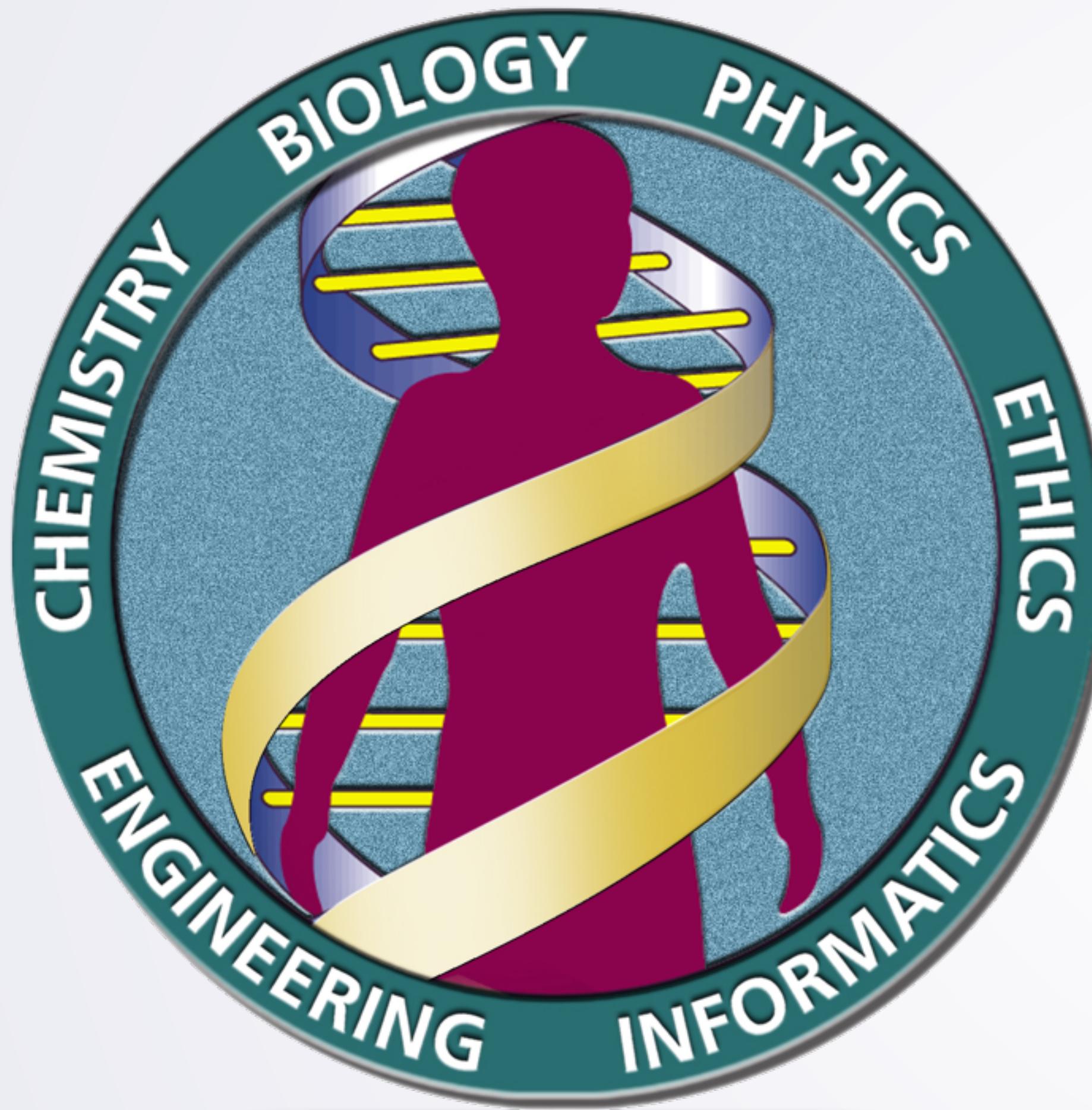


What Is a String?

The Code of Life

Raluca Gordân



What Conductors Think: Strings



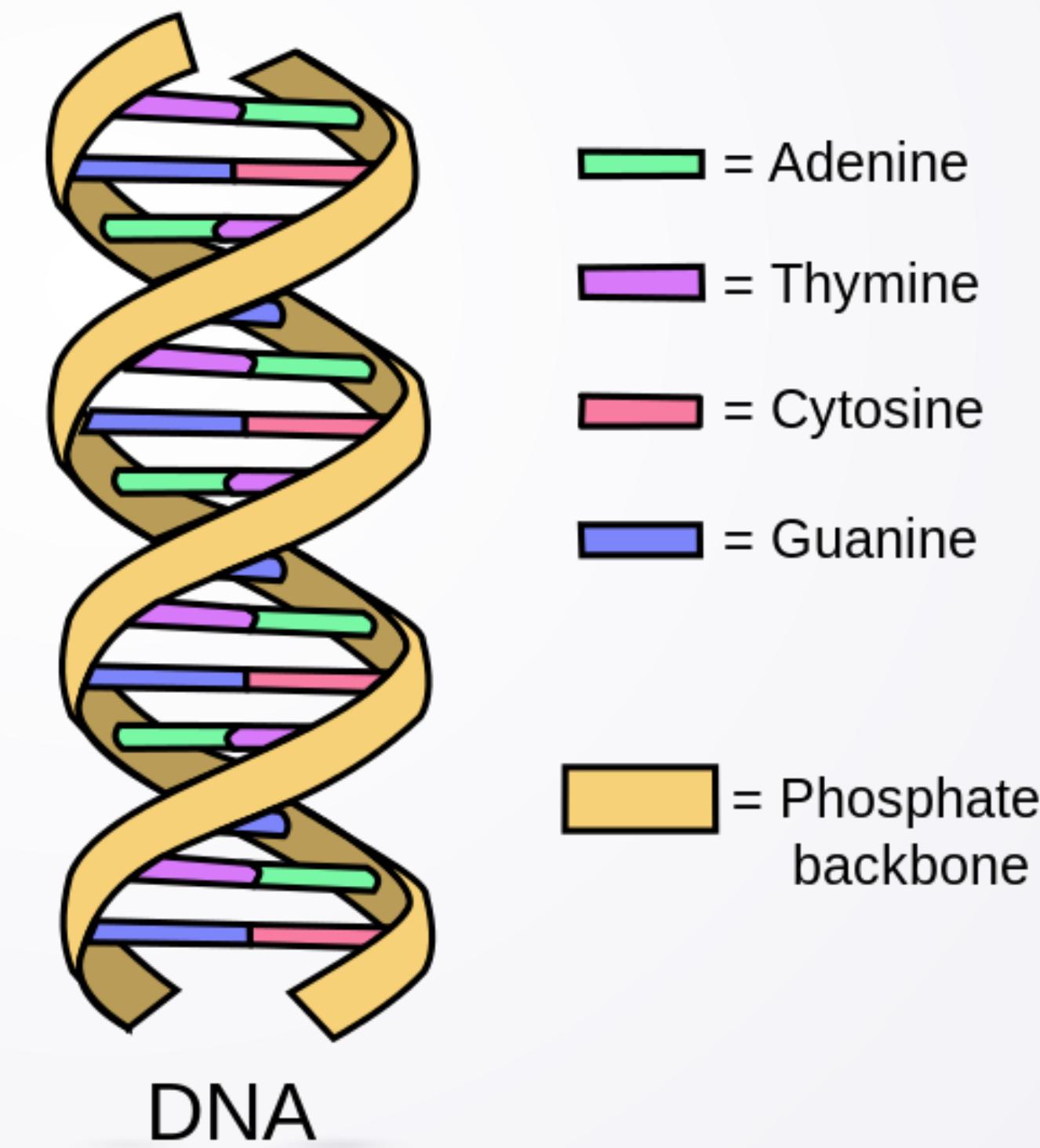
What Sailors Think: Strings



What Pianists Think: Strings

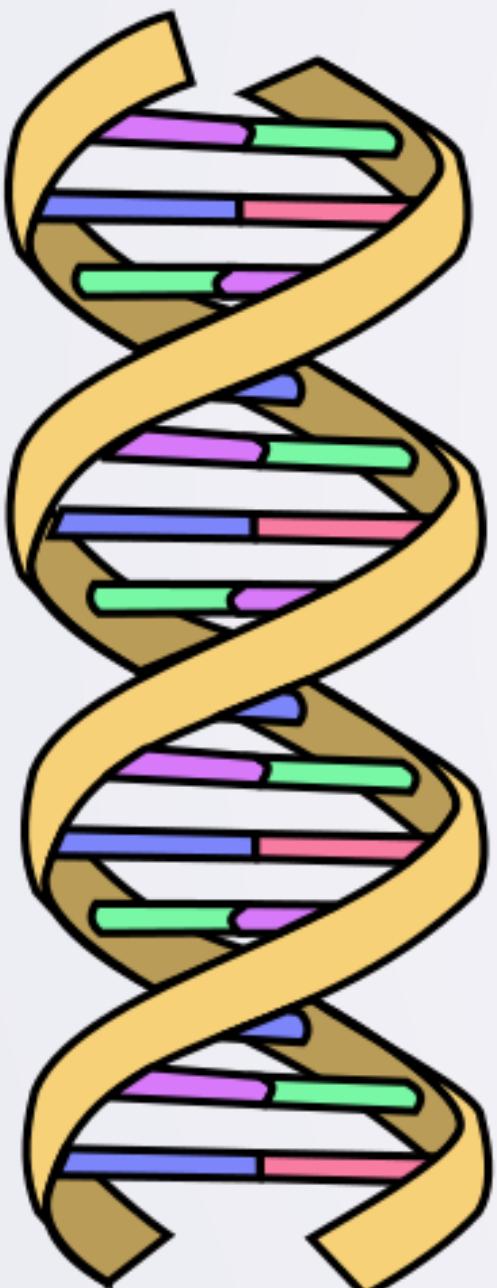


What Genome Scientists Think: Strings



The Genome: A Long String Over {A,T,C,G}

- TGGGGAAATAGTGATCTGTCCCGTGAATGATC...
 - From 30 basepairs to 3,000 to 3 billion

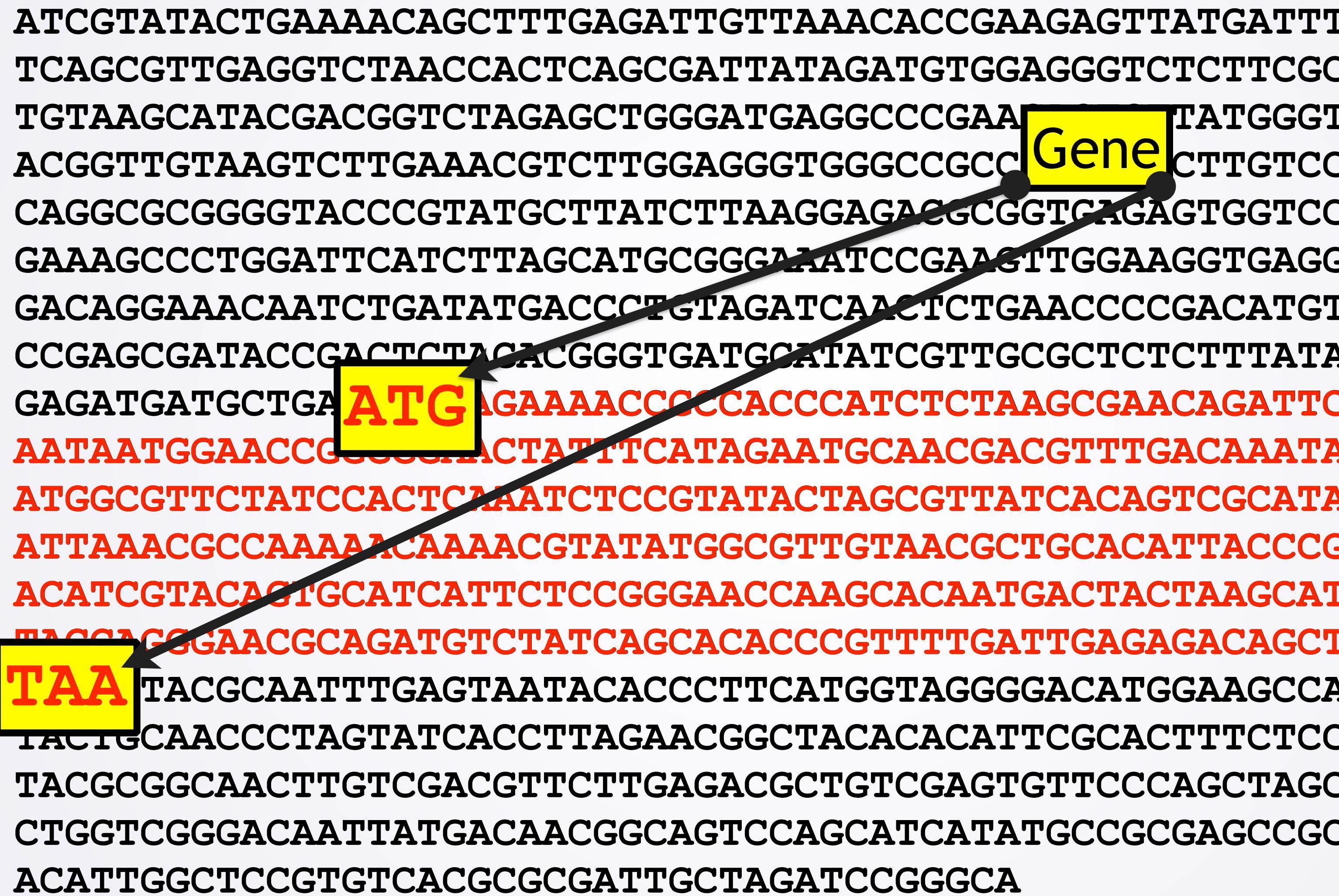


DNA

- = Adenine
- = Thymine
- = Cytosine
- = Guanine
- = Phosphate backbone

TGGGGAAATAGTGATCTGTCCCGTGAATGATCACTTGGAAATGCATCCGACTGAGTGACGCCGTCAGGTACCCGTGATTGCTAAAGGTC
TAATCGTTAACCTACTCACACACCGTTCACTGAAAAGAGCACAGGGACGGAACCTCCTGAGAAGTTATGAGATGATCACGAATGCC
ACTGCGTAGGGCCCGCGCTCTACCATGTCCTGGAACCTCAACCGAATCGACGAGCAACATGGACTGGTCAGCGCTTCACGCTC
TAGCACATGACTTGCCGGTTGGCCTATGTTGGTGTGAGAATATTGATGAGTCGACCCGATTGTATGTCGGAGCGTGGTCCCAC
GGAGGCACCTTGTACAAAGTGCTTCGTCACGGCTAATCTCAGTTGAGAATGGGGACTCGTACCCCTGCGATTGCAAACAGGG
GTGCATGATCTGTCCTGAAGTCGTTACTTGCTCGTACCGCTTAGGCGGGCAGATCATACTGTTCAAAGATGTGGGGTACATCC
CATTGATTCAATTGTCGTAGTCCGAGTTGAAAGGTGGGCTAGAATCAAGAAATCGATCTCAGCTAACCGCGACAATTCTCTTAG
CACGGCCAAGGAACCGATTGGGTTGGAGACCTGACCTGACAGTTGCGATCTAACGTGCCCTCGCGATCAGATCAGCACAAC
CTGATCTTAAGTAGAAACCGGGTCAATTGGCGCTGGCAATCATCTCTTCGATCAATCCACCCCCCATAGGAAATTGTAACACGG
ATGGGCCGCGTCGACCCTTATCTACGCTCATCTCCACCCCTGAGACAGTCAGTGGAACGACCCGGGCGTCAAAGTTAAACATT
GGTTGGGAATGCACTAGAATCTAGAGTGTATGCCGTCTGATTCAACAGAGAAAACACTTCATGCGGTTCCAGACTCAG
ACAGTTGGGATCAACACGGCTCGTCATTGGGAATAGTGATCTGTCGTAATGATCACTTGGAAATGCACTCGACTGAGTGAC
GCGGCTCAGGTACCCGTGATTGCTAAAGGCTAATGTTAAGTTACTCACACACCGTTACTGAAAAGAGCACAGGGACGGAAC
CTCCATTGAGATGATCACGAATGCCCACTGCGTAGGGCCCGCGCTCTACCAAGTGTCCACTGGAACCTAACCGAATCGAC
GCAACATGGACTGGTCAGCGCTTCACGCTCTAGCACATGACTTGCCGGTTGGCCTATGTTGGTGTAGAATATTGAGTC
CCGATTGTATGCCGGAGCGTGGTCCCACCTGGAGGCACCTTGTACAAAGTGTCTCGCACGGCTAATCTCAGTTGAGAATGG
GACTCGTACCCCTGCGATTGCAAACAGGGGGCGTGCATGATCTGTCCTGAAGTCGCTTACTTGTCTCGTACCGCTTAGG
GCCAGAATGCACTGGGACTATCCCATTGATTCAATTGTCGTAGTCCGAGTTGAAAGGTGGGCTAGAATCAAGAAATCG
TCATACTGTTCAAAGATGTGGGGTACATCCCATTGATTCAATTGTCGTAGTCCGAGTTGAAAGGTGGGCTAGAATCAAGAA
ATCTCAGCTAACCGCGACAATTCTCTAGTCACGGCCAAGGAACCGATTGGGTTGGAGACACTGACCTGCAAGTTGCGATCT
TGCCCTCGCGATCAGATCAGCACAACTTAACTGATCTTAAGTAGAAACCGGGTCAATTGGCGCTGGCAATCATCTCTCGAT
TCAAACCCCCCATAGGAAATTGTAACACGGTACGGCCGCGTCGACCGACTTATCTACGCTCATCTCCACCCCTGAGACAG
GAACGACCCGGGCGTCAAAGTTAAACATTGGTGGGAATGCACTGAGTAGAATCTAGAGTGTATGCCGTCTGATTCA
GAAAACACTTCATGCCGTTCCAGACTCAGGACAGTTGGGATCAACACGGCTCGTCACTGGGAATAGTGATCTGTC
GATCACTTGGAAATGCACTGGACTGAGTGACGCCGTCAGGTACCCGTGATTGCTAAAGGTCTAATGTTAACCT
TCACTGAAAAGAGCACAGGGACGGAACCTCCTGAGAAGTTATGAGATGATCACGAATGCCCACTGCGTAGGGCC
AGTGTCCACTGGAACCTAACCGAATCGACGAGCAACATGGACTGGTCAGCGCTTACGCTCTAGCACATGACTTG
GCCGACGGCTAATCTCAGTGAGAATGGGGACTCGTACCCCTGCGATTGCAAACAGGGGGCGTGCATGATCTG
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AGACCTGACCTGCATAGGTTGCGATCTAACGTGCCCTCGCGATCAGCACAACTTAACCTGATCTTAAGTAGAAAC
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TACGCTCATCTCCACCCCTGAGACAGTCAGTGGAACGACCCGGCGTCAAAGTTAAAACATTGGTGGGAAT
GTGAGTAGTCAGTGGGATCAACACGGACAGTGGGACTCAGGACAGTTGGGATCAACACGG
GTCATTGGGAATAGTGATCTGTCGTGAATGATCACTTGGAAATGCATCCGACTGAGTGACGCC

Needles in Haystacks, Genes in DNA

ATCGTATACTGAAAACAGCTTGAGATTGTTAACACCGAAGAGTTATGATT
TCAGCGTTGAGGTCTAACCACTCAGCGATTATAGATGTGGAGGGTCTTCGC
TGTAAGCATACGACGGTAGAGCTGGGATGAGGCCGAA

ACGGTTGTAAGTCTTGAACGTCTGGAGGGTGGGCCGCC
CAGGCGCGGGTACCGTATGCTTATCTTAAGGAGACCGGGTGAAGAGTGGTCC
GAAAGCCCTGGATTCACTCTAGCATGC
GACAGGAAACAATCTGATATGAC
CCGAGCGATACCGACTCTACACGGGTGATGC
GAGATGATGCTGA
ATG AGAAAACCCCACCCATCTCTAAGCGAACAGATT
AATAATGGAACCG ACTATTCATAGAATGCAACGACGTTGACAAATA
ATGGCGTTCTATCCACTCAAATCTCCGTATACTAGCGTTATCACAGTCGCATA
ATTAAACGCCAAAAACAAAACGTATATGGCGTTGTAACGCTGCACATTACCCG
ACATCGTACAGTGCATATTCTCCGGAACCAAGCACAATGACTACTAACGAT
TAA TACGCAATTGAGTAATAACACCCTCATGGTAGGGACATGGAAGCCA
TACTGCAACCCCTAGTATCACCTTAGAACGGCTACACACATTGCACTTCTCC
TACGCGGCAACTTGTGACGTTCTGAGACGCTGTCGAGTGTCCCAGCTAGC
CTGGTCGGGACAATTATGACAACGGCAGTCCAGCATTGCGCGAGCCGC
ACATTGGCTCCGTGTCACGCGCGATTGCTAGATCCGGGCA

Genes and Regulatory Elements in DNA

GAATCGTATACTGAAAACAGCTTGAGATTGTTAACACCGAAGAGTTATGAT
TTTCAGCGTTGAGGTCTAACCACTCAGCATTATAGATGTGGAGGGTCTCTC
GCTGTAAGCATACGACGGTCTAGACCTGGGATGAGGCCAACACTGTTATGG
GTACGGTTGTAAGTCTTAAACGTCTTGGAGGGTGGGCCAACAGTACTTGT
CCCAGGCGCGCGTACCGTATGCTTATCTTAAGGAGACGCGGTGAGAGTGGT
CCGAAAGCCCTGGATTTCATCTTAGCATGCGGGAAATCCGAAGTTGGAAGGTGA
GG **Regulatory Elements** ACCCTGTAGATCAAACCTCTGAACCCCCGACAT
GTCTGGAGCGATAACCGACCTCACGGGTGATGCATATCGTTGCGCTCTTTA
TAGACATGATGCTGA **ATGGAAAGAAAACGCCACCCATCTCTAAGCGAACAGAT**
TCAATAATGGAACCAGGCCGAACTATTTCATAGAATGCAACGACGTTGACAAA
TAATGGCGTTCTATCCACTCAAATCTCCGTATACTAGCGTTATCACAGTCGCA
TAATTAAACGCCAAAAACAAAACGTATATGGCGTTGTAACGCTGCACATTACC
CGACATCGTACAGTGCATCATTCTCCGGAACCAAGCACAATGACTACTAACG
ATTACCAGGGAACGCAGATGTCTATCAGCACACCCGTTTGATTGAGAGACAG
CTTAATGTAACGCAATTGAGTAATAACACCCCTCATGGTAGGGACATGGAAGC
CATACTGCAACCCCTAGTATCACCTTAGAACGGCTACACACATTGCACTTTCT
CCTACGCGGCCA **CTTGTGACGTTCTGAGACGCTGTCGAGTGTGTTCCCAGCTA**
GCCTGGTCGGGACAATTATGACAACGGCAGTCCAGCATTGACATATGCCGCGAGCC
GCACATTGGCTCCGTGTCACGCGCGATTGCTAGATCCGGGCA

Genes and Regulatory Elements in DNA

GAATCGTATACTGAAAACAGCTTGAGA
TTTCAGCGTTGAGGTCTAACCACTCAGC
GCTGTAAGCATACGACGGTCTAGACCTG
GTACGGTTGTAAGTCTTAAACGTCTGGAGGGTGGGCCAAGTACTTGT
CCCAGGCGCGGGTACCGTATGCTTATCTTAAGGAGACGCGGTGAGAGTGGT
CCGAAAGCCCTGGATTCATCTTAGCATGC
GG **Regulatory Elements** ACCCTGTAGATCAA
GTCTGGAGCGATAACCGACCTTACCGGTGATGCATATCGTTGCGCTCTTTA
TAGACATGATGCTGA **ATGGAAAGAAAACGCCACCCATCTCTAAGCGAACAGAT**
TCAATAATGGAACCGGCCGAACTATTTCATAGAATGCAACGACGTTGACAAA
TAATGGCGTTCTATCCACTCAAATCTCCGTATACTAGCGTTATCACAGTCGCA
TAATTAAACGCCAAAAACAAAACGTATATGGCGTTGTAACGCTGCACATTACC
CGACATCGTACAGTGCATCATTCTCCGGAACCAAGCACAATGACTACTAAC
ATTACCAGGGAACGCAGATGTCTATCAGCACACCCGTTTGATTGAGAGACAG
CTTAATGTACGCAATTGAGTAATAACACCCCTCATGGTAGGGACATGGAAAGC
CATACTGCA TATCACCTTAGAACGGCTACACACATTGCACTTTCT
CCTACGCGG TCGACGTTCTTGAGACGCTGTCGAGTGTCCCCAGCTA
GCCTGGTCG TATGACAACGGCAGTCCAGCATTGCGCGAGCC
GCACATTGG TCACCGCGATTGCTAGATCCGGGCA

