

Alignment of sequences published in Haring et al.: Mol.Biol.Evol 18:1892-1904, 2001

tRNAs

All tRNAs are in the same orientation; Complementary sections coloured
(anticodon = green)

tRNA-Phe

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-----1-----2-----3-----4-----5-----6-----7-----8
bute  gtccagtagctt acaa--ta aagc atggcact gaagatgcc aagatggg-tac-tacacataaccacggaca
falc  gtccccgtagctt acagccaa aagc atggtaact gaagatgcc aagatgggataca-atataaaaccggggaca
gall  gcccacatagctt aaccacaa aagc atggcact gaagatgcc aagatgggta---cctactatacctgtgggca
ayth  gtccacatagctt acacc-taa aagc atggcact gaagctgcc aagacggca--cacagaca-tgcctgcggaca
smit  gtccctgtagctt ataac--aa aagc atgacact gaagatgtc aagatagttgc--cacacagcatccaaggaca
vidu  gtctttgtagctt ataa---aa aagc atgacact gaagatgtc aagatgggctgttacacaca-caccaaaagaca
corv  gtccatgtagctt acaac--aa aagc atgacact gaagatgtc aagacggctgc--cacaacaccccatggaca
rhea  gtccttatagctt aaacc-ca aagc atggcact gaagatgcc gagatgggtac-----aacagtgcctaaggaca
stru  gtccttatagctt aatgc--aa aagc atggcact gaagatgcc aagatgggtatctag---taatccctaaggaca
emeu  gtcctagtagctt aaaca-ca aagc atggcact gaagatgcc aagacggtag---ccc-tcctaccctaaggaca
casu  gtccttatggctt aaacatca aagc atggcact gaagatgcc aagatgggta---cccgcctacctaaggaca
alli  gttatcgtagctt aaacacta aagc ataaactg aaatgtta acatgga---cagac-tagtccgaataaca
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tRNA-Val

```
-----1-----2-----3-----4-----5-----6-----7-----8
bute  cggggcgtagctt ataata--taa aagc attcagcct tacacctgaa aagataaccttccac-tcctaggtcgcctga
falc  caggggtgtagctt ataaga-ctaa aagc actcagcct tacacctgaa aagatgtctgtcaccaaccagatcacctga
gall  caaggcgtagctt ataact-tcaa aagc attcagcct tacacctgaa aagataacctcaacagacaaggtcgccttga
ayth  caagacgtagctt ataac-ccaa aagc actcagcct tacacctgaa aagatatactgctaa--accagatcgtcttga
smit  caagatgtagctt caa---ctaa aagc attcagcct tacacctgaa aagatactcaccaccactgagtcattcttga
vidu  caagacgtagctt -taagt--taa aagc attcagcct tacgcctgaaaaatgtctgcta-acaccagatcgtcttga
corv  caagacgtagctt -taag--caa aagc attcagcct tacacctgaaaaatatactgcta-acaccagatcgtcttga
rhea  caagacgtagctt ataag-ccaa aagc attcagcct tacgcctgaa aagatgtctacc--ctctaagaccgtcttga
stru  caagacgtagctt a-aaa-ccaa aagc actcagcct tacacctgag aagatgtct---aacataggaccgtcttga
emeu  cagagcgtagctt ataaatccaa aagc actcagcct tacacctgaa aagatgtcttctaaacacaagaccgcctga
casu  caaggcgtagctt ataataat-ccaa aagc attcagcct tacacctgaa aagatgtcttac-aaac-taggaaccgccttga
alli  caaaatgtagctt -taaat-ttaa aagc attcagtt tacacctgaaaa -gtccacac---catcggaccatttga
```

tRNA-Leu-UUR

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

bute gctagcgtggcagagcccggc-aaaTgcAAAaggctTaaGccctttA-cccagaggttcaagtCctctCcttagcc

falc gctagtgtagcaagcctggc-aaaTgcAAAaggctTaaAccctttA-actagaggttcaaatCctctCcttagct

gall gctagcgtggcagagctcggc-aaaTgcAAAaggctTaaGccctttA-tccagaggttcaaatCctctCcttagct

ayth gctagagtggcagagcccggc-aaaTgcAaaaggctTaaGccctttA-cccagaggttcaaatCctctCcttagct

smit gctagagttagcagagcccggc-aaaTgcAAAagactTaaAccctttA-cccagaggttcaaatCctctCcttagcc

vidu gctagcgtggcagagctcggc-aaaTgcAAAaggctTaaGccctttAaatcagaggttcaaatCctctCcttagct

corv gctagcgtggcagagctcggc-aaaTgcAAAaggctTaaGccctttAatcagaggttcaaatCctctCcttagct

rhea gctagagtggcagagctcggc-aaaTgcAaaaggctTaaGccctttA-cccagaggttcaaatCctctCcttagct

stru gctagcgtggcagagctcggc-aagTgcAAAaggctTaaGccctttA-ttcagaggttcaaatCctctCcttagct

emeu gctagcgtggcagagcttggc-aaaTgcAAAaggctTaaGccctttA-cccagaggttcaaatCctctCactagct

casu gctagcgtggcagagctcggc-aaaTgcAAAaggctTaaGccctttA-tccagaggttcaagtCctctCcttagct

alli gctagggtggcagagcctggcctaaTgcAAAaggccTaaAccctttA-ctcagagattcaaatCctctacctagca

tRNA-Ile

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

bute ggaaatgtgcctgaatg--caaaggTcactatgatAaagt-gaacatagaggTactactaacCctctCatttcct

falc ggaaatgtgcctgaacat-ctaaggTcactatgatAaagt-gaacatagaggTctaccaatCctctCatttcct

gall ggaagcgtgcctgaaca--aaaaggTcactatgatAaagt-gaacatagaggTataacaacCctctCatttcct

ayth ggaaatgtgcctgaacc--caaaggTcactatgatAaagt-gaacatagaggTacaacagcCctctCatttcct

smit ggaaatgtgcctgaac----aaaggTcactatgatAaagt-ggacatagaggTataccaacCctctCatttcct

vidu ggaaatgtgcctgaacg--ttaaggTcactatgatAaagt-gaacatggaggTgcaccaacCctctCatttcct

corv ggaaatgtgcctgaacatcaaaaggTcactatgatAaagt-gaacatagaggTaccaccagcCctctCatttcct

rhea ggaaatgtgcctgaac---taaaggTcactatgatAaagt-gaacatggaggTccaccagcCctctCatttcct

stru ggaaatgtgcctgaatc---aaaggTcactatgatAaagt-gaacatagaggTttaccagcCctctCatttcct

emeu ggaaatgtgcctgaat---taaaggTcactatgatAaagt-gaacatagaggTttactagcCctctCatttcct

casu ggaaatgtgcctgaatc--taaaggTcactatgatAaagt-gaacatagaggTccaccaatCctctCatttcct

alli ggatccgtgcctgaacca-taaaggTcactttgatagagtagataataggggT-tag-agcCctctcgatcct

tRNA-Gln (antiparallel)

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

bute	tagaaaataataataaaggaag	tatggagggttttgatctcttctgtgtaggttcgattcctacttttctaa
falc	taggaagtaataataaggggag	tatggagggttttgatctcttctgtgcaggttcaattcctgtcttctctaa
gall	tagaaaataatataagaggag	tatgaagagttttgatctcttctgtgtaggttcgattcctacttttctag
ayth	tagaaaataataataaggaag	tatggagagttttgatctcttctgtgtaggttcaattcctacttttctaa
smit	taggagataataataaaggaag	tatggagagttttgatctcttttgtgtaggttcaagtccctactttctag
vidu	tagaaaataataataatggaag	tatagagggttttgatccctcttgtgtaggttcaatccctacttttctaa
corv	tagaaaataataataaaggaag	tatggagggttttgatccctcttgtacaggttcgattcctgttttctaa
rhea	tagaaaataatataaggaag	tatgaggagttttgatctcttctgtgtaggttcgattcctacttttctaa
stru	tagaaaataataataaggaag	tatgaggagttttgatctcttttgtgcaggttcgattcctgttttctaa
emeu	tagaaaataatataaggggaag	tatgaagagttttgatctcttttgtgtaggttcgattcctacttttctaa
casu	tagaaaataatataaggaag	tatggggagttttgatctcttctgtgtaggttcgattcctacttttctaa
alli	tagggggtactataaaggaag	taggaaggaattttgatccctttgaaatagggttcgaatcctatctccctag

tRNA-Met

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

bute	agcagggtcagctaaca---aagcta	tcgggcccataccccgaaaatgatggttcgactccttcctctgcta
falc	agtagggtcagctaaacataaagcta	tcgggcccataccccgaaaatgatggtttaacccttccttacta
gall	agtaagggtcagctaaact---aagcta	tcgggcccataccccgaaaatgatggtttaacccttccttacta
ayth	agtagagtcagctaatc---aagcta	accgggcccataccccgaaaatgatggttcaacccttccttacta
smit	agtaagggtcagctaaaa---aagcta	tcgggcccataccccgaaaatgatggttcaatccttccttacta
vidu	agtagggtaagctaaat---aagcta	tcgggcccataccccgaaaatgatggttcaactccttccttgcta
corv	agtagggtcagctaatc---aagcta	tcgggcccataccccgaaaatgatggtttaacccttccttgcta
rhea	agtaagggtcagctaatc---aagcta	tcgggcccataccccgaaaatgatggtttaacccttccttgcta
stru	agtaagggtcagctaat---aagcta	tcgggcccataccccgaaaatgatggtttaacccttccttacta
emeu	agtaagggtcagctaaaca---aagcta	tcgggcccataccccgaaaatgatggttcaacccttccttacta
casu	agtaagggtcagctaacccaagcta	attgggcccataccccgaaaatgatggtttaacccttccttacta
alli	agaagtgttaagctaacccaagcta	attgggcccataccccgaaaatgaagact-aactccttcactccta

tRNA-Trp

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute agaaacttaggataacc-----accaaacgaaggccttcaaacgcttaaataaagagttaaaccctcttagtttct-g
falc agaaacttaggataaccgtctacttaaacgaaggccttcaaacgcttaaataaagagttaaatcctcttagtttct-g
gall agaaacttaggataaac-tgtcaccaaaccgaaggccttcaaacgcttaaataaagagttaaactctcttagtttct-g
ayth agaaacttaggataa-tgccctcaaacgaaggccttcaaacgcttaaataaagagttaaactctcttagtttct-g
smit agaaacttaggatacac-----ttctaacgaaggccttcaaacgcttaaacaagagttaaaccctcttagtttct-g
vidu agaaacttaggattac-----ccaaaccgaaggccttcaaacgcttaaacaagagttaaaccctcttagtttct-g
corv agaaacttaggatttac-----tgaaaccgaaggccttcaaacgcttaaacaagagttagaccctcttagtttct-g
rhea agaaacttaggataaac-----tataaacgaaggccttcaaacgcttaaataaagagttaaagcctcttagtttct-g
stru agaaacttaggataactaaa---ccaaaccgaaggccttcaaacgcttaaataaagagttaaagcctcttagtttct-g
emeu agaaacttaggataactaaccccccaaacgaaggccttcaaacgcttaaataaagagttaaagcctcttagtttct-g
casu agaaacttaggataactaaa--cctaacgaaggccttcaaacgcttaaataaagagttaaagtctcttagtttct-g
alli aagaaattaggtttaa---attccaagcggggccttcaaacgcttaaatgggagtaaacaccctcttagtttctg
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tRNA-Ala (antiparallel)

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute aaggctcttagcttaattaaagtgtctgggttgcattcagaggatgcagggt-agtat-ctgcggatctta
falc gaggcccttagcttaattagagtatctaagttgcatttagatggtgcaggtttagtgtcctgcgggtctta
gall gaggccttagcttaattaaagcgtctgatttgcattcaggagatgcagggtt-aatgtcctggttggctta
ayth aaggctttagcttaattaaagcgcctgggttgcattcaggagatgcagggtt-agtgtcctggttggcctta
smit aagatccttagcttaatgaaagtgtctgagttgcattcagaagatgtaggtt-agtgtcctacggatctta
vidu aaagtccttagcttaattaaagtgctgggttgcattcaggagatgcagggtt-agtatcctgcggatctta
corv aaaatccttagcttaattaaagcatctgagttgcattcaggggatgcagggtt-aacgtcctgcggatctta
rhea aaggccttagcttaattaaagcgtctgatttgcattcgggagatgcagggtt-aatatcctggttggctta
stru aaggccttagcttaattaaagcatctgatttgcgttcaggagatgcagggtt-aatgtcctggttggctta
emeu aaggccttagcttaattaaagtgctgatttgcattcaggagatgcagggtt-agtgtcctggttggctta
casu gaggccttagcttaattaaagtacctgacttgcactcaggagatgcagggtt-aatatcctggttggctta
alli gaggttttagcttaattaaagttctgatttgcactttgaagatgcagggtt-agggtcctgcaaacctta
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tRNA-Asn (antiparallel)

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

bute taggtagaagccttgctggg-tggagc atctagctgttaactagaggtttatgggatcaaggcccattctatctag
falc tagacagaagccttggtgggtt-gagcgtcctaactgttaattagaagttatgggatcgaggcccatttgtctag
gall taggcagaagccaaattgggtg-tggcatttagctgttaactaaaattgtatgggatcgaagcccattctgtctag
ayth taggcagaagccagtaggc-taaggcgttttagctgttaactaaaactttacgggatcgaagcccgctctgtctag
smit taggcagaagcccgatgggttagggcatttagctgttaactagagttcatgggatcgaagcccattctgtctag
vidu taggtagaagccttggtgggtt-gggcatatagctgttaactatagtggtgtgggatcgaagcccattctacctag
corv taggcagaagccttggtgggttggggcatatagctgttaactatagtgatcatgggatcgaagcccattctgtctag
rhea tagacagaagccttggtgga-tagggcatttagctgttaactagagtattatgggatcgaggcccattctgtctag
stru tagacagaggccttgctgga-taaggcattctagctgttaactagactattatgggatcgaggcccattctgtctag
emeu tagacagaagccttgctgga-tgaggcatttagctgttaactagaatattatgggatcgaggcccattctgtctag
casu tagacagaagccttgctgga-tagggcatttagctgttaactatactattatgggatcaaggcccattctgtctag
alli taaacagaaactcgttggt-tggagtgtttagctgttaactaaatatttgtgagatcgaagctcgcctgtttat

tRNA-Cys (antiparallel)

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

bute ggccctgtgg tgaagttcatggtgagttgcaagctcattgatgagcattaagaatgtgccagggctc
falc gactctgtgg tgaagttcatggtgagttgcaaaactcattgatgtacattgagagtggtgccggagctc
gall gactctgtag tgaagttcataatgagttgcaaaactcgttgatgtacact-aaagtgtgccggggctc
ayth ggccccgtgg tgaagttcatggtgagttgcaagctcatcgatgcacat-gagagtggtgccggggctc
smit ggttctgtag tgaaatccatactgagttgcaaaactcagtgatgtacatttagacatgtgccaggactc
vidu ggccctgtag tgaaatccatagtgagttgcaaaactcattgatgtgcatgaccatgtaccggggctc
corv ggctctgtag tgaagttcatggtgagttgcaagctcattgatgtgtactaacagtacaccggagctc
rhea gactccgtag tgaagttcatggtgagttgcaagctcatcgatgagcattaaatgtgtgccggagctc
stru ggtcccgtag tgaaatccatggtgagttgcaaaactcattgatgcacgttagaggcgtgtcggggctc
emeu gaccctgtag tgaaatccatggtgagttgcaagctcattgatcacattgaaaatgtgtcggggctc
casu ggtcctgtag tgaagttcatagtgagttgcaaaactcattgatgcacattaaagggtgtgccaggatc
alli agcctcatag tgaaatccataacggattgcaaatcgtagatgtacttt-aagtagtactggggttt

tRNA-Tyr (antiparallel)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

bute ggtaagatg gctgagtgt-tta agc gttaggctgtagtcct ttttacaggggtttaatt cctcttcttatcg
falc ggtaagatg gctgagtgt-ttaggc gttaggctgtagtcct ttttacagagggttgatt cctcttcttatcg
gall ggtaagatg gctgagtgt-tga agc gttaggctgtagtcct ttttacagagggttcaatt cctcttcttatcg
ayth ggtaagatg gctgagtgt-taa agc gttaggctgtagtcct ttttacagagggttcgatt cctcttcttatcg
smit ggtaagatg gctgaatg ttttaggc gttaggctgtagacct ttttatagagggtttaatt cctcttcttatcg
vidu ggtaagatg gctgagtgt-ata agc gttaggctgtagtcct ttttacagagggttcaatt cctcttcttatcg
corv ggtaagatg gctgagtgt-ata agc gttaggctgtagtcct ttttacagagggttcaatt cctcttcttatcg
rhea ggtaagatg gctgagtgg-tta agc gttaggctgtagtcct ttttacagagggtttaatt cctcttcttatcg
stru ggtaagatg gctgagtgt-tca agc gttaggctgtagtcct ttttacagagggttcaatt cctcttcttatcg
emeu ggtaagatg gctgaatg agtta agc gttaggctgtagacct ttttacaggggtttaatt cccttcttatcg
casu ggtaagatg gctgagtgt-tta agc gttaggctgtagtcct tttcacagagggttcaatt cctcttcttatcg
alli ggtaaggtg gccgagtgttaat ggc gttaggctgtaaacct atttacagagggttgatt cccttcttatca

tRNA-Ser-UCN (antiparallel)

----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

bute aagaaagaagcat -aggtggttatg agc gctggcttgaaccagtgtagcaggggttcgattccttctttcttg
falc aagaaagaagcat -gagtggtttgatg agc gctggcttgaaccagcgtgtgaggggttcgattccttctttcttg
gall aagaaagaagcat taagtggtttgatg agc gctggcttgaaccaacatgtgaggggttcgattccttctttcttg
ayth gagaaagaagcat -gaatgg-tta atgcagctggcttgaaccagtgtagtgggggttcgattccttctttcttg
smit gagaaagaagcat -gagtgggtta atgcggcttggcttgaaccagcctgtgaggggttcgactccttctttcttg
vidu gagaaagaagcat -aggtgg--c tatg cggcttggcttgaaccaacat atgggggttcgactccttctttcttg
corv gagaaagaagcat -aagtgg-tt tatg cggcttggcttgaaccaacat atgggggttcgactccttctttcttg
rhea aagaaagaagcat -aagtgg-ttagt gcagctggcttgaaccagtgcggtgaggggttcgattccttctttcttg
stru gagaaagaagcat -aagtggtttagt gcagctggcttgaaccaacgtgagggaggttcgattccttctttcttg
emeu aagaaagaagcat -aagtgg-ttagt gcagctggcttgaaccagcgtgtgaggggttcgattccttctttcttg
casu aagaaagaagcat -aagtggtttagt gcagctggcttgaaccatc atgtggaggggttcgattccttctttcttg
alli gagga tggagcat --ggtgg--tat tgcggctggcttgaaccagatgggtgggggttcgattccctctgtccttg

tRNA-Asp

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

bute ggagtggttagt^{aa}aa---caatt^{ac}ata^{aac}ctt^{gtc}agag^{tta}aat^{acagg}tgaa^{agc}cct^{gca}ac^{ccca}

falc ggagtggttagt^{aa}ac---ccatt^{ac}acag^{ctt}gtc^{aaag}ctaa^{atc}acag^{gtg}aa^{acc}cct^{gtac}ac^{cccc}

gall gagacggttagt^{aa}ac---caatt^{ac}atag^{act}gtc^{aaag}ctaa^{atc}acag^{gtg}caa^{ac}cct^{gtac}at^{ctca}

ayth gaggcgttagt^{aa}ac---caatt^{ac}atag^{act}gtc^{aaag}ctaa^{atc}acag^{gtg}aaa^{ac}cct^{gtac}ac^{cctca}

smit ggactggttagt^{aa}aaa---caatt^{ac}atgat^{ctt}gtc^{aaag}ccaa^{att}acag^{gcg}aaa^{aat}cct^{gtac}ag^{cca}

vidu gagatgctagt^{aa}aaa---ctatt^{ac}atag^{act}gtc^{aaag}ctaa^{att}acag^{gtg}aa^{acc}ccag^{tgca}t^{ctcc}

corv gaggtggttagt^{aa}aaa---cca^{ttac}atag^{ctt}gtc^{aaag}ctaa^{att}acag^{gtg}aa^{agc}ccag^{tac}ac^{cctca}

rhea gagacggttagt^{aa}aat---aca^{ttac}atg^{acct}gtc^{aaag}ccaa^{atc}acag^{gtt}aaa^{ac}cct^{gtac}at^{ctca}

stru gagaaggttagt^{aa}ac---ctatt^{ac}atag^{act}gtc^{aaag}ctaa^{atc}acag^{gtt}caa^{aac}cct^{gtac}at^{ctca}

emeu gagaaggttagt^{aa}ac---cta^{ttac}atag^{act}gtc^{aaag}ctaa^{atc}acag^{gtt}aaa^{ac}cct^{gtac}at^{ctca}

casu gagaaggttagt^{aa}ac---cta^{ttac}atag^{act}gtc^{aaag}ctaa^{atc}acag^{gtt}aaa^{ac}cct^{gtac}at^{ctca}

alli gaggggttagt^{aa}tactctatatt^{ac}ctatt^{ctt}gtc^{aaag}acag^{aaa}atagg^{att}gaac^{cctata}acc^{cctct}

tRNA-Lys

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

bute cattaagaagctatgca-acag^dactag^cct^{ttt}aag^{ctag}agaaa^{gagga}-----cctccc^{cctc}ctta^{atga}

falc cattgagaagctatgca-acag^dactag^cct^{ttt}aag^{ctag}agaaa^{gaggacag}-----cccacc^{cctc}ctta^{atga}

gall cattaagaagctatgca-ccag^dactag^cct^{ttt}aag^{ctag}agagag^{gggaca}-----ccctccc^{cctc}ctta^{atga}

ayth cattaagaagctatgca-acag^dactag^cct^{ttt}aag^{ctag}ctaa^{agaggac}-----cacctc^{cctc}ctta^{atgg}

smit cattaagaagctatgta-ccag^dactag^cct^{ttt}aag^{ctag}aaat^{agaggac}-----ccctc^{cctc}ctta^{atga}

vidu cattaagaagctatgaa-tcag^dg^{ttag}c^{ct}ttt^{aag}ctaa^{agaa}gagg^{aat}-----cacc^{ccctc}ctta^{atgg}

corv cattaagaagctatgaa-ccag^dactag^cct^{ttt}aag^{ctag}agaaa^{gaggacta}-----tctat^{cctc}ctta^{atgg}

rhea cattaagaagctatgta-acag^dactag^cct^{ttt}aag^{ctag}agaaa^{gaggata}-----ccc^{ccctc}ctta^{atgg}

stru cattaagaagctatgga-acag^dactag^cct^{ttt}aag^{ctag}agaaa^{gaggata}-----tcc^{ccctc}ctta^{atga}

emeu cattaagaagctatgga-gcag^dactag^cct^{ttt}aag^{ctag}agagag^{aggcaca}-----cctgt^{cctc}ctta^{atga}

casu cattaagaagctatgaa-acag^dactag^cct^{ttt}aag^{ctag}agaaa^{gaggctca}-----ctt^{cctc}ctta^{atga}

alli cactaagaagctaaatagtcag^dactag^cct^{ttt}aag^{ctag}gatt^{agggga}ctag^{tatt}acc^{ccc}cctccc^{ccttag}ta

tRNA-Gly

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute  gctcttctagatataactaatatacaaatgacttccaatctatagaatctgg--tgcaacc-ccaga-gaagagta
falc  gctcccctagatataatatacaaatgacttccaatctctaaaatctgg--tgtaacc-ccaga-ggagagca
gall  gctcttctagatatactcattacaactgacttccaatctttaaatactgg--tatcaac-ccaga-gaagagca
ayth  gctcttctagatataatatacaaatgacttccaatctctaaaatctgg--tgcaagc-ccaga-gaagagca
smit  gccattctagatataactaaatacaaatgacttccaatctctaaaatccgg--tcaaac-ccgga-gaaaggca
vidu  actcttctagatataatatacaaatcgacttccaatcctaaaatctgg--tttaaat-ccaga-gaagagta
corv  actcttctagatataatatacaaatcgacttccaatcctaaaatctgg--tttaaat-ccaga-gaagagta
rhea  gctcttctagatatactcattacaactgacttccaatctctaaaatctgg--tgcaacc-ccaga-gaagagca
stru  gctcttctagatataatatacaaatgacttccaatctctaaaatctgg--tgtgacc-ccaga-gaagagca
emeu  gctcttctagatataactaatatacaaatgacttccaatctctaaaatctgg--tataacc-ccaga-gaagagca
casu  gctcttctagatataactaatatacaaatgacttccaatctctaaaatctgg--tgcaacc-ccaga-gaagagca
alli  gcttttctagatatacaacaatacaagtgacttccaatcactagaccccacaattatcccaccaggggaaaagca
```

tRNA-Arg

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute  agaaaggtagtctaacc-aagacagttgatttcggtcaacaaatcatagatc-aaccctatgcctctctt
falc  agagagttagtctaact--aagacagttgatttcgactcaacaaaccatag-tcccaccctatgactttctt
gall  agaaagttagtctaact--aagacagctggtttcgaccagcaaatataga-cca-cctataactttctt
ayth  agaaagttagtctaatacataagacagctggtttcggccagcagactacag--ccaaccctgtaactttctt
smit  aggaaattagtttgacc--aagacagttgatttcggtcaacagaccatagtt--tatcctatgatttctc
vidu  ggaaagttagtctaacc--aagacagttgatttcgactcaacaaatataagccatcaccctataactttctt
corv  agaaagttagtctaact--aagacagttgatttcgactcaacagattatagctcacaccctataactttctt
rhea  agaaagttagtctaatt--aagacagctgatttcggctcagcagattataga--gaatactataactttctt
stru  agaaagttagtctaatt-aaagacagctgatttcggctcagcaaatatag--caaacactataactttctt
emeu  agaaagttagtctaaac--aagatagctgatttcggctcagcagattataga--aaatactataactttctt
casu  agaaagttagtctaact--aagacagctgatttcggctcagcagattatag--cgaactctataactttctt
alli  ccagaactcgtctaacacaaagactcttaatttcggcttagaaaatcatggttc--accacatggttctaca
```


tRNA-His

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute  gcagatatagtttc-aaccaaacattagactgtgatcctaaaaaatagaagttaaacccttcttatctgc
falc  gcaggcatagttttaaatccaaacatcaggtgtatcctgaaaatagaagctgaacccttctgctcgc
gall  gcaaacatagttt--aaccaaacattagattgtgatctaaaaaataggagttaaaccctcctggtcgc
ayth  gcaagcatagttt-aaaccaaacattagattgtgatcctaaaaaatagaagttcaagtcttctgctgc
smit  gcagacatagtttcaaaccaaacattagactgtgattctaaaaaatagaagttaaaacccttcttatctgc
vidu  gcaagtatagttt-aaaccaaacattagactgtgactctaaaaacagaagttagacccttcttactgc
corv  gcaagtatagttt--aaccaaaacattagattgtgattctaaaaaatagaagttagacccttcttactgc
rhea  gcaaatatagtttc-aaccaaacattagattgtgattctaaaaaatagaagttaaaacccttcttatctgc
stru  gcaaatatagtttt-aaccaaacattagactgtgattctaaaaaatagaagttaaaatcttcttattgc
emeu  gcaaatatagtttt-aaccaaacattagactgtgattctaaaaaatagaagttaaaatcttcttatctgc
casu  gcaaatatagtttt-aactaaacattagattgtgattctaaaaaatagaagttaaaatcttcttattgc
alli  gtaagtatagttt--aaacaaaacattagaatgtgaacctaaaaaataggagactactcccttactcacc
```

tRNA-Ser-AGY

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute  gaggggaagttcaa-ccagcaagaactgctaattcct-gcatctgagcctaaaaccctcagtcccctta
falc  gaggggaagttcaa-ccagcaagaactgctaattcct-gcatctgagcctaaaatctcagtccccttg
gall  gaggggagggccaagccagcaagaactgctaattcct-gcatctgagctttaaaccctcagtcccctta
ayth  gaggggaggtaaa-ccacaagaactgctaattcct-gcatctgggctttaaacccccagccccctta
smit  agggggaggtcca-ccacaagaactgctaattcct-gtacctgagcctaacacctcagcccccttg
vidu  gaggggaggtaaa-ccagcaagaactgctaattcct-gcatctgagtataaaaaccctcagcccccttg
corv  gaggggaggtaaa-ccacaagaactgctaattcct-gcatctgagcataaaaaccctcagccccctta
rhea  gaggggtggtttaa-ccagcaagaactgctaattcct-gcatctgagtctagaccctcagccccctca
stru  gaggggtggtttaa-ccagcaagaactgctaattcct-gcatctgagtctaagccctcagccccctta
emeu  aaggggtggtaaa-ccacaagaactgctaattcct-gcatctgagtctaagccctcagcccccttg
casu  gaggggtggtttaa-ccagcaagaactgctaattcct-gcatctgagtctaaaccctcagcccccttg
alli  gagag-agatc---cgcgcaggaactgctaattcctagcccccaggactaacagctggccctctcg
```

tRNA-Leu-CUN

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute  acttttaaaaggataaac-agc--aatccactgggtcttaggaaccaatccatcttgggtgcaaatccaagtaaaagta
falc  gcttttaaaaggatagtagc--aatccactgggtcttaggaaccaaccaccttgggtgcaaatccaagtaaaagca
gall  acttttaaaaggataag-agc--aatccgctgggtcttaggaaccacctatcttgggtgcaaatccaagtaaaagta
ayth  acttttaaaaggataac-agt--aatccgctgggtcttaggagccaatctatcttgggtgcaactccaagtaaaagta
smit  gcttttaaaaggataac-agt--aatctatgggtcttaggagccacctaccttgggtgcaaatccaagtaaaagca
vidu  gctttcaaaggatagtagt--aatccaatgggtcttaggagccaatccaccttgggtgcaaatccaagtgaaagta
corv  actttcaaaggataat-agt--aatccaatgggtcttaggaaccagtaatcttgggtgcaaatccaagtgaaagta
rhea  acttttaaaaggataag-agt--aatccactgggtcttaggagccattcatcttgggtgcaactccaagtaaaagta
stru  acttttaaaaggataac-agt--aatccactgggtcttaggaaccaccatcttgggtgcaactccaagtaaaagta
emeu  gcttttaaaaggataac-agtccaatccactgggtcttaggaaccagccatcttgggtgcaactccaagtaaaagca
casu  gcttttaaaaggataac-agt--aatccatgggtcttaggagccaatcttgggtgcaactccaagtaaaagca
alli  actttcataggataaactagg-acatcccctggccttaggagccaataatcttgggtgcaaccccaagtgaaaata

```

tRNA-Thr

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute  actcctaagtttat-aaaaaacattgggtcttgtaaaccaa-aaactgaagg-cctacc-cttcttagagtt
falc  actcctaagtttat--aaaaacgttgggtcttgtaaaccaaagagtgagg-cctataac-cttcttagagtt
gall  actcctaagtttat-gaaaaaacattgggtcttgtaaaccaa-aaactgaaga-ctcc-acc-cttcttagagta
ayth  actcctaagtttat-aaaaaacattgggtcttgtaaaccaaagactgaaga-cttg-ccc-cttcttagagta
smit  actcctaagtttat--gaaaaaacattgggtcttgtaaaccaaagatcgaaga-ctta-ccc-cttcttagagtt
vidu  actcctaagtttat-ga-aaacattgggtcttgtaaaccaaagattgaaga-ttacacc-cttcttagagtt
corv  actcctaagtttat--aaaaaacattgggtcttgtaaaccaaagattgaaga-ctaaacat-cttcttagagtt
rhea  actcctaagtttat-aaaaaacattgggtcttgtaaaccaaagagtgagg-cgcacc-cttcttagagta
stru  actcctaagtttat-acaaaaaacattgggtcttgtaaaccaaagaatgaaga-tcacacc-cttcttagagta
emeu  actcctaagtttat-acaaaaaacattgggtcttgtaaaccaa-aaactgaaga-ctacat-cttcttagagta
casu  actcctaagtttat-gaaaaaacattgggtcttgtaaaccaaagactgaaga-ctgcacc-cttcttagagta
alli  actccgctggtctaaaggaaaagcgtggccttgtaaagacaga-agtgga-cggaaccaaccctcccgtagta

```

tRNA-Pro (anitparallel)

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute  cagagagtagtttaatgt-aaaaatgccagctttgggaggttggtgatggagggtttaagtcctctttttctga
falc  cagaagatagtttaata--agaatgccagctttgggaggttggtggttagaggtttgagtcctctttttctga
gall  cagagagtagtttatttg-aaaataccagctttgggagctggagatggagggttgagccctcctttttctga
ayth  cagagaatagtttattat-aaaataccagctttgggagctggagataaagggtttaagtcctctttttctga
smit  cagaaagtagtttagtttaaaaatgccagctttgggaggttggtgatgaagggttgattcctttctttttga
vidu  cagaaagtagtttaattg-aaagcgcagctttgggaggttggtgatgaagggttgagtcctttctttctga
corv  cagaaagtagtttaattg-agaatgccagctttgggaggttggtggtaaagggttgactcctttctttctga
rhea  cagaagatagtttaatag-agaatatcagctttgggagctggaggtagagggtttaagtcctctttttctga
stru  cagaaggtagtttagtag-agaatatcagctttgggagctggaggcggagggttcaagtcctctctttctga
emeu  cagaaaatagtttagtga-agaataccagctttgggaggttgaggcgaagggttgagtcctttttttctga
casu  caggaggtagtttaatga-agaatatcagctttgggagctgaaggtaaagggtttaagtccttttttctga
alli  caagaagtagtttagtt--agaatgctggctttggggccgaagggtgcaaggttttg-tttgctttctga
```

tRNA-Glu (anitparallel)

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
bute  gtttctgtagttgaag--tttacaacggcgatctttcaggtcgttaggttttggagagaagccaagcagaaatt
falc  gttctcgtggttgaa--ttatacaacgacagtttttcaagctgttaggtctcggggagggtgccgagcgagaatg
gall  gttcccgtagttgaga----acaacaatggcttttcaagccgttagtccttgggggtctaaaccaagcgggaata
ayth  gttcctgtagttgagg----acaacaacggcttttcaagccgttaggcctcggatagtagccgagcaggaata
smit  gttctttagttgaagg-ttgacaacggtagtttttatactacgggtcctggag-gaaaccaggcaagaatt
vidu  gtttctgtagttaa---ttttataacagcggcttttcagggcgcagttctcggagagaggccgagcaggaata
corv  gttcctgtagttaaaa-ttttataacaatggtttttcagcccgtagatcttggggagggtccaagcaggaact
rhea  gtttctgtagttgag---ttacaacgatggtttttcagaccataggtccttggatagtgccaagcaggaatt
stru  gtttctatagttgaaa----acaacgacagtttttcagactgttaggtctcgggtaatatccgagtagaaatt
emeu  gttcctgtagttgagg----acaacggtggtttttcagaccgctggccttgggtag-aaccaagcaggaact
casu  gtttctgtagttgagag---tcaacgacggtttttcagaccgtagaccttgggtaatgtccaagcagaaatt
alli  gttttatagttgaaa---taacaacag-ggttttcagacctcaggttttgggtgaaggccaataaaaaata
```

12S rRNA

-----1-----2-----3-----4-----5-----6-----7-----8
bute -aaagacttagtcctaaccttgctgtaactcttgctaaacata-tacatgcaagt-atccgcgccccagtgtaaatgcc
falc aaaagacttagtcctaaccttacggttgccctgctagacata-tacatgcaagt-atctgcggtccagtgtaaatgcc
cico -aaagacttagtcctaaccttacggttaacttttgctaaatata-tacatgcaagt-atccgcacccccagtgtaaatgcc
gall aaaagacttagtcctaaccttctattgggttttgctagacata-tacatgcaagt-atccgcacccccagtgtaaatgcc
ayth aaaagacttagtcctgaccttacagttgggttttgctagacata-tacatgcaagt-atccgcgccccagtgtaaatgcc
smit aaaagacttagtcctaaccttactattaattcttactgaacata-tacatgcaagt-atccgcacccccagtgtaaatgcc
vidu aaaagacttagtcctaaccttactgttagtttttgctaggtata-tacatgcaagt-atccgcgatccagtgtagaagcc
corv aaaagacttagtcctaaccttactgttgggttttgccaggaataatacatgcaagttatccgcggtccagtgtaaatgcc
rhea aaaagacttagtcctaaccttactgttaattttcgctaaacata-tacatgcaagt-atccgcgcaccagtgtaaatgcc
stru aaaagacttagtcctaaccttactgttaattttcgctagacata-tacatgcaagt-atccgcacccccagtgtaaatgcc
emeu aaaagacttagtcctaaccttaccattagttctcgctaaacata-tacatgcaagt-atccgcgccccagtgtaaatgcc
casu -aaagacttagtcctaaccttactgttaatttttgctagacata-tacatgcaagt-atccgcgccccagtgtaaatgcc
alli aacagacttagtcctgggtcttttcattagctagtactcaactta-tacatgcaagc-atccgcgaaccagtgagaacacc

bute cttaa---tttcttactaagataaataggagctgggtatcaggcacacccacctagct-gtagcccaagacaccttgc-tct
falc ctaga---cctcttaccagactaaaggagcaggcatcaggcacacaccatcaatt-gtagcccaagacgccttgc-tca
cico ccaga---tttcttaccatagatgaagggagcgggtatcaggcacacccact--gtt-gtagcccaagacaccttgc-tta
gall cccaaacctttcttcccaagca-aaaggagcagggtatcaggcacactc-----agcagtagcccaagacgccttgc-tta
ayth ctcaacagcct--accaggccttaaggagcgggtatcaggcacaccc---aagtagtagcccaagacgccttgc-taa
smit ctcaata-cct-taacaaggcag-caggagcaggcatcaggcgcacac----aaccagtagcccaagacaccttgc-cca
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corv ctgg-caccctttaaccaagtcgataggagcgggcatcaggcacacac----aatt-gtagcccaagacgccttgc-actt
rhea ctcagc-gtctaccccacagacctaaggagcagggtatcaggcgcactac----acc-gtagcccaagacgccttgc-tca
stru cttaat-gtctccccattagacaaaaggagcagggtatcaggcacactatct--at--gtagcccaaaaacgccttgc-tta
emeu ctaaaa--catcccactcggataaaaaggagcagggtatcaggcacacacacc-----gtagcccaaaaacaccttgc-tca
casu cttaac-gtctaccccctaagacaaaaggagcagggtatcaggcacacaaccc---gcagtagcccaagacaccttgc-tta
alli ctacaa-gtct----gacagacgaatggagcgggcatcaggcacatcaaccga----tagcccaaaaacgccttagc-cca

bute gccacacccccacgggcactcagcagtaattaacattaagcaataagtgtaaacttgacttagttatagcata--cctc-
falc gccacaccccccaagggcactcagcagtaattaacattaagcaataagcgcaagcttgacttagtcatggcaa---cctt-
cico gccacacccccacgggtactcagcagtaattaacattaagcaataagtgtaaacttgacttagttatagcaa---catcc
gall gccacacccccacgggtactcagcagtaattaaccttaagcaataagtgtaaacttgacttagccatagcaa-----ccc
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vidu gccacacccccacgggtattcagcagtagttaatattaagcaatgagtgtaaacttgacttagccatagcaaa--tct--
corv gccacgccccccacgggtattcagcagtggttaacattaagcaatgagtgtaaacttgacttagtcatggcaa---cctt-
rhea gccacacccccacgggtattcagcagtaattgacattaagcaataagtgcaaacttgacttagttatagcga---ccacc
stru gccacacccccacgggtactcagcagtaattaacattaagcaataagtgtaaacttgacttagccatggcga---cccc
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casu gccacacccccacgggtattcagcagtaatagacattaagcaataagtgtaaacttgacttagtcatagca-----ctcc
alli gccacaccccccaagggg-ctcagcagtgattaaccttaaaccataagcgaaagcttgatttagttagagtaga--tata-

bute -agggttggt-aaatcttgtgccagccaccgcggtcatacaagagacccaagctaacag-----catccggcgtaaag
falc -agggttggt-aaatcttgtgccagccaccgcggtcatacaagaaacccaagccaacagt-----cacacggcgtaaag
cico -agggttggt-aaatcttgtgccagccaccgcggtcacacaagaaacccaagttaactg-----caatcggcgtaaag
gall -agggttggt-aaatcttgtgccagccaccgcggtcatacaagaaacccaatcaatagc-----taccggcgtaaag
ayth aagggtcggg-aaatcttgtgccagccaccgcggtcatacaagagacccaaatcaactgttccacacaagcggcgtaaag
smit cagggttggg-aaatcttgtgccagccaccgcggtcacacaagaaacccaaattaat-----cacctacggcgtaaag
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corv aagggtcggg-aaatcctgtgccagccaccgcggtcatalcaggagactcaaattaacagt-----ataacggcggtgaag
rhea --gggtcggg-aaatcttgtgccagccaccgcggtcacacaagagacccgaactaacagt-----aatcggcgtaaag
stru aagggttggg-aaatcttgtgccagccaccgcggtcacacaagagacccaaactaacagt-----agcggcgtaaag
emeu cagggccggg-aaatcttgtgccagccaccgcggtcatacaagagggccaaactaatag------aatcggcgtaaag
casu aagggttggg-aaatcttgtgccagccaccgcggtcacacaagagacccaaactaacagt-----aaccggcgtaaag
alli gagg--cgggcaactctcgtgccagcaaccgcggttagacgaaaacctcaagtttaattga-----caaacggcgtaaag

bute agcgg-gtacata-ctatctagg-caactagga----ttaa atcgcaactgagctgtcataagc-ccaagatacgcctaa
falc agtggactagaac-ctgtcataa-taactaggaataatcaaaacataactgagctgtcataagc-ccaagatatccctaa
cico agtgg-tatcaca-ttgtcacia-caactagga----ttaa agtacaactgagctgtcataagc-caaagatgcacctaa
gall agtgg-ccacatg-ttatctgcaccagctaaga----ttaa aatgcaaccaagctgtcataagc-ctaagatccacctaa
ayth agtgg-taaaatgcctatcctacctaactaaga----tcaaaatgcaactaagctgtcgcaagc-acaagatgcacctaa
smit agtggatccaatg-ctattc--ccccactgagg----ttaa aatgcaactaagccgttataagc-acatgatgcacctaa
vidu agtgg-tcacatg-ttatccaag-tagctaaga----ttaa aaagcaactgagccgtcacaagc-ccaagatgctcataa
corv ggtgg-taacatg-ctatctaag-taactaaga----ttaa aaagcaactgagctgtataagc-ccaagatgctcataa
rhea tgtgg-taacatg-ctatccaac-tagctaaga----cfaaaatgcaactaagctgtcataagc-tgacgatgcacttaa
stru agtgg-taatatg-ttatccaaccaaattaaga----cfaaaacacagctaagctgtcacaagc-ccaagatggtcctaa
emeu cgtgg-taatatg-ttatctaa-ctaactaaga----cfaaaatacaactaagctgtcataagc-ccaagatgccctaa
casu tgtgg-taacatg-ctatctaa-ctaactaaga----tcaaaatgcaactaagctgtcataagc-ctaagatgcacctaa
alli tgtggctagaact-ctatct-ccccattagtg--cagatacgggtatcacagtagtgataaacttcatcacaccgcaa

bute agccatc---ccaagacgaccctagcgcccac-gattgactaacccccgcgaaagccagggctcaaactgggattagat
falc ggccaac---ttaa aatgatcctagtatatcc-gacggaccaaaccacgaaagctaggatccaaactgggattagat
cico aaccacc---ctcaagacgatcctagcaactac-gactgatt-aagcccacgaaagccaaggcacaactgggattagat
gall acccaac---cfaaatccatcttagcctcaac-gattaattttaaccacgaaagctaggacccaaactgggattagat
ayth acacacc---atcaagatgatcttagcaactagcgcgatcgatttaagcccacgaaagccagggccaaactgggattagat
smit catctac--cataaagacaaccccagcacctacagaccaattacactccacgaaagctaagacacaactgggattagat
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corv ggccaacta-cfaaagaagatcttaggctg-ac-gattgattgaaatccacgaaagccagggccaaactgggattagat
rhea aacccc---ataaaatggtctcagtaccac-gatcaatttaaacccacgaaagctaagacacaactgggattagat
stru aatcacc---ataaaatggtcttaacaccac-gatcaatttcaccccacgaaagctaaggcacaactgggattagat
emeu aacctcc---ataaatatgatcttagcatccac-gaccaatttcaccccacgaaagctaaggcacaactgggattagat
casu aacctcc---ctaaaaggatcttagcgcccac-gataaatttcaccccacgaaagctaaggcacaactgggattagat
alli catcaac---acfaaactggccctaactctcaa-agatgtactcgattccacgaaagctgagaacacaactgggattagat

bute accccactatgcctggccctaaatcctgatac-ttatct-taccaaagta--tccgcccgagaactacgagcacaaaacgc
falc accccactatgcctagccctaaatcctgatgt-ttattg-taccatagcacatccgcccgagaattacgagcacaaaacgc
cico accccactatgcttagccctaaatcctgggtac-ttacc-tactaaagta--cccgcccgagaactacgagcacaaaacgc
gall accccactatgcctagccctaaatctagatac-ctcccatcacacatgta--tccgcctgagaactacgagcacaaaacgc
ayth accccactatgcctggccctaaatcctgatac-ttacta-taccaaagta--tccgcccagagaactacgagcacaaaacgc
smit accccactatgcttagccctaaatccagatgc-ttaa--ctaccccatca--tccgcccgagaactacgagcacaaaacgc
vidu accccactatgcctggccctaaatcctgatgc-ttacacctacaaaagca--tccgcccgagaactacgagcaccaacgc
corv accccactatgcctggccctaaatcctgatgc-tctatgctacctgagca--tccgcccgagaactacgagcacaaaacgc
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