimized   ATG ACC ACC CGT ACC AAA GGT CGT GGT CAC ACC GCG GCG ACC ACC CAG AAC GAC CGT ATG

            P   G   P   E   L   S   G   W   I   S   E   Q   L   M   T   G   R   I   P   V
Query       CCA GGC CCT GAG CTT TCG GGC TGG ATC TCT GAG CAG CTA ATG ACC GGA AGA ATT CCT GTA
            ||# ||# ||* ||# ||* ||* ||# ||| ||| ||| ||# ||| ||# ||| ||| ||* *|* ||# ||* ||*
Optimized   CCG GGT CCG GAA CTG TCT GGT TGG ATC TCT GAA CAG CTG ATG ACC GGT CGT ATC CCG GTT

            S   D   I   F   C   D   I   E   N   N   P   G   L   C   Y   A   S   Q   M   Q
Query       AGC GAC ATC TTC TGT GAT ATT GAG AAC AAT CCA GGA TTA TGC TAC GCA TCC CAA ATG CAA
            **# ||| ||| ||| ||# ||# ||# ||# ||| ||# ||# ||* #|# ||| ||| ||# ||# ||# ||| ||#
Optimized   TCT GAC ATC TTC TGC GAC ATC GAA AAC AAC CCG GGT CTG TGC TAC GCG TCT CAG ATG CAG

            Q   T   K   P   N   P   K   T   R   N   S   Q   T   Q   T   D   P   I   C   N
Query       CAA ACC AAG CCA AAC CCG AAG ACG CGC AAC AGT CAA ACC CAA ACG GAC CCA ATT TGC AAT
            ||# ||| ||# ||# ||| ||| ||# ||* ||# ||| **| ||# ||| ||# ||* ||| ||# ||# ||| ||#
Optimized   CAG ACC AAA CCG AAC CCG AAA ACC CGT AAC TCT CAG ACC CAG ACC GAC CCG ATC TGC AAC

            H   S   F   E   E   V   V   Q   T   L   A   S   L   A   T   V   V   Q   Q   Q
Query       CAT AGT TTT GAG GAG GTA GTA CAA ACA TTA GCT TCA TTG GCT ACT GTT GTG CAA CAA CAA
            ||# **| ||# ||# ||# ||* ||* ||# ||* #|# ||* ||* #|| ||* ||# ||| ||* ||# ||# ||#
Optimized   CAC TCT TTC GAA GAA GTT GTT CAG ACC CTG GCG TCT CTG GCG ACC GTT GTT CAG CAG CAG

            T   I   A   S   E   S   L   E   Q   R   I   T   S   L   E   N   G   L   K   P
Query       ACC ATT GCA TCA GAA TCA TTA GAA CAA CGC ATT ACG AGT CTT GAG AAT GGT CTA AAG CCA
            ||| ||# ||# ||* ||| ||* #|# ||| ||# ||# ||# ||* **| ||* ||# ||# ||| ||# ||# ||#
Optimized   ACC ATC GCG TCT GAA TCT CTG GAA CAG CGT ATC ACC TCT CTG GAA AAC GGT CTG AAA CCG

            V   Y   D   M   A   K   T   I   S   S   L   N   R   V   C   A   E   M   V   A
Query       GTT TAT GAT ATG GCT AAA ACA ATC TCC TCA TTG AAC AGG GTT TGT GCT GAG ATG GTT GCA
            ||| ||# ||# ||| ||* ||| ||* ||| ||# ||* #|| ||| *|* ||| ||# ||* ||# ||| ||| ||#
Optimized   GTT TAC GAC ATG GCG AAA ACC ATC TCT TCT CTG AAC CGT GTT TGC GCG GAA ATG GTT GCG

            K   Y   D   L   L   V   M   T   T   G   R   A   T   A   T   A   A   A   T   E
Query       AAA TAT GAT CTT CTG GTG ATG ACA ACC GGT CGG GCA ACA GCA ACC GCT GCG GCA ACT GAG
            ||| ||# ||# ||* ||| ||* ||| ||* ||| ||| ||* ||# ||* ||# ||| ||* ||| ||# ||# ||#
Optimized   AAA TAC GAC CTG CTG GTT ATG ACC ACC GGT CGT GCG ACC GCG ACC GCG GCG GCG ACC GAA
```

```
          A   Y   W   A   E   H   G   Q   P   P   P   G   P   S   L   Y   E   E   S   A
Query     GCT TAT TGG GCC GAA CAT GGT CAA CCA CCA CCT GGA CCA TCA CTT TAT GAA GAA AGT GCA
          ||* ||# ||| ||* ||| ||# ||| ||# ||# ||# ||* ||* ||# ||* ||* ||# ||| ||| **| ||#
Optimized GCG TAC TGG GCG GAA CAC GGT CAG CCG CCG CCG GGT CCG TCT CTG TAC GAA GAA TCT GCG

          I   R   G   K   I   E   S   R   D   E   T   V   P   Q   S   V   R   E   A   F
Query     ATT CGG GGT AAG ATT GAA TCT AGA GAT GAG ACC GTC CCT CAA AGT GTT AGG GAG GCA TTC
          ||# ||* ||| ||# ||# ||| ||| *|* ||# ||# ||| ||# ||* ||# **| ||| *|* ||# ||# |||
Optimized ATC CGT GGT AAA ATC GAA TCT CGT GAC GAA ACC GTT CCG CAG TCT GTT CGT GAA GCG TTC

          N   N   L   D   S   T   T   S   L   T   E   E   N   F   G   K   P   D   I   S
Query     AAC AAT CTA GAC AGT ACC ACT TCA CTA ACT GAG GAA AAT TTT GGG AAA CCT GAC ATT TCG
          ||| ||# ||# ||| **| ||| ||# ||* ||# ||# ||# ||| ||# ||# ||* ||| ||* ||| ||# ||*
Optimized AAC AAC CTG GAC TCT ACC ACC TCT CTG ACC GAA GAA AAC TTC GGT AAA CCG GAC ATC TCT

          A   K   D   L   R   N   I   M   Y   D   H   L   P   G   F   G   T   A   F   H
Query     GCA AAG GAT TTG AGA AAC ATT ATG TAT GAT CAC TTG CCT GGT TTT GGA ACT GCT TTC CAC
          ||# ||# ||# #|| *|* ||| ||# ||| ||# ||# ||| #|| ||* ||| ||# ||* ||# ||* ||| |||
Optimized GCG AAA GAC CTG CGT AAC ATC ATG TAC GAC CAC CTG CCG GGT TTC GGT ACC GCG TTC CAC

          Q   L   V   Q   V   I   C   K   L   G   K   D   S   N   S   L   D   I   I   H
Query     CAA TTA GTA CAA GTG ATT TGT AAA TTG GGA AAA GAT AGC AAC TCA TTG GAC ATC ATT CAT
          ||# #|# ||* ||# ||* ||# ||# ||| #|| ||* ||| ||# **# ||| ||* #|| ||| ||| ||# ||#
Optimized CAG CTG GTT CAG GTT ATC TGC AAA CTG GGT AAA GAC TCT AAC TCT CTG GAC ATC ATC CAC

          A   E   F   Q   A   S   L   A   E   G   D   S   P   Q   C   A   L   I   Q   I
Query     GCT GAG TTC CAG GCC AGC CTG GCT GAA GGA GAC TCT CCT CAA TGT GCC CTA ATT CAA ATT
          ||* ||# ||| ||| ||* **# ||| ||* ||| ||* ||| ||| ||* ||# ||# ||* ||# ||# ||# ||#
Optimized GCG GAA TTC CAG GCG TCT CTG GCG GAA GGT GAC TCT CCG CAG TGC GCG CTG ATC CAG ATC

          T   K   R   V   P   I   F   Q   D   A   A   P   P   V   I   H   I   R   S   R
Query     ACA AAA AGA GTT CCA ATC TTC CAA GAT GCT GCT CCA CCT GTC ATC CAC ATC CGC TCT CGA
          ||* ||| *|* ||| ||# ||| ||| ||# ||# ||* ||* ||# ||* ||# ||| ||| ||| ||# ||| ||*
Optimized ACC AAA CGT GTT CCG ATC TTC CAG GAC GCG GCG CCG CCG GTT ATC CAC ATC CGT TCT CGT

          G   D   I   P   R   A   C   Q   K   S   L   R   P   V   P   P   S   P   K   I
Query     GGT GAC ATT CCC CGA GCT TGC CAG AAA AGC TTG CGT CCA GTC CCA CCA TCG CCC AAG ATT
          ||| ||| ||# ||* ||* ||* ||| ||| ||| **# #|| ||| ||# ||# ||# ||# ||* ||* ||# ||#
Optimized GGT GAC ATC CCG CGT GCG TGC CAG AAA TCT CTG CGT CCG GTT CCG CCG TCT CCG AAA ATC
```

```
          D   R   G   W   V   C   V   F   Q   L   Q   D   G   K   T   L   G   L   K   I
Query     GAT CGA GGT TGG GTA TGT GTT TTT CAG CTT CAA GAT GGT AAA ACA CTT GGA CTC AAA ATT
          ||# ||* ||| ||| ||* ||# ||| ||# ||| ||* ||# ||# ||| ||| ||* ||* ||* ||* ||| ||#
Optimized GAC CGT GGT TGG GTT TGC GTT TTC CAG CTG CAG GAC GGT AAA ACC CTG GGT CTG AAA ATC

          .
Query     TGA
          |||
Optimized TGA
```

Supplementary Figure 3. The sequence alignment of natural-type (Query) and modified (codon optimized) DNA for VP40 gene of Ebola virus for accession number MG572235.1.

*The specific-coloured symbols stand for (*): Transversion change, (#): Transition change and (|): Unchanged nucleotide.

ALIGNMENT

```
           M   R   R   V   I   L   P   T   A   P   P   E   Y   M   E   A   I   Y   P   V
Query      ATG AGG CGG GTT ATA TTA CCT ACT GCT CCT CCT GAA TAT ATG GAG GCC ATA TAC CCT GTC
           ||| *|* ||* ||| ||* #|# ||* ||# ||* ||* ||* ||| ||# ||| ||# ||* ||* ||| ||* ||#
Optimized  ATG CGT CGT GTT ATC CTG CCG ACC GCG CCG CCG GAA TAC ATG GAA GCG ATC TAC CCG GTT

           R   S   N   S   T   I   A   R   G   G   N   S   N   T   G   F   L   T   P   E
Query      AGG TCA AAT TCA ACA ATT GCT AGA GGT GGC AAC AGC AAT ACA GGC TTC CTG ACA CCG GAG
           *|* ||* ||# ||* ||* ||# ||* *|* ||| ||# ||| **# ||# ||* ||# ||| ||| ||* ||| ||#
Optimized  CGT TCT AAC TCT ACC ATC GCG CGT GGT GGT AAC TCT AAC ACC GGT TTC CTG ACC CCG GAA

           S   V   N   G   D   T   P   S   N   P   L   R   P   I   A   D   D   T   I   D
Query      TCA GTC AAT GGG GAC ACT CCA TCG AAT CCA CTC AGG CCA ATT GCC GAT GAC ACC ATC GAC
           ||* ||# ||# ||* ||| ||# ||# ||* ||# ||# ||* *|* ||# ||# ||* ||# ||| ||| ||| |||
Optimized  TCT GTT AAC GGT GAC ACC CCG TCT AAC CCG CTG CGT CCG ATC GCG GAC GAC ACC ATC GAC

           H   A   S   H   T   P   G   S   V   S   S   A   F   I   L   E   A   M   V   N
Query      CAT GCC AGC CAC ACA CCA GGC AGT GTG TCA TCA GCA TTC ATC CTT GAA GCT ATG GTG AAT
           ||# ||* **# ||| ||* ||# ||# **| ||* ||* ||* ||# ||| ||| ||* ||| ||* ||| ||* ||#
Optimized  CAC GCG TCT CAC ACC CCG GGT TCT GTT TCT TCT GCG TTC ATC CTG GAA GCG ATG GTT AAC

           V   I   S   G   P   K   V   L   M   K   Q   I   P   I   W   L   P   L   G   V
Query      GTC ATA TCG GGC CCC AAA GTG CTA ATG AAG CAA ATT CCA ATT TGG CTT CCT CTA GGT GTC
           ||# ||* ||* ||# ||* ||| ||* ||# ||| ||# ||# ||# ||# ||# ||| ||* ||* ||# ||| ||#
Optimized  GTT ATC TCT GGT CCG AAA GTT CTG ATG AAA CAG ATC CCG ATC TGG CTG CCG CTG GGT GTT

           A   D   Q   K   T   Y   S   F   D   S   T   T   A   A   I   M   L   A   S   Y
Query      GCT GAT CAA AAG ACC TAC AGC TTT GAC TCA ACA ACG GCC GCC ATC ATG CTT GCT TCA TAT
           ||* ||# ||# ||# ||| ||| **# ||# ||| ||* ||* ||* ||* ||* ||| ||| ||* ||* ||* ||#
Optimized  GCG GAC CAG AAA ACC TAC TCT TTC GAC TCT ACC ACC GCG GCG ATC ATG CTG GCG TCT TAC

           T   I   T   H   F   G   K   A   T   N   P   L   V   R   V   N   R   L   G   P
Query      ACT ATC ACC CAT TTC GGC AAG GCA ACC AAT CCA CTT GTC AGA GTC AAT CGG CTG GGT CCT
           ||# ||| ||| ||# ||| ||# ||# ||# ||| ||# ||# ||* ||# *|* ||# ||# ||* ||| ||| ||*
Optimized  ACC ATC ACC CAC TTC GGT AAA GCG ACC AAC CCG CTG GTT CGT GTT AAC CGT CTG GGT CCG

           G   I   P   D   H   P   L   R   L   L   R   I   G   N   Q   A   F   L   Q   E
Query      GGA ATC CCG GAT CAC CCC CTC AGG CTC CTG CGA ATT GGA AAC CAG GCC TTC CTC CAG GAG
           ||* ||| ||| ||# ||| ||* ||* *|* ||* ||| ||* ||# ||* ||| ||| ||* ||| ||* ||| ||#
Optimized  GGT ATC CCG GAC CAC CCG CTG CGT CTG CTG CGT ATC GGT AAC CAG GCG TTC CTG CAG GAA
```

```
           F   V   L   P   P   V   Q   L   P   Q   Y   F   T   F   D   L   T   A   L   K
    Query  TTC GTT CTT CCG CCA GTC CAA CTA CCC CAG TAT TTC ACC TTT GAT TTG ACA GCA CTC AAA
           ||| ||| ||* ||| ||# ||# ||# ||# ||* ||| ||# ||| ||| ||# ||# #|| ||* ||# ||* |||
Optimized  TTC GTT CTG CCG CCG GTT CAG CTG CCG CAG TAC TTC ACC TTC GAC CTG ACC GCG CTG AAA

           L   I   T   Q   P   L   P   A   A   T   W   T   D   D   T   P   T   G   S   N
    Query  CTG ATC ACC CAA CCA CTG CCT GCT GCA ACA TGG ACC GAT GAC ACT CCA ACA GGA TCA AAT
           ||| ||| ||| ||# ||# ||| ||* ||* ||# ||* ||| ||| ||# ||| ||# ||# ||* ||* ||* ||#
Optimized  CTG ATC ACC CAG CCG CTG CCG GCG GCG ACC TGG ACC GAC GAC ACC CCG ACC GGT TCT AAC

           G   A   L   R   P   G   I   S   F   H   P   K   L   R   P   I   L   L   P   N
    Query  GGA GCG TTG CGC CCA GGG ATT TCA TTT CAT CCA AAA CTT CGC CCC ATT CTT TTA CCC AAC
           ||* ||| #|| ||# ||# ||* ||# ||* ||# ||# ||# ||| ||* ||# ||* ||# ||* #|# ||* |||
Optimized  GGT GCG CTG CGT CCG GGT ATC TCT TTC CAC CCG AAA CTG CGT CCG ATC CTG CTG CCG AAC

           K   S   G   K   K   G   N   S   A   D   L   T   S   P   E   K   I   Q   A   I
    Query  AAG AGT GGG AAG AAG GGG AAT AGT GCC GAT CTA ACA TCT CCG GAG AAA ATC CAA GCA ATA
           ||# **| ||* ||# ||# ||* ||# **| ||* ||# ||# ||* ||| ||| ||# ||| ||| ||# ||# ||*
Optimized  AAA TCT GGT AAA AAA GGT AAC TCT GCG GAC CTG ACC TCT CCG GAA AAA ATC CAG GCG ATC

           M   T   S   L   Q   D   F   K   I   V   P   I   D   P   T   K   N   I   M   G
    Query  ATG ACT TCA CTC CAG GAC TTT AAG ATC GTT CCA ATT GAT CCA ACC AAA AAT ATC ATG GGA
           ||| ||# ||* ||* ||| ||| ||# ||# ||| ||| ||# ||# ||# ||# ||| ||| ||# ||| ||| ||*
Optimized  ATG ACC TCT CTG CAG GAC TTC AAA ATC GTT CCG ATC GAC CCG ACC AAA AAC ATC ATG GGT

           I   E   V   P   E   T   L   V   H   K   L   T   G   K   K   V   T   S   K   N
    Query  ATC GAA GTG CCA GAA ACT CTG GTC CAC AAG CTG ACC GGT AAG AAG GTG ACT TCT AAA AAT
           ||| ||| ||* ||# ||| ||# ||| ||# ||| ||# ||| ||| ||| ||# ||# ||* ||# ||| ||| ||#
Optimized  ATC GAA GTT CCG GAA ACC CTG GTT CAC AAA CTG ACC GGT AAA AAA GTT ACC TCT AAA AAC

           G   Q   P   I   I   P   V   L   L   P   K   Y   I   G   L   D   P   V   A   P
    Query  GGA CAA CCA ATC ATC CCT GTT CTT TTG CCA AAG TAC ATT GGT TTG GAC CCG GTG GCT CCA
           ||* ||# ||# ||| ||| ||* ||| ||* #|| ||# ||# ||| ||# ||| #|| ||| ||| ||* ||* ||#
Optimized  GGT CAG CCG ATC ATC CCG GTT CTG CTG CCG AAA TAC ATC GGT CTG GAC CCG GTT GCG CCG

           G   D   L   T   M   V   I   T   Q   D   C   D   T   C   H   S   P   A   S   L
    Query  GGA GAC CTC ACC ATG GTA ATC ACA CAG GAT TGT GAC ACG TGT CAT TCT CCT GCG AGT CTT
           ||* ||| ||* ||| ||| ||* ||| ||* ||| ||# ||# ||| ||* ||# ||# ||| ||* ||| **| ||*
Optimized  GGT GAC CTG ACC ATG GTT ATC ACC CAG GAC TGC GAC ACC TGC CAC TCT CCG GCG TCT CTG

           P   A   V   I   E   K   .
    Query  CCA GCT GTG ATT GAG AAG TAA
           ||# ||* ||* ||# ||# ||# |||
Optimized  CCG GCG GTT ATC GAA AAA TAA
```

Supplementary Figure 4. The sequence alignment of natural-type (Query) and modified (codon optimized) DNA for glycoprotein (GP) gene of Ebola virus for accession number MG572235.1.

*The specific-coloured symbols stand for (*): Transversion change, (#): Transition change and (|): Unchanged nucleotide.

ALIGNMENT

```
           D   E   D   .   A   D   S   E   R   N   L   H   L   S   .   I   I   C   P   P
Query      GAT GAA GAT TAA GCC GAC AGT GAG CGT AAT CTT CAT CTC TCT TAG ATT ATT TGT CCT CCA
           ||# ||| ||# ||| ||* ||| **| ||# ||| ||# ||* ||# ||* ||| ||| ||# ||# ||# ||* ||#
Optimized  GAC GAA GAC TAA GCG GAC TCT GAA CGT AAC CTG CAC CTG TCT TAG ATC ATC TGC CCG CCG

           E   .   G   S   S   G   P   F   Q   S   Y   N   Q   N   K   L   H   .   K   D
Query      GAG TAG GGA TCG TCA GGT CCT TTT CAA TCG TAT AAC CAA AAT AAA CTT CAC TAG AAG GAT
           ||# ||| ||* ||* ||* ||| ||* ||# ||# ||* ||# ||| ||# ||# ||| ||* ||| ||| ||# ||#
Optimized  GAA TAG GGT TCT TCT GGT CCG TTC CAG TCT TAC AAC CAG AAC AAA CTG CAC TAG AAA GAC

           I   V   G   Q   Q   H   N   G   C   Y   R   N   I   A   V   T   S   .   S   I
Query      ATT GTG GGG CAA CAA CAC AAT GGG TGT TAC AGG AAT ATT GCA GTT ACC TCG TGA TCG ATT
           ||# ||* ||* ||# ||# ||| ||# ||* ||# ||| *|* ||# ||# ||# ||| ||| ||* ||| ||* ||#
Optimized  ATC GTT GGT CAG CAG CAC AAC GGT TGC TAC CGT AAC ATC GCG GTT ACC TCT TGA TCT ATC

           Q   E   D   I   I   L   S   L   G   N   Y   P   F   P   K   N   I   F   H   P
Query      CAA GAG GAC ATC ATT CTT TCT TTG GGT AAT TAT CCT TTT CCA AAG AAC ATT TTC CAT CCC
           ||# ||# ||| ||| ||# ||* ||| #|| ||| ||# ||# ||* ||# ||# ||# ||| ||# ||| ||# ||*
Optimized  CAG GAA GAC ATC ATC CTG TCT CTG GGT AAC TAC CCG TTC CCG AAA AAC ATC TTC CAC CCG

           T   W   S   H   P   Q   .   H   I   T   G   .   .   C   R   Q   T   G   L   P
Query      ACT TGG AGT CAT CCA CAA TAG CAC ATT ACA GGT TAG TGA TGT CGA CAA ACT GGT TTG CCG
           ||# ||| **| ||# ||# ||# ||| ||| ||# ||* ||| ||| ||| ||# ||* ||# ||# ||| #|| |||
Optimized  ACC TGG TCT CAC CCG CAG TAG CAC ATC ACC GGT TAG TGA TGC CGT CAG ACC GGT CTG CCG

           .   Q   T   V   I   H   K   S   I   E   I   S   W   T   E   S   R   R   E   W
Query      TGA CAA ACT GTC ATC CAC AAA TCA ATT GAG ATC AGT TGG ACT GAA TCT CGA AGG GAA TGG
           ||| ||# ||# ||# ||| ||| ||| ||* ||# ||# ||| **| ||| ||# ||| ||| ||* *|* ||| |||
Optimized  TGA CAG ACC GTT ATC CAC AAA TCT ATC GAA ATC TCT TGG ACC GAA TCT CGT CGT GAA TGG

           S   G   N   .   R   A   I   C   N   .   K   M   G   L   Q   V   R   C   P   T
Query      AGT GGC AAC TGA CGT GCC ATC TGC AAC TAA AAG ATG GGG CTT CAG GTC CGG TGT CCC ACC
           **| ||# ||| ||| ||| ||* ||| ||| ||| ||| ||# ||| ||* ||* ||| ||# ||* ||# ||* |||
Optimized  TCT GGT AAC TGA CGT GCG ATC TGC AAC TAA AAA ATG GGT CTG CAG GTT CGT TGC CCG ACC

           K   G   G   Q   L   .   S   W   .   M   G   .   K   L   L   Q   S   .   N   Q
Query      AAA GGT GGT CAA TTA TGA AGC TGG TGA ATG GGC TGA AAA CTG CTA CAA TCT TGA AAT CAA
           ||| ||| ||| ||# #|# ||| **# ||| ||| ||| ||# ||| ||| ||| ||# ||# ||| ||| ||# ||#
Optimized  AAA GGT GGT CAG CTG TGA TCT TGG TGA ATG GGT TGA AAA CTG CTG CAG TCT TGA AAC CAG
```

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```
          K   T   .   R   E   .   V   S   T   S   S   A   R   R   D   S   G   L   P   P
   Query  AAA ACC TGA CGG GAG TGA GTG TCT ACC AGC AGC GCC AGA CGG GAT TCG GGG CTT CCC CCG
          ||| ||| ||| ||* ||# ||| ||* ||| ||| **# **# ||* *|* ||* ||# ||* ||* ||* ||* |||
Optimized AAA ACC TGA CGT GAA TGA GTT TCT ACC TCT TCT GCG CGT CGT GAC TCT GGT CTG CCG CCG

          V   P   V   C   A   Q   S   I   R   N   G   T   V   C   R   R   L   C   L   P
   Query  GTG CCG GTA TGT GCA CAA AGT ATC AGG AAC GGG ACC GTG TGC CGG AGA CTT TGC CTT CCA
          ||* ||| ||* ||# ||# ||# **| ||| *|* ||| ||* ||| ||* ||| ||* *|* ||* ||| ||* ||#
Optimized GTT CCG GTT TGC GCG CAG TCT ATC CGT AAC GGT ACC GTT TGC CGT CGT CTG TGC CTG CCG

          Q   R   G   C   F   L   P   V   .   P   T   C   F   H   S   Y   L   P   R   N
   Query  CAA AGA GGG TGC TTT CTT CCT GTA TGA CCG ACT TGC TTC CAC AGT TAT CTA CCG AGG AAC
          ||# *|* ||* ||| ||# ||* ||* ||* ||| ||| ||# ||| ||| ||| **| ||# ||# ||| *|* |||
Optimized CAG CGT GGT TGC TTC CTG CCG GTT TGA CCG ACC TGC TTC CAC TCT TAC CTG CCG CGT AAC

          D   F   R   .   R   C   R   C   I   S   D   T   A   P   S   .   E   G   L   L
   Query  GAC TTT CGC TGA AGG TGT CGT TGC ATT TCT GAT ACT GCC CCA AGC TAA GAA GGA CTT CTT
          ||| ||# ||# ||| *|* ||# ||| ||| ||# ||| ||# ||# ||* ||# **# ||| ||| ||* ||* ||*
Optimized GAC TTC CGT TGA CGT TGC CGT TGC ATC TCT GAC ACC GCG CCG TCT TAA GAA GGT CTG CTG

          Q   L   T   P   L   E   R   A   G   Q   C   N   G   G   P   V   .   W   L   L
   Query  CAG CTC ACA CCC CTT GAG AGA GCC GGT CAA TGC AAC GGA GGA CCC GTC TAG TGG CTA CTA
          ||| ||* ||* ||* ||* ||# *|* ||* ||| ||# ||| ||| ||* ||* ||* ||# ||| ||| ||# ||#
Optimized CAG CTG ACC CCG CTG GAA CGT GCG GGT CAG TGC AAC GGT GGT CCG GTT TAG TGG CTG CTG

          F   Y   H   N   .   I   S   S   Y   R   F   W   N   Q   .   D   R   V   F   V
   Query  TTC TAC CAC AAT TAG ATA TCA AGC TAC CGG TTT TGG AAC CAA TGA GAC AGA GTA TTT GTT
          ||| ||| ||| ||# ||| ||* ||* **# ||| ||* ||# ||| ||| ||# ||| ||| *|* ||* ||# |||
Optimized TTC TAC CAC AAC TAG ATC TCT TCT TAC CGT TTC TGG AAC CAG TGA GAC CGT GTT TTC GTT

          R   G   .   Q   F   D   L   R   P   T   .   I   K   I   H   T   T   V   S   A
   Query  CGA GGT TGA CAA TTT GAC CTA CGT CCA ACT TGA ATC AAG ATT CAC ACC ACA GTT TCT GCT
          ||* ||| ||| ||# ||# ||| ||# ||| ||# ||# ||| ||| ||# ||# ||| ||| ||* ||| ||| ||*
Optimized CGT GGT TGA CAG TTC GAC CTG CGT CCG ACC TGA ATC AAA ATC CAC ACC ACC GTT TCT GCG

          P   A   E   .   D   N   I   Y   K   W   E   K   E   Q   Y   H   G   K   T   N
   Query  CCA GCT GAA TGA GAC AAT ATA TAC AAG TGG GAA AAG GAG CAA TAC CAC GGG AAA ACT AAT
          ||# ||* ||| ||| ||| ||# ||* ||| ||# ||| ||| ||# ||# ||# ||| ||| ||* ||| ||# ||#
Optimized CCG GCG GAA TGA GAC AAC ATC TAC AAA TGG GAA AAA GAA CAG TAC CAC GGT AAA ACC AAC
```

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```
           L   E   G   Q   P   R   N   .   Y   N   N   R   G   V   G   L   L   G   N   .
    Query  TTG GAA GGT CAA CCC CGA AAT TGA TAC AAC AAT CGG GGA GTG GGC CTT CTG GGA AAC TAA
           #|| ||| ||| ||# ||* ||* ||# ||| ||| ||| ||# ||* ||* ||* ||# ||* ||| ||* ||| |||
Optimized  CTG GAA GGT CAG CCG CGT AAC TGA TAC AAC AAC CGT GGT GTT GGT CTG CTG GGT AAC TAA

           K   N   L   T   R   K   I   R   S   E   E   L   S   F   T   A   V   S   N   R
    Query  AAA AAC CTC ACT AGA AAA ATT CGC AGT GAA GAG TTG TCT TTC ACA GCT GTA TCA AAC AGA
           ||| ||| ||* ||# *|* ||| ||# ||# **| ||| ||# #|| ||| ||| ||* ||* ||* ||* ||| *|*
Optimized  AAA AAC CTG ACC CGT AAA ATC CGT TCT GAA GAA CTG TCT TTC ACC GCG GTT TCT AAC CGT

           A   K   N   I   S   G   Q   S   P   A   R   T   S   S   D   P   G   T   N   T
    Query  GCC AAA AAC ATC AGT GGT CAG AGT CCG GCG CGA ACT TCT TCC GAC CCA GGG ACC AAC ACA
           ||* ||| ||| ||| **| ||| ||| **| ||| ||| ||* ||# ||| ||# ||| ||# ||* ||| ||| ||*
Optimized  GCG AAA AAC ATC TCT GGT CAG TCT CCG GCG CGT ACC TCT TCT GAC CCG GGT ACC AAC ACC

           T   T   E   D   H   K   I   M   A   S   E   N   S   S   A   M   V   Q   V   H
    Query  ACA ACT GAA GAC CAC AAA ATC ATG GCT TCA GAA AAT TCC TCT GCA ATG GTT CAA GTG CAC
           ||* ||# ||| ||| ||| ||| ||| ||| ||* ||* ||| ||# ||# ||| ||# ||| ||| ||# ||* |||
Optimized  ACC ACC GAA GAC CAC AAA ATC ATG GCG TCT GAA AAC TCT TCT GCG ATG GTT CAG GTT CAC

           S   Q   G   R   E   A   A   V   S   H   L   T   T   L   A   T   I   S   T   S
    Query  AGT CAA GGA AGG GAA GCT GCA GTG TCG CAT CTG ACA ACC CTT GCC ACA ATC TCC ACG AGT
           **| ||# ||* *|* ||| ||* ||# ||* ||* ||# ||| ||* ||| ||* ||* ||* ||| ||# ||* **|
Optimized  TCT CAG GGT CGT GAA GCG GCG GTT TCT CAC CTG ACC ACC CTG GCG ACC ATC TCT ACC TCT

           P   Q   P   P   T   T   K   P   G   P   D   N   S   T   H   N   T   P   V   Y
    Query  CCT CAA CCC CCC ACA ACC AAA CCA GGT CCG GAC AAC AGC ACC CAC AAT ACA CCC GTG TAT
           ||* ||# ||* ||* ||* ||| ||| ||# ||| ||| ||| ||| **# ||| ||| ||# ||* ||* ||* ||#
Optimized  CCG CAG CCG CCG ACC ACC AAA CCG GGT CCG GAC AAC TCT ACC CAC AAC ACC CCG GTT TAC

           K   L   D   I   S   E   A   T   Q   V   E   Q   H   H   R   R   T   D   N   D
    Query  AAA CTT GAC ATC TCT GAG GCA ACT CAA GTT GAA CAA CAT CAC CGC AGA ACA GAC AAC GAC
           ||| ||* ||| ||| ||| ||# ||# ||# ||# ||| ||| ||# ||# ||| ||# *|* ||* ||| ||| |||
Optimized  AAA CTG GAC ATC TCT GAA GCG ACC CAG GTT GAA CAG CAC CAC CGT CGT ACC GAC AAC GAC

           S   T   A   S   D   T   P   P   A   T   T   A   A   G   P   L   K   A   E   N
    Query  AGC ACA GCC TCC GAC ACT CCC CCC GCC ACG ACC GCA GCC GGA CCC CTA AAA GCA GAG AAC
           **# ||* ||* ||# ||| ||# ||* ||* ||* ||* ||| ||# ||* ||* ||* ||# ||| ||# ||# |||
Optimized  TCT ACC GCG TCT GAC ACC CCG CCG GCG ACC ACC GCG GCG GGT CCG CTG AAA GCG GAA AAC
```

```
          T   N   T   S   K   G   T   D   L   L   D   P   A   T   T   T   S   P   Q   N
Query     ACC AAC ACG AGC AAG GGT ACC GAC CTC CTG GAC CCC GCC ACC ACA ACA AGT CCC CAA AAC
          ||| ||| ||* **# ||# ||| ||| ||| ||* ||| ||| ||* ||* ||| ||* ||* **| ||* ||# |||
Optimized ACC AAC ACC TCT AAA GGT ACC GAC CTG CTG GAC CCG GCG ACC ACC ACC TCT CCG CAG AAC

          H   S   E   T   A   G   N   N   N   T   H   H   Q   D   T   G   E   E   S   A
Query     CAC AGC GAG ACC GCT GGC AAC AAC AAC ACT CAT CAC CAA GAT ACC GGA GAA GAG AGT GCC
          ||| **# ||# ||| ||* ||# ||| ||| ||| ||# ||# ||| ||# ||# ||| ||* ||| ||# **| ||*
Optimized CAC TCT GAA ACC GCG GGT AAC AAC AAC ACC CAC CAC CAG GAC ACC GGT GAA GAA TCT GCG

          S   S   G   K   L   G   L   I   T   N   T   I   A   G   V   A   G   L   I   T
Query     AGC AGC GGG AAG CTA GGC TTA ATT ACC AAT ACT ATT GCT GGA GTC GCA GGA CTG ATC ACA
          **# **# ||* ||# ||# ||# #|# ||# ||| ||# ||# ||# ||* ||* ||# ||# ||* ||| ||| ||*
Optimized TCT TCT GGT AAA CTG GGT CTG ATC ACC AAC ACC ATC GCG GGT GTT GCG GGT CTG ATC ACC

          G   G   R   R   A   R   R   E   A   I   V   N   A   Q   P   K   C   N   P   N
Query     GGC GGG AGG AGA GCT CGA AGA GAA GCA ATT GTC AAT GCT CAA CCC AAA TGC AAC CCT AAT
          ||# ||* *|* *|* ||* ||* *|* ||| ||# ||# ||# ||# ||* ||# ||* ||| ||| ||| ||* ||#
Optimized GGT GGT CGT CGT GCG CGT CGT GAA GCG ATC GTT AAC GCG CAG CCG AAA TGC AAC CCG AAC

          L   H   Y   W   T   T   Q   D   E   G   A   A   I   G   L   A   W   I   P   Y
Query     TTA CAT TAC TGG ACT ACT CAG GAT GAA GGT GCT GCA ATC GGA CTG GCC TGG ATA CCA TAT
          #|# ||# ||| ||| ||# ||# ||| ||# ||| ||| ||* ||# ||| ||* ||| ||* ||| ||* ||# ||#
Optimized CTG CAC TAC TGG ACC ACC CAG GAC GAA GGT GCG GCG ATC GGT CTG GCG TGG ATC CCG TAC

          F   G   P   A   A   E   G   I   Y   I   E   G   L   M   H   N   Q   D   G   L
Query     TTC GGG CCA GCA GCC GAG GGA ATT TAC ATA GAG GGG CTG ATG CAC AAT CAA GAT GGT TTA
          ||| ||* ||# ||# ||* ||# ||* ||# ||| ||* ||# ||* ||| ||| ||| ||# ||# ||# ||| #|#
Optimized TTC GGT CCG GCG GCG GAA GGT ATC TAC ATC GAA GGT CTG ATG CAC AAC CAG GAC GGT CTG

          I   C   G   L   R   Q   L   A   N   E   T   T   Q   A   L   Q   L   F   L   R
Query     ATC TGT GGG TTG AGA CAG CTG GCC AAC GAG ACG ACT CAA GCT CTT CAA CTG TTC CTG AGA
          ||| ||# ||* #|| *|* ||| ||| ||* ||| ||# ||* ||# ||# ||* ||* ||# ||| ||| ||| *|*
Optimized ATC TGC GGT CTG CGT CAG CTG GCG AAC GAA ACC ACC CAG GCG CTG CAG CTG TTC CTG CGT

          A   T   T   E   L   R   T   F   S   I   L   N   R   K   A   I   D   F   L   L
Query     GCC ACA ACC GAG CTA CGC ACC TTT TCA ATC CTC AAC CGT AAG GCA ATT GAT TTC TTG CTG
          ||* ||* ||| ||# ||# ||# ||| ||# ||* ||| ||* ||| ||| ||# ||# ||# ||# ||| #|| |||
Optimized GCG ACC ACC GAA CTG CGT ACC TTC TCT ATC CTG AAC CGT AAA GCG ATC GAC TTC CTG CTG
```

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```
           Q   R   W   G   G   T   C   H   I   L   G   P   D   C   C   I   E   P   H   D
    Query  CAG CGA TGG GGC GGC ACA TGC CAC ATT TTG GGA CCG GAC TGC TGT ATC GAA CCA CAT GAT
           ||| ||* ||| ||# ||# ||* ||| ||| ||# #|| ||* ||| ||| ||| ||# ||| ||| ||# ||# ||#
Optimized  CAG CGT TGG GGT GGT ACC TGC CAC ATC CTG GGT CCG GAC TGC TGC ATC GAA CCG CAC GAC

           W   T   K   N   I   T   D   K   I   D   Q   I   I   H   D   F   V   D   K   T
    Query  TGG ACC AAG AAC ATA ACA GAC AAA ATT GAT CAG ATT ATT CAT GAT TTT GTT GAT AAA ACC
           ||| ||| ||# ||| ||* ||* ||| ||| ||# ||# ||| ||# ||# ||# ||# ||# ||| ||# ||| |||
Optimized  TGG ACC AAA AAC ATC ACC GAC AAA ATC GAC CAG ATC ATC CAC GAC TTC GTT GAC AAA ACC

           L   P   D   Q   G   D   N   D   N   W   W   T   G   W   R   Q   W   I   P   A
    Query  CTT CCG GAC CAG GGG GAC AAT GAC AAT TGG TGG ACA GGA TGG AGA CAA TGG ATA CCG GCA
           ||* ||| ||| ||| ||* ||| ||# ||| ||# ||| ||| ||* ||* ||| *|* ||# ||| ||* ||| ||#
Optimized  CTG CCG GAC CAG GGT GAC AAC GAC AAC TGG TGG ACC GGT TGG CGT CAG TGG ATC CCG GCG

           G   I   G   V   T   G   V   I   I   A   V   I   A   L   F   C   I   C   K   F
    Query  GGT ATT GGA GTT ACA GGC GTT ATA ATT GCA GTT ATC GCT TTA TTC TGT ATA TGC AAA TTT
           ||| ||# ||* ||| ||* ||# ||| ||* ||# ||# ||| ||| ||* #|# ||| ||# ||* ||| ||| ||#
Optimized  GGT ATC GGT GTT ACC GGT GTT ATC ATC GCG GTT ATC GCG CTG TTC TGC ATC TGC AAA TTC

           V   F   .   F   F   F   R   L   L   H   G   K   A   Q   P   Q   I   N   E   T
    Query  GTC TTT TAG TTT TTC TTC AGA TTG CTT CAT GGC AAA GCT CAG CCT CAA ATC AAT GAA ACC
           ||# ||# ||| ||# ||| ||| *|* #|| ||* ||# ||# ||| ||* ||| ||* ||# ||| ||# ||| |||
Optimized  GTT TTC TAG TTC TTC TTC CGT CTG CTG CAC GGT AAA GCG CAG CCG CAG ATC AAC GAA ACC

           R   I   .   L   Y   G   L   L   E   S   K   I   T   .   Q   M   I   I   .   Y
    Query  AGG ATT TAA TTA TAT GGA TTA CTT GAA TCT AAG ATT ACT TGA CAA ATG ATA ATA TAA TAC
           *|* ||# ||| #|# ||# ||* #|# ||* ||| ||| ||# ||# ||# ||| ||# ||| ||* ||* ||| |||
Optimized  CGT ATC TAA CTG TAC GGT CTG CTG GAA TCT AAA ATC ACC TGA CAG ATG ATC ATC TAA TAC

           T   G   A   L   N   I   A   N   V   I   L   T   L   L   N   S   Q   L   I   I
    Query  ACT GGA GCT TTA AAC ATA GCC AAT GTG ATT CTA ACT CTT TTA AAC TCA CAG TTA ATC ATA
           ||# ||* ||* #|# ||| ||* ||* ||# ||* ||# ||# ||# ||* #|# ||| ||* ||| #|# ||| ||*
Optimized  ACC GGT GCG CTG AAC ATC GCG AAC GTT ATC CTG ACC CTG CTG AAC TCT CAG CTG ATC ATC

           N   K   V   .   H   Q   S   S   Y   L   F   E   N   D   K   L   D   E   D   .
    Query  AAT AAG GTT TGA CAT CAA TCT AGT TAT CTC TTT GAG AAT GAT AAA CTT GAT GAA GAT TAA
           ||# ||# ||| ||| ||# ||# ||| **| ||# ||* ||# ||# ||# ||# ||| ||* ||# ||| ||# |||
Optimized  AAC AAA GTT TGA CAC CAG TCT TCT TAC CTG TTC GAA AAC GAC AAA CTG GAC GAA GAC TAA
```

```
           E   K
    Query  GAA AAA
           ||| |||
Optimized  GAA AAA
```

Supplementary Figure 5. The sequence alignment natural-type (Query) and modified (codon optimized) DNA for VP30 gene of Ebola virus for accession number MG572235.1.

*The specific-coloured symbols stand for (*): Transversion change, (#): Transition change and (|): Unchanged nucleotide.

ALIGNMENT

```
           M   E   A   S   Y   E   R   G   R   P   R   A   A   R   Q   H   S   R   D   G
Query      ATG GAA GCT TCA TAT GAG AGA GGA CGC CCA CGA GCT GCC AGA CAG CAT TCA AGG GAT GGA
           ||| ||| ||* ||* ||# ||# *|* ||* ||# ||# ||* ||* ||* *|* ||| ||# ||* *|* ||# ||*
Optimized  ATG GAA GCG TCT TAC GAA CGT GGT CGT CCG CGT GCG GCG CGT CAG CAC TCT CGT GAC GGT

           H   D   H   H   V   R   A   R   S   S   S   R   E   N   Y   R   G   E   Y   R
Query      CAC GAC CAC CAT GTT CGA GCA CGA TCA TCA TCC AGA GAG AAT TAT CGA GGT GAG TAC CGT
           ||| ||| ||| ||# ||| ||* ||# ||* ||* ||* ||# *|* ||# ||# ||# ||* ||| ||# ||| |||
Optimized  CAC GAC CAC CAC GTT CGT GCG CGT TCT TCT TCT CGT GAA AAC TAC CGT GGT GAA TAC CGT

           Q   S   R   S   A   S   Q   V   R   V   P   T   V   F   H   K   K   R   V   E
Query      CAA TCA AGG AGC GCC TCA CAA GTG CGC GTT CCT ACT GTA TTT CAT AAG AAG AGA GTT GAA
           ||# ||* *|* **# ||* ||* ||# ||* ||# ||| ||* ||# ||* ||# ||# ||# ||# *|* ||| |||
Optimized  CAG TCT CGT TCT GCG TCT CAG GTT CGT GTT CCG ACC GTT TTC CAC AAA AAA CGT GTT GAA

           P   L   T   V   P   P   A   P   K   D   I   C   P   T   L   K   K   G   F   L
Query      CCA TTA ACA GTT CCT CCA GCA CCT AAA GAC ATA TGT CCG ACC TTG AAA AAA GGA TTT TTG
           ||# #|# ||* ||| ||* ||# ||# ||* ||| ||| ||* ||# ||| ||| #|| ||| ||| ||* ||# #||
Optimized  CCG CTG ACC GTT CCG CCG GCG CCG AAA GAC ATC TGC CCG ACC CTG AAA AAA GGT TTC CTG

           C   D   S   S   F   C   K   K   D   H   Q   L   E   S   L   T   D   R   E   L
Query      TGT GAC AGT AGT TTT TGC AAA AAA GAT CAC CAG TTG GAG AGT TTA ACT GAT AGG GAA TTA
           ||# ||| **| **| ||# ||| ||| ||| ||# ||| ||| #|| ||# **| #|# ||# ||# *|* ||| #|#
Optimized  TGC GAC TCT TCT TTC TGC AAA AAA GAC CAC CAG CTG GAA TCT CTG ACC GAC CGT GAA CTG

           L   L   L   I   A   R   K   T   C   G   S   V   E   Q   Q   L   N   I   T   A
Query      CTC CTA CTA ATC GCC CGT AAG ACT TGT GGA TCA GTA GAA CAA CAA TTA AAT ATA ACT GCA
           ||* ||# ||# ||| ||* ||| ||# ||# ||# ||* ||* ||* ||| ||# ||# #|# ||# ||* ||# ||#
Optimized  CTG CTG CTG ATC GCG CGT AAA ACC TGC GGT TCT GTT GAA CAG CAG CTG AAC ATC ACC GCG

           P   K   D   S   R   L   A   N   P   T   A   D   D   F   Q   Q   E   E   G   P
Query      CCC AAG GAC TCG CGC TTA GCA AAT CCA ACG GCT GAT GAT TTC CAG CAA GAG GAA GGT CCA
           ||* ||# ||| ||* ||# #|# ||# ||# ||# ||* ||* ||# ||# ||| ||| ||# ||# ||| ||| ||#
Optimized  CCG AAA GAC TCT CGT CTG GCG AAC CCG ACC GCG GAC GAC TTC CAG CAG GAA GAA GGT CCG

           K   I   T   L   L   T   L   I   K   T   A   E   H   W   A   R   Q   D   I   R
Query      AAA ATT ACC TTG TTG ACT CTG ATC AAG ACG GCA GAA CAC TGG GCG AGA CAA GAC ATC AGA
           ||| ||# ||| #|| #|| ||# ||| ||| ||# ||* ||# ||| ||| ||| ||| *|* ||# ||| ||| *|*
Optimized  AAA ATC ACC CTG CTG ACC CTG ATC AAA ACC GCG GAA CAC TGG GCG CGT CAG GAC ATC CGT
```

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```
           T   I   E   D   S   K   L   R   A   L   L   T   L   C   A   V   M   T   R   K
    Query  ACC ATA GAG GAT TCA AAA TTA AGA GCA TTG TTG ACT CTA TGT GCT GTG ATG ACG AGG AAA
           ||| ||* ||# ||# ||* ||| #|# *|* ||# #|| #|| ||# ||# ||# ||* ||* ||| ||* *|* |||
Optimized  ACC ATC GAA GAC TCT AAA CTG CGT GCG CTG CTG ACC CTG TGC GCG GTT ATG ACC CGT AAA

           F   S   K   S   Q   L   S   L   L   C   E   T   H   L   R   R   E   G   L   G
    Query  TTC TCA AAA TCC CAG CTG AGT CTT TTA TGT GAG ACA CAC CTA AGG CGT GAG GGG CTT GGG
           ||| ||* ||| ||# ||| ||| **| ||* #|# ||# ||# ||* ||| ||# *|* ||| ||# ||* ||* ||*
Optimized  TTC TCT AAA TCT CAG CTG TCT CTG CTG TGC GAA ACC CAC CTG CGT CGT GAA GGT CTG GGT

           Q   D   Q   A   E   P   V   L   E   V   Y   Q   R   L   H   S   D   K   G   G
    Query  CAA GAT CAG GCA GAA CCT GTT CTC GAA GTA TAT CAA CGA TTA CAC AGT GAT AAA GGA GGC
           ||# ||# ||| ||# ||| ||* ||| ||* ||| ||* ||# ||# ||* #|# ||| **| ||# ||| ||* ||#
Optimized  CAG GAC CAG GCG GAA CCG GTT CTG GAA GTT TAC CAG CGT CTG CAC TCT GAC AAA GGT GGT

           S   F   E   A   A   L   W   Q   Q   W   D   R   Q   S   L   I   M   F   I   T
    Query  AGT TTT GAA GCT GCA CTA TGG CAA CAA TGG GAC CGA CAA TCC CTA ATT ATG TTT ATC ACT
           **| ||# ||| ||* ||# ||# ||| ||# ||# ||| ||| ||* ||# ||# ||# ||# ||| ||# ||| ||#
Optimized  TCT TTC GAA GCG GCG CTG TGG CAG CAG TGG GAC CGT CAG TCT CTG ATC ATG TTC ATC ACC

           A   F   L   N   I   A   L   Q   L   P   C   E   S   S   A   V   V   V   S   G
    Query  GCA TTC TTG AAT ATC GCT CTC CAG TTA CCG TGT GAA AGT TCT GCT GTC GTT GTT TCA GGG
           ||# ||| #|| ||# ||| ||* ||* ||| #|# ||| ||# ||| **| ||| ||* ||# ||| ||| ||* ||*
Optimized  GCG TTC CTG AAC ATC GCG CTG CAG CTG CCG TGC GAA TCT TCT GCG GTT GTT GTT TCT GGT

           L   R   T   L   V   P   Q   S   D   N   E   E   A   S   T   N   P   G   T   C
    Query  TTA AGA ACA TTG GTT CCT CAA TCA GAT AAT GAG GAA GCT TCA ACC AAC CCG GGG ACA TGC
           #|# *|* ||* #|| ||| ||* ||# ||* ||# ||# ||# ||| ||* ||* ||| ||| ||| ||* ||* |||
Optimized  CTG CGT ACC CTG GTT CCG CAG TCT GAC AAC GAA GAA GCG TCT ACC AAC CCG GGT ACC TGC

           S   W   S   D   E   G   T   P   .
    Query  TCA TGG TCT GAT GAG GGT ACC CCT TAA
           ||* ||| ||| ||# ||# ||| ||| ||* |||
Optimized  TCT TGG TCT GAC GAA GGT ACC CCG TAA
```

Supplementary Figure 6. The sequence alignment of natural-type (Query) and modified (codon optimized) DNA for VP24 gene of Ebola virus for accession number MG572235.1.

*The specific-coloured symbols stand for (*): Transversion change, (#): Transition change and (|): Unchanged nucleotide.

ALIGNMENT

```
           M   A   K   A   T   G   R   Y   N   L   I   S   P   K   K   D   L   E   K   G
Query      ATG GCT AAA GCT ACG GGA CGA TAC AAT CTA ATA TCG CCC AAA AAG GAC CTG GAG AAA GGG
           ||| ||* ||| ||* ||* ||* ||* ||| ||# ||# ||* ||* ||* ||| ||# ||| ||| ||# ||| ||*
Optimized  ATG GCG AAA GCG ACC GGT CGT TAC AAC CTG ATC TCT CCG AAA AAA GAC CTG GAA AAA GGT

           V   V   L   S   D   L   C   N   F   L   V   S   Q   T   I   Q   G   W   K   V
Query      GTT GTC TTA AGC GAC CTC TGT AAC TTC TTA GTT AGC CAA ACT ATT CAG GGG TGG AAG GTT
           ||| ||# #|# **# ||| ||* ||# ||| ||| #|# ||| **# ||# ||# ||# ||| ||* ||| ||# |||
Optimized  GTT GTT CTG TCT GAC CTG TGC AAC TTC CTG GTT TCT CAG ACC ATC CAG GGT TGG AAA GTT

           Y   W   A   G   I   E   F   D   V   T   H   K   G   M   A   L   L   Q   R   L
Query      TAT TGG GCT GGT ATT GAG TTT GAT GTG ACT CAC AAA GGA ATG GCC CTA TTG CAA AGA CTG
           ||# ||| ||* ||| ||# ||# ||# ||# ||* ||# ||| ||| ||* ||| ||* ||# #|| ||# *|* |||
Optimized  TAC TGG GCG GGT ATC GAA TTC GAC GTT ACC CAC AAA GGT ATG GCG CTG CTG CAG CGT CTG

           K   T   N   D   F   A   P   A   W   S   M   T   R   N   L   F   P   H   L   F
Query      AAA ACT AAT GAC TTT GCC CCT GCA TGG TCA ATG ACA AGG AAT CTC TTT CCT CAT TTA TTT
           ||| ||# ||# ||| ||# ||* ||* ||# ||| ||* ||| ||* *|* ||# ||* ||# ||* ||# #|# ||#
Optimized  AAA ACC AAC GAC TTC GCG CCG GCG TGG TCT ATG ACC CGT AAC CTG TTC CCG CAC CTG TTC

           Q   N   P   N   S   T   I   E   S   P   L   W   A   L   R   V   I   L   A   A
Query      CAA AAT CCG AAT TCC ACA ATT GAA TCA CCG CTG TGG GCA TTG AGA GTC ATC CTT GCA GCA
           ||# ||# ||| ||# ||# ||* ||# ||| ||* ||| ||| ||| ||# #|| *|* ||# ||| ||* ||# ||#
Optimized  CAG AAC CCG AAC TCT ACC ATC GAA TCT CCG CTG TGG GCG CTG CGT GTT ATC CTG GCG GCG

           G   I   Q   D   Q   L   I   D   Q   S   L   I   E   P   L   A   G   A   L   G
Query      GGG ATA CAA GAC CAG CTG ATT GAC CAG TCT TTG ATT GAA CCC TTA GCA GGA GCC CTT GGT
           ||* ||* ||# ||| ||| ||| ||# ||| ||| ||| #|| ||# ||| ||* #|# ||# ||* ||* ||* |||
Optimized  GGT ATC CAG GAC CAG CTG ATC GAC CAG TCT CTG ATC GAA CCG CTG GCG GGT GCG CTG GGT

           L   I   S   D   W   L   L   T   T   N   T   N   H   F   N   M   R   T   Q   R
Query      CTG ATC TCT GAT TGG CTG CTA ACA ACC AAC ACT AAC CAT TTC AAC ATG CGA ACA CAA CGT
           ||| ||| ||| ||# ||| ||| ||# ||* ||| ||| ||# ||| ||# ||| ||| ||| ||* ||* ||# |||
Optimized  CTG ATC TCT GAC TGG CTG CTG ACC ACC AAC ACC AAC CAC TTC AAC ATG CGT ACC CAG CGT

           V   K   E   Q   L   S   L   K   M   L   S   L   I   R   S   N   I   L   K   F
Query      GTC AAG GAA CAA TTG AGC CTA AAA ATG CTG TCG TTG ATT CGA TCC AAT ATT CTC AAG TTT
           ||# ||# ||| ||# #|| **# ||# ||| ||| ||| ||* #|| ||# ||* ||# ||# ||# ||* ||# ||#
Optimized  GTT AAA GAA CAG CTG TCT CTG AAA ATG CTG TCT CTG ATC CGT TCT AAC ATC CTG AAA TTC
```

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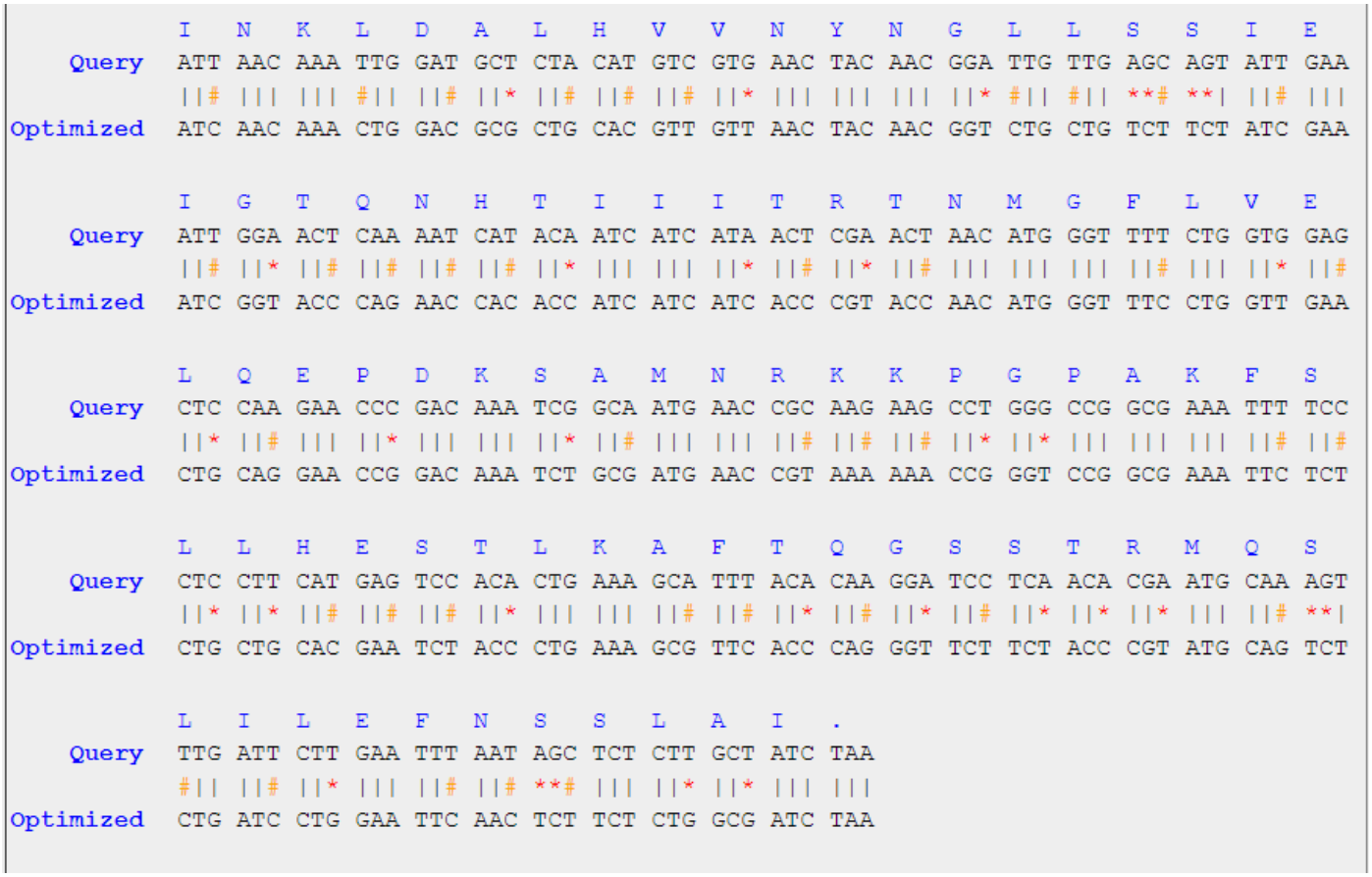

Supplementary Figure 7. The sequence alignment of natural-type (Query) and modified (codon optimized) DNA for polymerase (L) gene of Ebola virus for accession number MG572235.1.

*The specific-coloured symbols stand for (*): Transversion change, (#): Transition change and (|): Unchanged nucleotide.

 DOI: 10.47852/MEDIN42021822819

ALIGNMENT

```
           M   A   T   Q   H   T   Q   Y   P   D   A   R   L   S   S   P   I   V   L   D
    Query  ATG GCT ACA CAA CAT ACG CAA TAT CCA GAC GCA AGG TTA TCA TCA CCT ATA GTT TTA GAT
           ||| ||* ||* ||# ||# ||* ||# ||# ||# ||| ||# *|* #|# ||* ||* ||* ||* ||| #|# ||#
Optimized  ATG GCG ACC CAG CAC ACC CAG TAC CCG GAC GCG CGT CTG TCT TCT CCG ATC GTT CTG GAC

           Q   C   D   L   V   T   R   A   C   G   L   Y   S   A   Y   S   L   N   P   Q
    Query  CAG TGT GAT CTT GTC ACT CGT GCT TGT GGA TTG TAT TCC GCA TAC TCC TTA AAT CCC CAA
           ||| ||# ||# ||* ||# ||# ||| ||* ||# ||* #|| ||# ||# ||# ||| ||# #|# ||# ||* ||#
Optimized  CAG TGC GAC CTG GTT ACC CGT GCG TGC GGT CTG TAC TCT GCG TAC TCT CTG AAC CCG CAG

           L   K   N   C   R   L   P   K   H   I   Y   R   L   K   Y   D   T   T   V   T
    Query  CTA AAG AAC TGT AGA CTA CCG AAA CAT ATA TAC CGA CTA AAA TAT GAC ACC ACT GTT ACA
           ||# ||# ||| ||# *|* ||# ||| ||| ||# ||* ||| ||* ||# ||| ||# ||| ||| ||# ||| ||*
Optimized  CTG AAA AAC TGC CGT CTG CCG AAA CAC ATC TAC CGT CTG AAA TAC GAC ACC ACC GTT ACC

           E   F   L   S   D   V   P   V   A   T   L   P   A   D   F   L   V   P   T   F
    Query  GAG TTT TTG AGT GAT GTG CCG GTA GCA ACA TTG CCA GCG GAT TTT TTA GTA CCT ACA TTT
           ||# ||# #|| **| ||# ||* ||| ||* ||# ||* #|| ||# ||| ||# ||# #|# ||* ||* ||* ||#
Optimized  GAA TTC CTG TCT GAC GTT CCG GTT GCG ACC CTG CCG GCG GAC TTC CTG GTT CCG ACC TTC

           L   R   T   L   S   G   N   G   S   C   P   I   D   P   K   C   S   Q   F   L
    Query  CTT AGG ACT CTA TCA GGA AAT GGT TCT TGT CCA ATT GAT CCA AAA TGC AGT CAA TTT TTA
           ||* *|* ||# ||# ||* ||* ||# ||| ||| ||# ||# ||# ||# ||# ||| ||| **| ||# ||# #|#
Optimized  CTG CGT ACC CTG TCT GGT AAC GGT TCT TGC CCG ATC GAC CCG AAA TGC TCT CAG TTC CTG

           E   E   I   V   N   Y   T   L   Q   D   I   R   F   L   N   Y   Y   L   N   R
    Query  GAA GAA ATT GTC AAT TAT ACT CTA CAA GAT ATT CGC TTC CTA AAC TAT TAC CTC AAT CGA
           ||| ||| ||# ||# ||# ||# ||# ||# ||# ||# ||# ||# ||| ||# ||| ||# ||| ||* ||# ||*
Optimized  GAA GAA ATC GTT AAC TAC ACC CTG CAG GAC ATC CGT TTC CTG AAC TAC TAC CTG AAC CGT

           A   G   V   H   N   D   H   V   D   R   D   F   G   Q   K   I   R   N   L   I
    Query  GCC GGA GTG CAT AAC GAT CAT GTG GAT AGG GAT TTT GGA CAA AAA ATT CGC AAT CTA ATT
           ||* ||* ||* ||# ||| ||# ||# ||* ||# *|* ||# ||# ||* ||# ||| ||# ||# ||# ||# ||#
Optimized  GCG GGT GTT CAC AAC GAC CAC GTT GAC CGT GAC TTC GGT CAG AAA ATC CGT AAC CTG ATC

           C   D   N   E   V   L   H   Q   M   F   H   W   Y   D   L   A   I   L   A   R
    Query  TGC GAC AAT GAG GTT TTA CAT CAA ATG TTT CAC TGG TAT GAT CTT GCA ATT CTA GCA CGT
           ||| ||| ||# ||# ||| #|# ||# ||# ||| ||# ||| ||| ||# ||# ||* ||# ||# ||# ||# |||
Optimized  TGC GAC AAC GAA GTT CTG CAC CAG ATG TTC CAC TGG TAC GAC CTG GCG ATC CTG GCG CGT
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           R   G   R   L   N   R   G   N   N   R   S   T   W   F   A   S   D   N   L   V
    Query  AGA GGG CGA CTA AAT AGA GGG AAT AAT CGC TCA ACA TGG TTT GCA AGT GAT AAT TTG GTA
           *|* ||* ||* ||# ||# *|* ||* ||# ||# ||# ||* ||* ||| ||# ||# **| ||# ||# #|| ||*
Optimized  CGT GGT CGT CTG AAC CGT GGT AAC AAC CGT TCT ACC TGG TTC GCG TCT GAC AAC CTG GTT

           D   I   L   G   Y   G   D   Y   I   F   W   K   I   P   L   S   L   L   P   V
    Query  GAT ATC CTA GGT TAT GGA GAT TAT ATT TTT TGG AAA ATA CCA TTA TCA CTA CTA CCA GTG
           ||# ||| ||# ||| ||# ||* ||# ||# ||# ||# ||| ||| ||* ||# #|# ||* ||# ||# ||# ||*
Optimized  GAC ATC CTG GGT TAC GGT GAC TAC ATC TTC TGG AAA ATC CCG CTG TCT CTG CTG CCG GTT

           D   T   Q   G   L   P   H   A   A   K   D   W   Y   H   E   S   V   F   K   E
    Query  GAT ACA CAA GGC CTC CCA CAT GCA GCC AAG GAC TGG TAT CAT GAA TCG GTT TTC AAG GAG
           ||# ||* ||# ||# ||* ||# ||# ||# ||* ||# ||| ||| ||# ||# ||| ||* ||| ||| ||# ||#
Optimized  GAC ACC CAG GGT CTG CCG CAC GCG GCG AAA GAC TGG TAC CAC GAA TCT GTT TTC AAA GAA

           A   I   Q   G   H   T   H   I   V   S   V   S   T   A   D   V   L   I   M   C
    Query  GCT ATT CAA GGC CAT ACA CAC ATC GTG TCC GTC TCT ACA GCA GAT GTC TTA ATC ATG TGT
           ||* ||# ||# ||# ||# ||* ||| ||| ||* ||# ||# ||| ||* ||# ||# ||# #|# ||| ||| ||#
Optimized  GCG ATC CAG GGT CAC ACC CAC ATC GTT TCT GTT TCT ACC GCG GAC GTT CTG ATC ATG TGC

           K   D   I   I   T   C   R   F   N   T   L   L   I   A   A   V   A   N   L   E
    Query  AAG GAC ATA ATC ACC TGT CGA TTT AAT ACT TTA CTG ATT GCT GCT GTG GCA AAT CTA GAG
           ||# ||| ||* ||| ||| ||# ||* ||# ||# ||# #|# ||| ||# ||* ||* ||* ||# ||# ||# ||#
Optimized  AAA GAC ATC ATC ACC TGC CGT TTC AAC ACC CTG CTG ATC GCG GCG GTT GCG AAC CTG GAA

           D   S   V   H   S   D   Y   P   L   P   E   T   V   S   D   L   Y   K   A   G
    Query  GAT TCA GTT CAT TCA GAT TAC CCT TTA CCA GAA ACA GTG TCT GAC CTA TAC AAA GCA GGA
           ||# ||* ||| ||# ||* ||# ||| ||* #|# ||# ||| ||* ||* ||| ||| ||# ||| ||| ||# ||*
Optimized  GAC TCT GTT CAC TCT GAC TAC CCG CTG CCG GAA ACC GTT TCT GAC CTG TAC AAA GCG GGT

           D   Y   L   I   S   L   L   G   S   E   G   Y   K   V   I   K   F   L   E   P
    Query  GAT TAT TTA ATC TCA TTG CTA GGA TCA GAA GGT TAC AAA GTC ATA AAA TTC CTT GAG CCG
           ||# ||# #|# ||| ||* #|| ||# ||* ||* ||| ||| ||| ||| ||# ||* ||| ||| ||* ||# |||
Optimized  GAC TAC CTG ATC TCT CTG CTG GGT TCT GAA GGT TAC AAA GTT ATC AAA TTC CTG GAA CCG

           L   C   L   A   K   I   Q   L   C   S   N   Y   T   E   R   K   G   R   F   L
    Query  TTA TGC TTA GCA AAG ATC CAA CTC TGC TCA AAT TAC ACT GAG AGG AAA GGA AGA TTC CTC
           #|# ||| #|# ||# ||# ||| ||# ||* ||| ||* ||# ||| ||# ||# *|* ||| ||* *|* ||| ||*
Optimized  CTG TGC CTG GCG AAA ATC CAG CTG TGC TCT AAC TAC ACC GAA CGT AAA GGT CGT TTC CTG
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          T   Q   M   H   L   A   V   N   H   T   L   E   E   L   T   G   S   R   E   L
   Query  ACT CAA ATG CAT TTA GCT GTA AAT CAT ACA CTT GAG GAA CTT ACA GGG TCC CGA GAA TTA
          ||# ||# ||| ||# #|# ||* ||* ||# ||# ||* ||* ||# ||| ||* ||* ||* ||# ||* ||| #|#
Optimized ACC CAG ATG CAC CTG GCG GTT AAC CAC ACC CTG GAA GAA CTG ACC GGT TCT CGT GAA CTG

          R   P   Q   Q   I   R   K   V   R   E   F   H   Q   M   L   I   N   L   K   A
   Query  AGG CCA CAA CAG ATT CGG AAG GTA AGG GAA TTC CAT CAA ATG CTG ATA AAC CTT AAG GCA
          *|* ||# ||# ||| ||# ||* ||# ||* *|* ||| ||| ||# ||# ||| ||| ||* ||| ||* ||# ||#
Optimized CGT CCG CAG CAG ATC CGT AAA GTT CGT GAA TTC CAC CAG ATG CTG ATC AAC CTG AAA GCG

          T   P   Q   Q   L   C   E   L   F   S   V   Q   K   H   W   G   H   P   V   L
   Query  ACT CCT CAA CAA CTC TGT GAG TTG TTT TCA GTG CAA AAG CAT TGG GGG CAC CCT GTC TTG
          ||# ||* ||# ||# ||* ||# ||# #|| ||# ||* ||* ||# ||# ||# ||| ||* ||| ||* ||# #||
Optimized ACC CCG CAG CAG CTG TGC GAA CTG TTC TCT GTT CAG AAA CAC TGG GGT CAC CCG GTT CTG

          H   S   E   K   A   I   Q   K   V   K   K   H   A   T   V   I   K   A   L   R
   Query  CAT AGC GAA AAG GCT ATC CAA AAA GTA AAG AAG CAT GCA ACA GTG ATA AAA GCA TTG CGC
          ||# **# ||| ||# ||* ||| ||# ||| ||* ||# ||# ||# ||# ||* ||* ||* ||| ||# #|| ||#
Optimized CAC TCT GAA AAA GCG ATC CAG AAA GTT AAA AAA CAC GCG ACC GTT ATC AAA GCG CTG CGT

          P   I   I   I   F   E   T   Y   C   V   F   K   Y   S   I   A   K   H   Y   F
   Query  CCA ATA ATA ATC TTT GAA ACA TAT TGT GTG TTT AAA TAC AGC ATT GCA AAA CAT TAT TTT
          ||# ||* ||* ||| ||# ||| ||* ||# ||# ||* ||# ||| ||| **# ||# ||# ||| ||# ||# ||#
Optimized CCG ATC ATC ATC TTC GAA ACC TAC TGC GTT TTC AAA TAC TCT ATC GCG AAA CAC TAC TTC

          D   S   Q   G   T   W   Y   S   V   T   S   D   R   C   L   T   P   G   L   S
   Query  GAT AGT CAG GGT ACG TGG TAC AGT GTG ACT TCT GAC AGA TGC TTA ACA CCA GGC CTT TCC
          ||# **| ||| ||| ||* ||| ||| **| ||* ||# ||| ||| *|* ||| #|# ||* ||# ||# ||* ||#
Optimized GAC TCT CAG GGT ACC TGG TAC TCT GTT ACC TCT GAC CGT TGC CTG ACC CCG GGT CTG TCT

          S   Y   I   K   R   N   Q   F   P   P   L   P   M   I   K   E   L   L   W   E
   Query  TCT TAC ATC AAA AGA AAC CAA TTT CCT CCA CTA CCT ATG ATC AAA GAA CTT TTG TGG GAA
          ||| ||| ||| ||| *|* ||| ||# ||# ||* ||# ||# ||* ||| ||| ||| ||| ||* #|| ||| |||
Optimized TCT TAC ATC AAA CGT AAC CAG TTC CCG CCG CTG CCG ATG ATC AAA GAA CTG CTG TGG GAA

          F   Y   H   L   D   H   P   P   L   F   S   T   K   V   I   S   D   L   S   I
   Query  TTT TAT CAC TTA GAT CAT CCT CCG TTA TTC TCC ACC AAA GTG ATT AGT GAT TTG AGT ATC
          ||# ||# ||| #|# ||# ||# ||* ||| #|# ||| ||# ||| ||| ||* ||# **| ||# #|| **| |||
Optimized TTC TAC CAC CTG GAC CAC CCG CCG CTG TTC TCT ACC AAA GTT ATC TCT GAC CTG TCT ATC
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          F   I   K   D   R   A   T   A   V   E   K   T   C   W   D   A   V   F   E   P
   Query  TTT ATT AAA GAT CGT GCT ACT GCA GTC GAG AAA ACA TGC TGG GAC GCA GTT TTT GAA CCC
          ||# ||# ||| ||# ||| ||* ||# ||# ||# ||# ||| ||* ||| ||| ||| ||# ||| ||# ||| ||*
Optimized TTC ATC AAA GAC CGT GCG ACC GCG GTT GAA AAA ACC TGC TGG GAC GCG GTT TTC GAA CCG

          N   V   L   G   Y   N   P   P   N   K   F   A   T   K   R   V   P   E   Q   F
   Query  AAT GTT CTT GGT TAT AAC CCA CCG AAT AAA TTT GCT ACA AAA AGG GTA CCT GAG CAA TTC
          ||# ||| ||* ||| ||# ||| ||# ||| ||# ||| ||# ||* ||* ||| *|* ||* ||* ||# ||# |||
Optimized AAC GTT CTG GGT TAC AAC CCG CCG AAC AAA TTC GCG ACC AAA CGT GTT CCG GAA CAG TTC

          L   E   Q   E   N   F   S   I   E   S   V   L   H   Y   A   Q   R   L   E   Y
   Query  CTT GAA CAG GAG AAT TTC TCA ATA GAG AGT GTC CTA CAT TAT GCT CAA CGT CTG GAA TAT
          ||* ||| ||| ||# ||# ||| ||* ||* ||# **| ||# ||# ||# ||# ||* ||# ||| ||| ||| ||#
Optimized CTG GAA CAG GAA AAC TTC TCT ATC GAA TCT GTT CTG CAC TAC GCG CAG CGT CTG GAA TAC

          L   L   P   E   Y   R   N   F   S   F   S   L   K   E   K   E   L   N   I   G
   Query  CTT CTC CCG GAG TAC CGG AAC TTC TCT TTT TCA CTC AAG GAG AAG GAG TTA AAC ATT GGA
          ||* ||* ||| ||# ||| ||* ||| ||| ||| ||# ||* ||* ||# ||# ||# ||# #|# ||| ||# ||*
Optimized CTG CTG CCG GAA TAC CGT AAC TTC TCT TTC TCT CTG AAA GAA AAA GAA CTG AAC ATC GGT

          R   A   F   G   K   L   P   Y   P   T   R   N   V   Q   T   L   C   E   A   L
   Query  CGA GCT TTT GGG AAA TTG CCA TAT CCA ACA CGC AAT GTT CAA ACT CTG TGC GAA GCT TTG
          ||* ||* ||# ||* ||| #|| ||# ||# ||# ||* ||# ||# ||| ||# ||# ||| ||| ||| ||* #||
Optimized CGT GCG TTC GGT AAA CTG CCG TAC CCG ACC CGT AAC GTT CAG ACC CTG TGC GAA GCG CTG

          L   A   D   G   L   A   K   A   F   P   S   N   M   M   V   V   T   E   R   E
   Query  TTA GCA GAT GGT TTG GCG AAA GCA TTC CCA AGC AAT ATG ATG GTT GTG ACA GAG CGC GAG
          #|# ||# ||# ||| #|| ||| ||| ||# ||| ||# **# ||# ||| ||| ||| ||* ||* ||# ||# ||#
Optimized CTG GCG GAC GGT CTG GCG AAA GCG TTC CCG TCT AAC ATG ATG GTT GTT ACC GAA CGT GAA

          Q   K   E   S   L   L   H   Q   A   S   W   H   H   T   S   D   D   F   G   E
   Query  CAA AAA GAA AGC CTT TTG CAT CAA GCG TCT TGG CAT CAC ACA AGT GAT GAT TTT GGT GAG
          ||# ||| ||| **# ||* #|| ||# ||# ||| ||| ||| ||# ||| ||* **| ||# ||# ||# ||| ||#
Optimized CAG AAA GAA TCT CTG CTG CAC CAG GCG TCT TGG CAC CAC ACC TCT GAC GAC TTC GGT GAA

          N   A   T   V   R   G   S   S   F   V   T   D   L   E   K   Y   N   L   A   F
   Query  AAT GCT ACT GTT AGA GGC AGT AGT TTT GTA ACA GAC TTG GAA AAA TAC AAT TTA GCA TTC
          ||# ||* ||# ||| *|* ||# **| **| ||# ||* ||* ||| #|| ||| ||| ||| ||# #|# ||# |||
Optimized AAC GCG ACC GTT CGT GGT TCT TCT TTC GTT ACC GAC CTG GAA AAA TAC AAC CTG GCG TTC
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           R   Y   E   F   T   A   P   F   I   E   Y   C   N   R   C   Y   G   V   R   N
    Query  CGA TAT GAG TTT ACA GCT CCT TTT ATT GAA TAC TGT AAT CGT TGT TAC GGT GTA AGA AAT
           ||* ||# ||# ||# ||* ||* ||* ||# ||# ||| ||| ||# ||# ||| ||# ||| ||| ||* *|* ||#
Optimized  CGT TAC GAA TTC ACC GCG CCG TTC ATC GAA TAC TGC AAC CGT TGC TAC GGT GTT CGT AAC

           L   F   N   W   M   H   Y   T   I   P   Q   C   Y   I   H   V   S   D   Y   Y
    Query  TTG TTT AAT TGG ATG CAC TAC ACT ATA CCA CAG TGT TAT ATA CAT GTG AGT GAT TAT TAT
           #|| ||# ||# ||| ||| ||| ||| ||# ||* ||# ||| ||# ||# ||* ||# ||* **| ||# ||# ||#
Optimized  CTG TTC AAC TGG ATG CAC TAC ACC ATC CCG CAG TGC TAC ATC CAC GTT TCT GAC TAC TAC

           N   P   P   H   G   V   S   L   E   N   R   E   N   P   P   E   G   P   S   S
    Query  AAC CCC CCA CAT GGA GTC TCT CTC GAA AAC CGA GAA AAT CCA CCA GAA GGT CCA AGC TCT
           ||| ||* ||# ||# ||* ||# ||| ||* ||| ||| ||* ||| ||# ||# ||# ||| ||| ||# **# |||
Optimized  AAC CCG CCG CAC GGT GTT TCT CTG GAA AAC CGT GAA AAC CCG CCG GAA GGT CCG TCT TCT

           Y   R   G   H   L   G   G   I   E   G   L   Q   Q   K   L   W   T   S   I   S
    Query  TAC CGT GGT CAT CTA GGC GGG ATT GAG GGA CTT CAA CAA AAA CTC TGG ACA AGC ATC TCA
           ||| ||| ||| ||# ||# ||# ||* ||# ||# ||* ||* ||# ||# ||| ||* ||| ||* **# ||| ||*
Optimized  TAC CGT GGT CAC CTG GGT GGT ATC GAA GGT CTG CAG CAG AAA CTG TGG ACC TCT ATC TCT

           C   A   Q   I   S   L   V   E   I   K   T   G   F   K   L   R   S   A   V   M
    Query  TGT GCA CAG ATT TCA TTA GTT GAA ATC AAA ACC GGT TTT AAA CTG CGA TCT GCG GTA ATG
           ||# ||# ||| ||# ||* #|# ||| ||| ||| ||| ||| ||| ||# ||| ||| ||* ||| ||| ||* |||
Optimized  TGC GCG CAG ATC TCT CTG GTT GAA ATC AAA ACC GGT TTC AAA CTG CGT TCT GCG GTT ATG

           G   D   N   Q   C   I   T   V   L   S   V   F   P   L   E   T   E   S   S   E
    Query  GGT GAC AAT CAA TGT ATA ACT GTA CTC TCT GTA TTT CCC CTC GAA ACT GAG TCT AGT GAG
           ||| ||| ||# ||# ||# ||* ||# ||* ||* ||| ||* ||# ||* ||* ||| ||# ||# ||| **| ||#
Optimized  GGT GAC AAC CAG TGC ATC ACC GTT CTG TCT GTT TTC CCG CTG GAA ACC GAA TCT TCT GAA

           Q   E   L   S   S   E   D   N   A   A   R   V   A   A   S   L   A   K   V   T
    Query  CAA GAA TTA AGT TCT GAA GAT AAT GCC GCT AGA GTA GCT GCT AGC TTA GCA AAA GTC ACA
           ||# ||| #|# **| ||| ||| ||# ||# ||* ||* *|* ||* ||* ||* **# #|# ||# ||| ||# ||*
Optimized  CAG GAA CTG TCT TCT GAA GAC AAC GCG GCG CGT GTT GCG GCG TCT CTG GCG AAA GTT ACC

           S   A   C   G   I   F   L   K   P   D   E   T   F   V   H   S   G   F   I   Y
    Query  AGT GCC TGC GGC ATC TTT TTA AAA CCT GAT GAA ACT TTT GTT CAC TCA GGT TTC ATT TAT
           **| ||* ||| ||# ||| ||# #|# ||| ||* ||# ||| ||# ||# ||| ||| ||* ||| ||| ||# ||#
Optimized  TCT GCG TGC GGT ATC TTC CTG AAA CCG GAC GAA ACC TTC GTT CAC TCT GGT TTC ATC TAC
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          F   G   K   K   Q   Y   L   N   G   V   Q   L   P   Q   S   L   K   T   A   T
   Query  TTT GGC AAA AAA CAA TAT TTG AAT GGA GTA CAA TTA CCT CAA TCA CTG AAA ACT GCT ACT
          ||# ||# ||| ||| ||# ||# #|| ||# ||* ||* ||# #|# ||* ||# ||* ||| ||| ||# ||* ||#
Optimized TTC GGT AAA AAA CAG TAC CTG AAC GGT GTT CAG CTG CCG CAG TCT CTG AAA ACC GCG ACC

          R   I   A   P   L   S   D   A   I   F   D   D   L   Q   G   T   L   A   S   I
   Query  AGA ATT GCA CCC TTG TCA GAT GCT ATC TTT GAT GAT CTT CAA GGG ACA CTA GCT AGC ATA
          *|* ||# ||# ||* #|| ||* ||# ||* ||| ||# ||# ||# ||* ||# ||* ||* ||# ||* **# ||*
Optimized CGT ATC GCG CCG CTG TCT GAC GCG ATC TTC GAC GAC CTG CAG GGT ACC CTG GCG TCT ATC

          G   T   A   F   E   R   S   I   S   E   T   R   H   V   V   P   C   R   V   A
   Query  GGC ACG GCT TTT GAA AGA TCT ATC TCC GAA ACT AGG CAC GTA GTC CCT TGT AGA GTA GCA
          ||# ||* ||* ||# ||| *|* ||| ||| ||# ||| ||# *|* ||| ||* ||# ||* ||# *|* ||* ||#
Optimized GGT ACC GCG TTC GAA CGT TCT ATC TCT GAA ACC CGT CAC GTT GTT CCG TGC CGT GTT GCG

          A   A   F   H   T   F   F   S   V   R   I   L   Q   Y   H   H   L   G   F   N
   Query  GCT GCA TTC CAT ACC TTT TTT TCC GTA AGA ATC TTA CAA TAT CAT CAT CTT GGC TTC AAC
          ||* ||# ||| ||# ||| ||# ||# ||# ||* *|* ||| #|# ||# ||# ||# ||# ||* ||# ||| |||
Optimized GCG GCG TTC CAC ACC TTC TTC TCT GTT CGT ATC CTG CAG TAC CAC CAC CTG GGT TTC AAC

          K   G   T   D   L   G   Q   L   S   L   S   K   P   L   D   F   G   T   I   T
   Query  AAG GGA ACA GAC CTG GGT CAA TTG TCA TTA AGC AAG CCA TTA GAT TTT GGA ACT ATA ACT
          ||# ||* ||* ||| ||| ||| ||# #|| ||* #|# **# ||# ||# #|# ||# ||# ||* ||# ||* ||#
Optimized AAA GGT ACC GAC CTG GGT CAG CTG TCT CTG TCT AAA CCG CTG GAC TTC GGT ACC ATC ACC

          L   A   L   A   V   P   Q   V   L   G   G   L   S   F   L   N   P   E   K   C
   Query  TTG GCC TTG GCA GTA CCA CAA GTC TTG GGT GGC TTA TCA TTC CTA AAT CCA GAA AAA TGT
          #|| ||* #|| ||# ||* ||# ||# ||# #|| ||| ||# #|# ||* ||| ||# ||# ||# ||| ||| ||#
Optimized CTG GCG CTG GCG GTT CCG CAG GTT CTG GGT GGT CTG TCT TTC CTG AAC CCG GAA AAA TGC

          F   Y   R   N   L   G   D   P   V   T   S   G   L   F   Q   L   K   T   Y   L
   Query  TTT TAT AGA AAT CTG GGT GAT CCT GTT ACT TCA GGG CTG TTT CAG CTC AAG ACA TAT CTT
          ||# ||# *|* ||# ||| ||| ||# ||* ||| ||# ||* ||* ||| ||# ||| ||* ||# ||* ||# ||*
Optimized TTC TAC CGT AAC CTG GGT GAC CCG GTT ACC TCT GGT CTG TTC CAG CTG AAA ACC TAC CTG

          Q   M   I   H   M   D   D   L   F   L   P   L   I   A   K   N   P   G   N   C
   Query  CAA ATG ATC CAC ATG GAT GAT TTG TTT TTA CCT TTG ATC GCA AAG AAC CCA GGG AAC TGT
          ||# ||| ||| ||| ||| ||# ||# #|| ||# #|# ||* #|| ||| ||# ||# ||| ||# ||* ||| ||#
Optimized CAG ATG ATC CAC ATG GAC GAC CTG TTC CTG CCG CTG ATC GCG AAA AAC CCG GGT AAC TGC
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```
          S   A   I   D   F   V   L   N   P   S   G   L   N   V   P   G   S   Q   D   L
   Query  AGC GCA ATT GAC TTT GTG TTA AAC CCT AGT GGG TTA AAC GTA CCG GGG TCA CAG GAT TTG
          **# ||# ||# ||| ||# ||* #|# ||| ||* **| ||* #|# ||| ||* ||| ||* ||* ||| ||# #||
Optimized TCT GCG ATC GAC TTC GTT CTG AAC CCG TCT GGT CTG AAC GTT CCG GGT TCT CAG GAC CTG

          T   S   F   L   R   Q   I   V   R   R   T   I   T   L   S   A   K   N   K   L
   Query  ACA TCC TTC CTA CGT CAG ATA GTG CGC CGA ACA ATT ACT CTA AGT GCT AAA AAT AAA TTA
          ||* ||# ||| ||# ||| ||| ||* ||* ||# ||* ||* ||# ||# ||# **| ||* ||| ||# ||| #|#
Optimized ACC TCT TTC CTG CGT CAG ATC GTT CGT CGT ACC ATC ACC CTG TCT GCG AAA AAC AAA CTG

          I   N   T   L   F   H   S   S   A   D   L   E   D   E   M   V   C   K   W   L
   Query  ATA AAC ACT TTG TTC CAT TCT TCT GCT GAT TTA GAA GAT GAA ATG GTT TGC AAA TGG TTG
          ||* ||| ||# #|| ||| ||# ||| ||| ||* ||# #|# ||| ||# ||| ||| ||| ||| ||| ||| #||
Optimized ATC AAC ACC CTG TTC CAC TCT TCT GCG GAC CTG GAA GAC GAA ATG GTT TGC AAA TGG CTG

          L   S   S   T   P   V   M   S   R   F   A   A   D   I   F   S   R   T   P   S
   Query  CTT TCT TCT ACA CCA GTC ATG AGT AGG TTT GCC GCC GAT ATA TTT TCT CGC ACT CCC AGT
          ||* ||| ||| ||* ||# ||# ||| **| *|* ||# ||* ||* ||# ||* ||# ||| ||# ||# ||* **|
Optimized CTG TCT TCT ACC CCG GTT ATG TCT CGT TTC GCG GCG GAC ATC TTC TCT CGT ACC CCG TCT

          G   K   R   L   Q   I   L   G   Y   L   E   G   T   R   T   L   L   A   S   K
   Query  GGG AAA CGT TTA CAG ATC TTA GGT TAC CTT GAA GGG ACT AGA ACA TTG TTA GCC TCT AAA
          ||* ||| ||| #|# ||| ||| #|# ||| ||| ||* ||| ||* ||# *|* ||* #|| #|# ||* ||| |||
Optimized GGT AAA CGT CTG CAG ATC CTG GGT TAC CTG GAA GGT ACC CGT ACC CTG CTG GCG TCT AAA

          I   I   N   H   N   T   E   T   P   I   L   D   R   L   R   K   I   T   L   Q
   Query  ATT ATA AAT CAT AAT ACT GAG ACA CCT ATC CTA GAT CGA TTG AGG AAA ATT ACG CTG CAA
          ||# ||* ||# ||# ||# ||# ||# ||* ||* ||| ||# ||# ||* #|| *|* ||| ||# ||* ||| ||#
Optimized ATC ATC AAC CAC AAC ACC GAA ACC CCG ATC CTG GAC CGT CTG CGT AAA ATC ACC CTG CAG

          R   W   S   L   W   F   S   Y   L   D   H   C   D   Q   V   L   A   D   A   L
   Query  AGG TGG AGC CTG TGG TTT AGT TAT CTC GAC CAC TGT GAT CAA GTT CTG GCT GAT GCC CTA
          *|* ||| **# ||| ||| ||# **| ||# ||* ||| ||| ||# ||# ||# ||| ||| ||* ||# ||* ||#
Optimized CGT TGG TCT CTG TGG TTC TCT TAC CTG GAC CAC TGC GAC CAG GTT CTG GCG GAC GCG CTG

          T   Q   I   T   C   T   V   D   L   A   Q   I   L   R   E   Y   T   W   A   H
   Query  ACT CAG ATA ACC TGC ACT GTG GAC TTA GCA CAG ATT CTT CGC GAG TAC ACC TGG GCA CAC
          ||# ||| ||* ||| ||| ||# ||* ||| #|# ||# ||| ||# ||* ||# ||# ||| ||| ||| ||# |||
Optimized ACC CAG ATC ACC TGC ACC GTT GAC CTG GCG CAG ATC CTG CGT GAA TAC ACC TGG GCG CAC
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           I   L   E   G   R   Q   L   I   G   A   T   L   P   C   I   L   E   Q   L   N
    Query  ATA CTA GAG GGA AGG CAG CTC ATT GGA GCA ACA CTT CCT TGT ATA CTA GAA CAA CTA AAT
           ||* ||# ||# ||* *|* ||| ||* ||# ||* ||# ||* ||* ||* ||# ||* ||# ||| ||# ||# ||#
Optimized  ATC CTG GAA GGT CGT CAG CTG ATC GGT GCG ACC CTG CCG TGC ATC CTG GAA CAG CTG AAC

           V   I   W   L   K   P   Y   E   H   C   P   K   C   A   K   S   A   N   P   K
    Query  GTC ATC TGG CTC AAA CCA TAT GAG CAT TGC CCT AAA TGT GCA AAG TCA GCA AAC CCT AAA
           ||# ||| ||| ||* ||| ||# ||# ||# ||# ||| ||* ||| ||# ||# ||# ||* ||# ||| ||* |||
Optimized  GTT ATC TGG CTG AAA CCG TAC GAA CAC TGC CCG AAA TGC GCG AAA TCT GCG AAC CCG AAA

           G   E   P   F   V   S   I   A   I   K   K   H   V   V   S   A   W   P   D   Q
    Query  GGG GAA CCT TTT GTT TCT ATT GCA ATT AAA AAA CAT GTA GTA AGT GCT TGG CCT GAT CAA
           ||* ||| ||* ||# ||| ||| ||# ||# ||# ||| ||| ||# ||* ||* **| ||* ||| ||* ||# ||#
Optimized  GGT GAA CCG TTC GTT TCT ATC GCG ATC AAA AAA CAC GTT GTT TCT GCG TGG CCG GAC CAG

           S   R   L   S   W   T   I   G   D   G   I   P   Y   I   G   S   R   T   E   D
    Query  TCA CGA CTT AGT TGG ACA ATT GGA GAT GGC ATC CCT TAT ATC GGA TCT CGA ACA GAG GAT
           ||* ||* ||* **| ||| ||* ||# ||* ||# ||# ||| ||* ||# ||| ||* ||| ||* ||* ||# ||#
Optimized  TCT CGT CTG TCT TGG ACC ATC GGT GAC GGT ATC CCG TAC ATC GGT TCT CGT ACC GAA GAC

           K   I   G   Q   P   A   I   K   P   K   C   P   S   A   A   L   R   E   A   I
    Query  AAG ATT GGG CAG CCA GCC ATC AAA CCA AAA TGC CCT TCA GCA GCC TTA CGT GAA GCA ATT
           ||# ||# ||* ||| ||# ||* ||| ||| ||# ||| ||| ||* ||* ||# ||* #|# ||| ||| ||# ||#
Optimized  AAA ATC GGT CAG CCG GCG ATC AAA CCG AAA TGC CCG TCT GCG GCG CTG CGT GAA GCG ATC

           E   L   T   S   R   L   T   W   V   T   Q   G   G   A   N   S   D   L   L   V
    Query  GAG TTG ACA TCA AGA TTG ACT TGG GTT ACT CAA GGT GGA GCA AAC AGC GAC TTA CTA GTT
           ||# #|| ||* ||* *|* #|| ||# ||| ||| ||# ||# ||| ||* ||# ||| **# ||| #|# ||# |||
Optimized  GAA CTG ACC TCT CGT CTG ACC TGG GTT ACC CAG GGT GGT GCG AAC TCT GAC CTG CTG GTT

           K   P   F   I   E   A   R   V   N   L   S   V   Q   E   I   L   Q   M   T   P
    Query  AAA CCC TTC ATA GAA GCA CGA GTA AAT TTA AGC GTA CAG GAA ATT CTC CAA ATG ACA CCT
           ||| ||* ||| ||* ||| ||# ||* ||* ||# #|# **# ||* ||| ||| ||# ||* ||# ||| ||* ||*
Optimized  AAA CCG TTC ATC GAA GCG CGT GTT AAC CTG TCT GTT CAG GAA ATC CTG CAG ATG ACC CCG

           S   H   Y   S   G   N   I   V   H   R   Y   N   D   Q   Y   S   P   H   S   F
    Query  TCT CAT TAC TCC GGC AAC ATT GTG CAT CGA TAT AAT GAT CAA TAT AGT CCA CAC TCA TTT
           ||| ||# ||| ||# ||# ||| ||# ||* ||# ||* ||# ||# ||# ||# ||# **| ||# ||| ||* ||#
Optimized  TCT CAC TAC TCT GGT AAC ATC GTT CAC CGT TAC AAC GAC CAG TAC TCT CCG CAC TCT TTC
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          M   A   N   R   M   S   N   S   A   T   R   L   V   V   S   T   N   T   L   G
   Query  ATG GCA AAT AGG ATG AGT AAT TCT GCT ACT AGG TTA GTT GTT TCG ACA AAC ACT CTT GGA
          |||  ||#  ||#  *|*  |||  **|  ||#  |||  ||*  ||#  *|*  #|#  |||  |||  ||*  ||*  |||  ||#  ||*  ||*
Optimized ATG GCG AAC CGT ATG TCT AAC TCT GCG ACC CGT CTG GTT GTT TCT ACC AAC ACC CTG GGT

          E   F   S   G   G   G   Q   S   A   R   D   S   N   I   I   F   Q   N   V   I
   Query  GAA TTT TCA GGA GGA GGT CAG TCA GCA AGA GAT AGT AAT ATT ATC TTC CAG AAT GTC ATT
          |||  ||#  ||*  ||*  ||*  |||  |||  ||*  ||#  *|*  ||#  **|  ||#  ||#  |||  |||  |||  ||#  ||#  ||#
Optimized GAA TTC TCT GGT GGT GGT CAG TCT GCG CGT GAC TCT AAC ATC ATC TTC CAG AAC GTT ATC

          N   F   A   V   A   L   F   D   L   R   F   R   N   V   A   T   S   S   I   Q
   Query  AAT TTT GCT GTT GCA CTT TTT GAT CTA CGA TTT AGG AAC GTG GCT ACT TCT TCT ATA CAA
          ||#  ||#  ||*  |||  ||#  ||*  ||#  ||#  ||#  ||*  ||#  *|*  |||  ||*  ||*  ||#  |||  |||  ||*  ||#
Optimized AAC TTC GCG GTT GCG CTG TTC GAC CTG CGT TTC CGT AAC GTT GCG ACC TCT TCT ATC CAG

          H   H   R   A   H   L   H   L   S   K   C   C   T   R   E   V   P   A   Q   Y
   Query  CAT CAT CGG GCT CAT CTT CAT TTG TCA AAG TGT TGC ACG CGA GAG GTT CCA GCC CAA TAT
          ||#  ||#  ||*  ||*  ||#  ||*  ||#  #||  ||*  ||#  ||#  |||  ||*  ||*  ||#  |||  ||#  ||*  ||#  ||#
Optimized CAC CAC CGT GCG CAC CTG CAC CTG TCT AAA TGC TGC ACC CGT GAA GTT CCG GCG CAG TAC

          L   V   Y   T   S   T   L   P   L   D   L   T   R   Y   R   D   N   E   L   I
   Query  TTA GTT TAT ACA TCA ACA TTG CCA TTG GAC CTT ACA CGG TAT CGG GAT AAT GAG TTG ATT
          #|#  |||  ||#  ||*  ||*  ||*  #||  ||#  #||  |||  ||*  ||*  ||*  ||#  ||*  ||#  ||#  ||#  #||  ||#
Optimized CTG GTT TAC ACC TCT ACC CTG CCG CTG GAC CTG ACC CGT TAC CGT GAC AAC GAA CTG ATC

          Y   D   D   N   P   L   R   G   G   L   N   C   N   L   S   F   D   N   P   L
   Query  TAC GAT GAC AAT CCA TTA AGA GGT GGT TTA AAT TGC AAT CTT TCT TTT GAT AAT CCG CTT
          |||  ||#  |||  ||#  ||#  #|#  *|*  |||  |||  #|#  ||#  |||  ||#  ||*  |||  ||#  ||#  ||#  |||  ||*
Optimized TAC GAC GAC AAC CCG CTG CGT GGT GGT CTG AAC TGC AAC CTG TCT TTC GAC AAC CCG CTG

          F   K   G   Q   R   L   N   I   I   E   E   D   L   I   R   L   P   Y   L   S
   Query  TTC AAG GGC CAG AGA CTT AAC ATA ATT GAA GAA GAC TTG ATT AGA CTA CCT TAC TTA TCA
          |||  ||#  ||#  |||  *|*  ||*  |||  ||*  ||#  |||  |||  |||  #||  ||#  *|*  ||#  ||*  |||  #|#  ||*
Optimized TTC AAA GGT CAG CGT CTG AAC ATC ATC GAA GAA GAC CTG ATC CGT CTG CCG TAC CTG TCT

          G   W   E   L   A   K   T   V   I   Q   S   I   I   S   D   S   N   N   S   S
   Query  GGA TGG GAG CTA GCT AAA ACT GTT ATC CAA TCT ATA ATT TCT GAC AGC AAC AAT TCA TCA
          ||*  |||  ||#  ||#  ||*  |||  ||#  |||  |||  ||#  |||  ||*  ||#  |||  |||  **#  |||  ||#  ||*  ||*
Optimized GGT TGG GAA CTG GCG AAA ACC GTT ATC CAG TCT ATC ATC TCT GAC TCT AAC AAC TCT TCT
```

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          T   D   P   I   S   S   G   E   T   R   S   F   T   T   H   F   L   T   Y   P
   Query  ACG GAT CCA ATC AGT AGT GGG GAA ACA CGA TCA TTC ACC ACT CAC TTC TTG ACA TAT CCT
          ||* ||# ||# ||| **| **| ||* ||| ||* ||* ||* ||| ||| ||# ||| ||| #|| ||* ||# ||*
Optimized ACC GAC CCG ATC TCT TCT GGT GAA ACC CGT TCT TTC ACC ACC CAC TTC CTG ACC TAC CCG

          K   I   G   L   L   Y   S   F   G   A   L   I   S   Y   Y   L   G   N   T   I
   Query  AAG ATT GGA CTA CTA TAT AGT TTT GGT GCA CTC ATC AGT TAT TAT CTA GGC AAC ACC ATT
          ||# ||# ||* ||# ||# ||# **| ||# ||| ||# ||* ||| **| ||# ||# ||# ||# ||| ||| ||#
Optimized AAA ATC GGT CTG CTG TAC TCT TTC GGT GCG CTG ATC TCT TAC TAC CTG GGT AAC ACC ATC

          I   R   T   K   K   L   T   L   N   N   F   I   Y   Y   L   A   T   Q   I   H
   Query  ATT AGA ACC AAA AAA TTG ACT CTT AAC AAC TTC ATA TAT TAC CTA GCT ACT CAA ATA CAT
          ||# *|* ||| ||| ||| #|| ||# ||* ||| ||| ||| ||* ||# ||| ||# ||* ||# ||# ||* ||#
Optimized ATC CGT ACC AAA AAA CTG ACC CTG AAC AAC TTC ATC TAC TAC CTG GCG ACC CAG ATC CAC

          N   L   P   H   R   S   L   R   I   L   K   P   T   L   K   H   A   S   V   I
   Query  AAT TTA CCT CAT CGC TCG TTG AGA ATC CTT AAA CCT ACT TTG AAA CAC GCT AGT GTT ATC
          ||# #|# ||* ||# ||# ||* #|| *|* ||| ||* ||| ||* ||# #|| ||| ||| ||* **| ||| |||
Optimized AAC CTG CCG CAC CGT TCT CTG CGT ATC CTG AAA CCG ACC CTG AAA CAC GCG TCT GTT ATC

          S   R   L   I   S   I   D   S   H   F   S   I   Y   I   G   G   T   A   G   D
   Query  TCG AGA TTA ATA AGT ATT GAC TCT CAC TTC TCA ATT TAT ATT GGA GGA ACT GCT GGT GAT
          ||* *|* #|# ||* **| ||# ||| ||| ||| ||| ||* ||# ||# ||# ||* ||* ||# ||* ||| ||#
Optimized TCT CGT CTG ATC TCT ATC GAC TCT CAC TTC TCT ATC TAC ATC GGT GGT ACC GCG GGT GAC

          R   G   L   S   D   A   A   R   L   F   L   R   T   A   I   T   V   F   L   Q
   Query  CGA GGA CTT TCC GAT GCG GCA AGA TTG TTT CTT AGA ACT GCC ATT ACT GTC TTC CTT CAA
          ||* ||* ||* ||# ||# ||| ||# *|* #|| ||# ||* *|* ||# ||* ||# ||# ||# ||| ||* ||#
Optimized CGT GGT CTG TCT GAC GCG GCG CGT CTG TTC CTG CGT ACC GCG ATC ACC GTT TTC CTG CAG

          F   V   R   K   W   I   V   E   R   K   T   A   I   P   L   W   V   I   Y   P
   Query  TTC GTT AGA AAG TGG ATA GTT GAA CGC AAG ACA GCT ATT CCA CTG TGG GTC ATC TAC CCT
          ||| ||| *|* ||# ||| ||* ||| ||| ||# ||# ||* ||* ||# ||# ||| ||| ||# ||| ||| ||*
Optimized TTC GTT CGT AAA TGG ATC GTT GAA CGT AAA ACC GCG ATC CCG CTG TGG GTT ATC TAC CCG

          L   E   G   Q   S   P   S   P   I   N   S   F   L   H   H   V   I   A   L   L
   Query  CTA GAA GGT CAA AGT CCT AGT CCG ATC AAC AGT TTT CTA CAC CAC GTC ATC GCA TTG TTG
          ||# ||| ||| ||# **| ||* **| ||| ||| ||| **| ||# ||# ||| ||| ||# ||| ||# #|| #||
Optimized CTG GAA GGT CAG TCT CCG TCT CCG ATC AAC TCT TTC CTG CAC CAC GTT ATC GCG CTG CTG
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          Q   H   E   S   S   H   D   H   V   C   A   A   E   A   H   S   R   V   E   T
   Query  CAA CAT GAG TCC TCC CAC GAT CAT GTT TGT GCT GCA GAA GCC CAC AGT CGA GTG GAG ACA
          ||# ||# ||# ||# ||# ||| ||# ||# ||| ||# ||* ||# ||| ||* ||| **| ||* ||* ||# ||*
Optimized CAG CAC GAA TCT TCT CAC GAC CAC GTT TGC GCG GCG GAA GCG CAC TCT CGT GTT GAA ACC

          F   D   N   L   V   Y   M   C   K   S   T   A   S   N   F   F   H   A   S   L
   Query  TTT GAT AAT TTA GTT TAT ATG TGT AAA AGC ACA GCA AGT AAC TTC TTT CAT GCT TCA TTA
          ||# ||# ||# #|# ||| ||# ||| ||# ||| **# ||* ||# **| ||| ||| ||# ||# ||* ||* #|#
Optimized TTC GAC AAC CTG GTT TAC ATG TGC AAA TCT ACC GCG TCT AAC TTC TTC CAC GCG TCT CTG

          A   Y   W   R   S   R   S   K   N   Q   D   K   R   E   M   T   K   I   L   S
   Query  GCA TAC TGG AGA AGT CGA TCT AAA AAT CAA GAC AAA AGA GAG ATG ACA AAG ATA TTA TCT
          ||# ||| ||| *|* **| ||* ||| ||| ||# ||# ||| ||| *|* ||# ||| ||* ||# ||* #|# |||
Optimized GCG TAC TGG CGT TCT CGT TCT AAA AAC CAG GAC AAA CGT GAA ATG ACC AAA ATC CTG TCT

          L   T   Q   T   E   K   K   N   S   F   G   Y   T   A   H   P   E   S   T   A
   Query  TTG ACG CAA ACG GAA AAG AAA AAT TCA TTC GGC TAT ACA GCA CAT CCA GAA AGC ACT GCT
          #|| ||* ||# ||* ||| ||# ||| ||# ||* ||| ||# ||# ||* ||# ||# ||# ||| **# ||# ||*
Optimized CTG ACC CAG ACC GAA AAA AAA AAC TCT TTC GGT TAC ACC GCG CAC CCG GAA TCT ACC GCG

          V   L   G   S   L   Q   T   S   L   A   P   P   P   S   A   D   E   A   T   Y
   Query  GTT CTT GGT TCC CTC CAG ACC AGC CTT GCT CCA CCT CCA TCT GCT GAC GAG GCT ACA TAT
          ||| ||* ||| ||# ||* ||| ||| **# ||* ||* ||# ||* ||# ||| ||* ||| ||# ||* ||* ||#
Optimized GTT CTG GGT TCT CTG CAG ACC TCT CTG GCG CCG CCG CCG TCT GCG GAC GAA GCG ACC TAC

          D   R   K   N   K   V   L   K   A   S   R   P   G   K   Y   S   Q   N   T   T
   Query  GAT AGG AAA AAC AAA GTT TTG AAA GCT TCC AGA CCT GGC AAG TAT TCC CAG AAT ACA ACC
          ||# *|* ||| ||| ||| ||| #|| ||| ||* ||# *|* ||* ||# ||# ||# ||# ||| ||# ||* |||
Optimized GAC CGT AAA AAC AAA GTT CTG AAA GCG TCT CGT CCG GGT AAA TAC TCT CAG AAC ACC ACC

          K   A   P   P   N   Q   T   S   C   R   D   V   S   P   N   I   T   G   T   D
   Query  AAA GCC CCA CCC AAC CAA ACC AGT TGT CGC GAT GTA TCT CCC AAT ATC ACA GGC ACA GAT
          ||| ||* ||# ||* ||| ||# ||| **| ||# ||# ||# ||* ||| ||* ||# ||| ||* ||# ||* ||#
Optimized AAA GCG CCG CCG AAC CAG ACC TCT TGC CGT GAC GTT TCT CCG AAC ATC ACC GGT ACC GAC

          G   C   P   S   A   N   E   G   S   N   S   N   N   N   N   L   V   S   H   R
   Query  GGG TGC CCT TCT GCC AAT GAG GGT TCT AAC AGC AAT AAC AAT AAT TTA GTC TCG CAC AGA
          ||* ||| ||* ||| ||* ||# ||# ||| ||| ||| **# ||# ||| ||# ||# #|# ||# ||* ||| *|*
Optimized GGT TGC CCG TCT GCG AAC GAA GGT TCT AAC TCT AAC AAC AAC AAC CTG GTT TCT CAC CGT
```

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          I   V   L   P   F   F   T   L   S   H   N   Y   N   E   R   P   S   I   R   K
   Query  ATT GTA CTG CCG TTT TTT ACA TTG TCT CAT AAT TAT AAC GAA AGA CCC TCT ATC AGA AAG
          ||# ||* ||| ||| ||# ||# ||* #|| ||| ||# ||# ||# ||| ||| *|* ||* ||| ||| *|* ||#
Optimized ATC GTT CTG CCG TTC TTC ACC CTG TCT CAC AAC TAC AAC GAA CGT CCG TCT ATC CGT AAA

          S   E   G   T   T   E   I   V   R   L   T   R   Q   L   R   A   I   P   D   T
   Query  TCT GAG GGG ACA ACA GAG ATT GTA AGG CTT ACT CGG CAG CTG AGG GCA ATA CCA GAC ACC
          ||| ||# ||* ||* ||* ||# ||# ||* *|* ||* ||# ||* ||| ||| *|* ||# ||* ||# ||| |||
Optimized TCT GAA GGT ACC ACC GAA ATC GTT CGT CTG ACC CGT CAG CTG CGT GCG ATC CCG GAC ACC

          T   I   Y   C   R   F   T   G   I   V   S   S   M   H   Y   K   L   D   E   V
   Query  ACA ATA TAT TGC CGC TTC ACG GGA ATA GTT TCT TCA ATG CAC TAT AAG CTC GAT GAA GTC
          ||* ||* ||# ||| ||# ||| ||* ||* ||* ||| ||| ||* ||| ||| ||# ||# ||* ||# ||| ||#
Optimized ACC ATC TAC TGC CGT TTC ACC GGT ATC GTT TCT TCT ATG CAC TAC AAA CTG GAC GAA GTT

          L   W   E   F   D   N   F   K   S   A   I   T   L   A   E   G   E   G   S   G
   Query  CTT TGG GAA TTT GAT AAT TTT AAG TCT GCT ATA ACA CTT GCC GAA GGT GAA GGT TCG GGT
          ||* ||| ||| ||# ||# ||# ||# ||# ||| ||* ||* ||* ||* ||* ||| ||| ||| ||| ||* |||
Optimized CTG TGG GAA TTC GAC AAC TTC AAA TCT GCG ATC ACC CTG GCG GAA GGT GAA GGT TCT GGT

          A   L   L   L   L   Q   K   Y   K   V   E   T   L   F   F   N   T   L   A   T
   Query  GCA TTA CTC TTA TTA CAA AAA TAT AAA GTA GAA ACC TTG TTT TTT AAT ACA CTA GCC ACA
          ||# #|# ||* #|# #|# ||# ||| ||# ||| ||* ||| ||| #|| ||# ||# ||# ||* ||# ||* ||*
Optimized GCG CTG CTG CTG CTG CAG AAA TAC AAA GTT GAA ACC CTG TTC TTC AAC ACC CTG GCG ACC

          E   H   S   I   E   A   E   I   I   S   G   I   T   T   P   R   M   L   L   P
   Query  GAA CAC AGC ATT GAA GCA GAA ATT ATT TCT GGA ATA ACT ACA CCA AGA ATG CTT CTC CCT
          ||| ||| **# ||# ||| ||# ||| ||# ||# ||| ||* ||* ||# ||* ||# *|* ||| ||* ||* ||*
Optimized GAA CAC TCT ATC GAA GCG GAA ATC ATC TCT GGT ATC ACC ACC CCG CGT ATG CTG CTG CCG

          I   M   S   R   F   H   G   G   Q   I   K   V   T   L   N   N   S   A   S   Q
   Query  ATT ATG TCT AGG TTC CAT GGT GGA CAA ATA AAA GTC ACT TTA AAC AAT TCT GCA AGC CAG
          ||# ||| ||| *|* ||| ||# ||| ||* ||# ||* ||| ||# ||# #|# ||| ||# ||| ||# **# |||
Optimized ATC ATG TCT CGT TTC CAC GGT GGT CAG ATC AAA GTT ACC CTG AAC AAC TCT GCG TCT CAG

          I   T   D   I   T   N   P   S   W   L   A   D   Q   K   S   R   I   P   K   Q
   Query  ATT ACC GAT ATT ACT AAT CCA AGT TGG TTG GCA GAC CAA AAA TCT AGG ATC CCT AAG CAA
          ||# ||| ||# ||# ||# ||# ||# **| ||| #|| ||# ||| ||# ||| ||| *|* ||| ||* ||# ||#
Optimized ATC ACC GAC ATC ACC AAC CCG TCT TGG CTG GCG GAC CAG AAA TCT CGT ATC CCG AAA CAG
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            V   E   I   I   T   M   D   A   E   T   T   E   N   I   N   R   S   K   L   Y
    Query   GTA GAG ATT ATA ACC ATG GAT GCT GAA ACA ACA GAA AAC ATT AAT CGG TCA AAA TTG TAC
            ||* ||# ||# ||* ||| ||| ||# ||* ||| ||* ||* ||| ||| ||# ||# ||* ||* ||| #|| |||
Optimized   GTT GAA ATC ATC ACC ATG GAC GCG GAA ACC ACC GAA AAC ATC AAC CGT TCT AAA CTG TAC

            E   A   V   Q   Q   L   I   V   S   H   I   D   P   N   A   L   K   V   V   V
    Query   GAA GCA GTC CAA CAG CTG ATT GTC TCA CAT ATT GAT CCG AAT GCA CTC AAA GTT GTG GTT
            ||| ||# ||# ||# ||| ||| ||# ||# ||* ||# ||# ||# ||| ||# ||# ||* ||| ||| ||* |||
Optimized   GAA GCG GTT CAG CAG CTG ATC GTT TCT CAC ATC GAC CCG AAC GCG CTG AAA GTT GTT GTT

            L   K   V   F   L   S   D   I   D   G   I   L   W   L   N   D   N   L   T   P
    Query   CTT AAA GTT TTC TTA AGT GAC ATT GAT GGA ATC CTA TGG CTG AAT GAT AAC CTT ACC CCT
            ||* ||| ||| ||| #|# **| ||| ||# ||# ||* ||| ||# ||| ||| ||# ||# ||| ||* ||| ||*
Optimized   CTG AAA GTT TTC CTG TCT GAC ATC GAC GGT ATC CTG TGG CTG AAC GAC AAC CTG ACC CCG

            L   F   G   L   G   Y   L   I   K   P   I   T   S   S   P   K   S   S   E   W
    Query   TTG TTT GGG CTG GGT TAC TTG ATC AAG CCG ATC ACC TCT AGC CCA AAA TCT AGT GAG TGG
            #|| ||# ||* ||| ||| ||| #|| ||| ||# ||| ||| ||| ||| **# ||# ||| ||| **| ||# |||
Optimized   CTG TTC GGT CTG GGT TAC CTG ATC AAA CCG ATC ACC TCT TCT CCG AAA TCT TCT GAA TGG

            Y   L   C   L   S   N   L   L   S   T   S   R   R   L   P   H   Q   S   H   T
    Query   TAC CTA TGT CTC TCA AAC CTT CTT TCA ACT TCA AGA CGA TTA CCT CAT CAG AGT CAT ACT
            ||| ||# ||# ||* ||* ||| ||* ||* ||* ||# ||* *|* ||* #|# ||* ||# ||| **| ||# ||#
Optimized   TAC CTG TGC CTG TCT AAC CTG CTG TCT ACC TCT CGT CGT CTG CCG CAC CAG TCT CAC ACC

            T   C   M   H   V   I   Q   T   A   L   Q   L   Q   I   Q   R   S   S   Y   W
    Query   ACT TGC ATG CAT GTT ATT CAA ACA GCA CTC CAG CTA CAA ATT CAG AGG AGC TCA TAT TGG
            ||# ||| ||| ||# ||| ||# ||# ||* ||# ||* ||| ||# ||# ||# ||| *|* **# ||* ||# |||
Optimized   ACC TGC ATG CAC GTT ATC CAG ACC GCG CTG CAG CTG CAG ATC CAG CGT TCT TCT TAC TGG

            L   S   H   L   V   Q   Y   A   N   H   N   L   H   L   D   Y   I   N   L   G
    Query   CTT AGC CAC CTT GTC CAG TAT GCC AAT CAT AAT TTG CAT TTA GAT TAT ATT AAT CTC GGT
            ||* **# ||| ||* ||# ||| ||# ||* ||# ||# ||# #|| ||# #|# ||# ||# ||# ||# ||* |||
Optimized   CTG TCT CAC CTG GTT CAG TAC GCG AAC CAC AAC CTG CAC CTG GAC TAC ATC AAC CTG GGT

            F   P   S   L   E   R   V   L   Y   H   R   Y   N   L   V   D   S   Q   K   G
    Query   TTC CCT TCA TTG GAG AGG GTT TTA TAC CAT AGA TAC AAT TTA GTC GAT TCT CAG AAA GGC
            ||| ||* ||* #|| ||# *|* ||| #|# ||| ||# *|* ||| ||# #|# ||# ||# ||| ||| ||| ||#
Optimized   TTC CCG TCT CTG GAA CGT GTT CTG TAC CAC CGT TAC AAC CTG GTT GAC TCT CAG AAA GGT
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```
          P   L   T   S   I   V   Q   H   L   A   H   L   Q   T   E   I   R   E   L   V
   Query  CCT TTG ACT TCC ATT GTC CAA CAT CTA GCG CAC CTG CAG ACC GAG ATT AGG GAG TTG GTT
          ||* #|| ||# ||# ||# ||# ||# ||# ||# ||| ||| ||| ||| ||| ||# ||# *|* ||# #|| |||
Optimized CCG CTG ACC TCT ATC GTT CAG CAC CTG GCG CAC CTG CAG ACC GAA ATC CGT GAA CTG GTT

          N   D   Y   N   Q   Q   R   Q   S   R   T   Q   T   Y   H   F   I   K   T   I
   Query  AAT GAC TAT AAT CAA CAA AGA CAA AGT CGA ACC CAA ACA TAT CAT TTC ATT AAA ACA ATA
          ||# ||| ||# ||# ||# ||# *|* ||# **| ||* ||| ||# ||* ||# ||# ||| ||# ||| ||* ||*
Optimized AAC GAC TAC AAC CAG CAG CGT CAG TCT CGT ACC CAG ACC TAC CAC TTC ATC AAA ACC ATC

          K   G   R   I   T   K   L   V   N   D   Y   L   K   F   F   L   I   I   Q   A
   Query  AAA GGT CGT ATT ACA AAA TTG GTA AAT GAT TAC CTT AAG TTC TTT CTA ATA ATA CAA GCC
          ||| ||| ||| ||# ||* ||| #|| ||* ||# ||# ||| ||* ||# ||| ||# ||# ||* ||* ||# ||*
Optimized AAA GGT CGT ATC ACC AAA CTG GTT AAC GAC TAC CTG AAA TTC TTC CTG ATC ATC CAG GCG

          L   K   H   N   C   T   W   Q   E   E   L   R   A   L   P   D   L   I   S   V
   Query  TTA AAG CAC AAT TGC ACA TGG CAA GAG GAA CTA AGA GCT CTT CCA GAT CTA ATT AGT GTC
          #|# ||# ||| ||# ||| ||* ||| ||# ||# ||| ||# *|* ||* ||* ||# ||# ||# ||# **| ||#
Optimized CTG AAA CAC AAC TGC ACC TGG CAG GAA GAA CTG CGT GCG CTG CCG GAC CTG ATC TCT GTT

          C   T   R   F   Y   H   T   R   N   C   S   C   E   N   R   F   L   V   Q   T
   Query  TGC ACT CGA TTC TAT CAT ACT CGA AAC TGT TCA TGT GAA AAC CGG TTC CTA GTA CAG ACT
          ||| ||# ||* ||| ||# ||# ||# ||* ||| ||# ||* ||# ||| ||| ||* ||| ||# ||* ||| ||#
Optimized TGC ACC CGT TTC TAC CAC ACC CGT AAC TGC TCT TGC GAA AAC CGT TTC CTG GTT CAG ACC

          L   Y   L   S   R   M   Q   D   S   E   I   K   L   I   D   R   L   T   G   L
   Query  TTA TAC TTA TCA CGC ATG CAG GAT TCG GAA ATC AAA CTA ATA GAT AGA TTG ACC GGC CTT
          #|# ||| #|# ||* ||# ||| ||| ||# ||* ||| ||| ||| ||# ||* ||# *|* #|| ||| ||# ||*
Optimized CTG TAC CTG TCT CGT ATG CAG GAC TCT GAA ATC AAA CTG ATC GAC CGT CTG ACC GGT CTG

          L   S   L   C   P   N   G   F   F   R   .
   Query  CTT AGT CTA TGT CCA AAT GGT TTT TTT CGG TAA
          ||* **| ||# ||# ||# ||# ||| ||# ||# ||* |||
Optimized CTG TCT CTG TGC CCG AAC GGT TTC TTC CGT TAA
```

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