Taxas de evolução molecular

Exercícios: Comparações de seqüências de macromoléculas.
Abaixo você encontrará as seqüências de aminoácidos alinhadas da desidrogenase alcoólica de algumas espécies de drosofilídios

```
                          5        15        25        35        45
                     ----+---------+---------+---------+---------+-----
D.buzzatti 1         MAIANKNIIFVAGLGGIGFDTSREIVKSGPKNLVILDRIENPAAIAELKA 50
D.buzzatti 2         MAIANKNIIFVAGLGGIGLDTSREIVKSGPKNLVILDRIENPAAIAELKA 50
D.hawaiiensis        MVIANSNIIFVAGLGGIGLDTSREIVKSGPKNLVLLDRIDNPAAIAELKA 50
I.grimshawi          MVIANSNIIFVAGLGGIGLDTSREIVKSGPKNLVVLDRVDNPAAIAELKA 50
D.affinisdisjuncta   MVIANSNVIFVAGLGGIGLDTSREIVKSGPKNLVVLDRVDNPAAIAELKA 50
                        55        65        75        85        95
                     ----+---------+---------+---------+---------+-----
D.buzzatti 1         LNPKVTVTFYPYDVTVPVAETTKLLKTIFDKLKTVDLLINGAGILDDYQI 100
D.buzzatti 2         LNPNVTVTFYTYDVTVSVAESTKLLKTIFDQLKTVDLLINGAGILDEDQV 100
D.hawaiiensis        LNPKVTVTFYPYDVTVPLAETKKLLKTIFDKLKTVDLLINGAGILDDNQI 100
I.grimshawi          LNPKVTITFYPYDVTVPLAETKKLLKTIFDKLKTVDLLINGAGILDDNQI 100
D.affinisdisjuncta   LNPKVTVTFYPYDVTVPLAETKKLLKTIFDKLKTVDLLINGAGILDDNQI 100
                        105       115       125       135       145
                     ----+---------+---------+---------+---------+-----
D.buzzatti 1         ERTIAVNFTGTVNTTTAIMAFWDKRKGGPGGVIANICSVTGFNSIYQVPV 150
D.buzzatti 2         ERTIAVNFAGTVNTTTAIMSFWDKRKGGPGGVIANICSVTGFNALYQAPV 150
D.hawaiiensis        ERTIAVNFTGLVNTTTAILDFWDKRKGGPVGVVANICSVTGFNSIYQVPV 150
I.grimshawi          ERTIAVNFTGTVNTTTAILDFWDKRKGGPGGVVANICSVTGFNSIYQVPV 150
D.affinisdisjuncta   ERTIAVNFTGTVNTTTAIMDFWDKRKGGPGGVVANICSVTGFNSIYQVPV 150
                        155       165       175       185       195
                     ----+---------+---------+---------+---------+-----
D.buzzatti 1         YSASKAAALSFTNSLAKLAPITGVTAYSINPGITKTTLVHKFNSWLDVEP 200
D.buzzatti 2         YSASKAAALSFTNSLAKLAPITGVTAYSINPGITKTALVHKLNSWLNVEP 200
D.hawaiiensis        YSASKAAALSFTTSIAKLAHITGVTAYSINPGITKTVLEHSFNSWLNVEP 200
I.grimshawi          YSASKAAALSFTTSIAKLAHITGVTAYSINPGITKTVLVHKFNSWLGVEP 200
D.affinisdisjuncta   YSASKAAALSFTTSIAKLAHITGVTAYSINPGITKTVLVHKFNSWLSVEP 200
                        205       215       225       235       245
                     ----+---------+---------+---------+---------+-----
D.buzzatti 1         RVAELLLEHPTQTTLQCAQNFVKAIEANQNGAIWKLDLGRLEAIEWTKHW 250
D.buzzatti 2         RLAELLLEHPTQTSLECAQNFVKAIEANQNGAIWKLDLGRLEAIEWTKHW 250
D.hawaiiensis        RVAELLLEHPTQTTLQCAQNFVKAIEANQNGAIWKLDLGRLDAIEWTKRW 250
I.grimshawi          RVAELLLEHPTQTTLQCAQNFVKAIEANQNGAIWKLDLGRLDAIEWTKHW 250
D.affinisdisjuncta   RVAELLLEHPTQTTLQCAQNFVKAIEANQNGAIWKLDLGRLDAIEWTKHW 250
                     ----
D.buzzatti 1         DSGI 254
D.buzzatti 2         DSGI 254
D.hawaiiensis        DSGI 254
I.grimshawi          DSGI 254
D.affinisdisjuncta   DSGI 254
```

1. Faça um retângulo (ou pinte) enquadrando todas as regiões em que os aminoácidos são os mesmos em todas as espécies.
2. Construa uma matriz comparativa para as espécies colocando sobre a diagonal, o número observado de aminoácidos diferentes e, sob a diagonal, a proporção de diferenças.
3. Com o auxílio do código genético, verifique, para cada diferença, o número mínimo de diferenças no nível do DNA.

Abaixo, estão representadas as seqüências alinhadas do terceiro exon da desidrogenase alcoólica das mesmas espécies:

```
                          5        15        25        35        45
                    ----+---------+---------+---------+---------+-----
D.buzzatti 1        aaactggcgcccatcactggcgtaactgcctactccatcaaccctggcat 50
D.buzzatti 2        aaattggcgcctattactggcgtaactgcctactccatcaaccctggcat 50
D.hawaiiensis       aaattggcacatattactggcgttacggcatattccatcaacccgggcat 50
I.grimshawi         aaattggcgcatattactggcgttacggcatattccatcaacccgggcat 50
D.affinisdisjuncta  aaattggcgcatattactggcgttacggcatattccatcaacccgggcat 50
                       55        65        75        85        95
                    ----+---------+---------+---------+---------+-----
D.buzzatti 1        cacgaagacaaccttggtccacaaattcaactcgtggctggatgttgagc 100
D.buzzatti 2        cacgaagactgctctggtccacaaactgaactcgtggttgaatgtggagc 100
D.hawaiiensis       taccaagactgttctggagcattctttcaactcctggctgaatgttgagc 100
I.grimshawi         taccaagactgttctggtgcataaattcaactcctggctcggtgttgagc 100
D.affinisdisjuncta  taccaagactgttctggtgcataaattcaactcctggctgagtgttgagc 100
                       105       115       125       135       145
                    ----+---------+---------+---------+---------+-----
D.buzzatti 1        cgcgtgtggcagagctgcttctggagcatcccactcagacaactctgcag 150
D.buzzatti 2        ctcgtctggccgaactgcttctggagcatcccactcagacaagtttggag 150
D.hawaiiensis       cacgcgttgccgagctactgcttgagcatcccacacagacaacattgcag 150
I.grimshawi         cacgcgttgccgagctactgcttgagcatcccacacagacaacattgcag 150
D.affinisdisjuncta  cacgcgttgccgagctactgcttgagcaccccacacagacaacattgcag 150
                       155       165       175       185       195
                    ----+---------+---------+---------+---------+-----
D.buzzatti 1        tgcgcacagaactttgtcaaggctattgaagccaaccagaatggcgccat 200
D.buzzatti 2        tgtgcacagaactttgtcaaggctattgaagccaaccagaatggcgccat 200
D.hawaiiensis       tgcgcacagaactttgtgaaggccattgaggccaaccagaatggtgccat 200
I.grimshawi         tgcgcacagaactttgtgaaggccattgaggccaaccagaatggtgccat 200
D.affinisdisjuncta  tgcgcacagaactttgtgaaggccattgaggccaaccagaatggtgccat 200
                       205       215       225       235       245
                    ----+---------+---------+---------+---------+-----
D.buzzatti 1        ctggaaactggacttgggtcgcttggaagccattgaatggaccaagcact 250
D.buzzatti 2        ctggaaactggatttgggtcgcttggaggccattgaatggaccaagcact 250
D.hawaiiensis       ctggaaactggatcttggccgtctggatgcaatcgaatggaccaagcgct 250
I.grimshawi         ctggaaactggatcttggccgtctggatgcaatcgaatggaccaagcact 250
D.affinisdisjuncta  ctggaaactggatcttggccgtctggatgcaatcgaatggaccaagcact 250
                       255       265
                    ----+---------+--
D.buzzatti 1        gggattcgggtatctaa 267
D.buzzatti 2        gggattcgggtatttaa 267
D.hawaiiensis       gggactcaggcatctaa 267
I.grimshawi         gggactcaggcatctaa 267
D.affinisdisjuncta  gggactcaggcatctaa 267
```

4. Faça os retângulos tal como no exercício 1 e também construa uma matriz como no exercício 2. (número de diferenças e proporção delas).
5. Quais são as diferenças e semelhanças com relação à comparação entre as seqüências de aminoácidos e nuceotídios? A que você atribui as diferenças?
6. As substituições que você observa entre as seqüências são todas as que ocorreram na evolução destes organismos?

Código genético universal

```
    AAs  = FFLLSSSSYY**CC*WLLLLPPPPHHQQRRRRIIIMTTTTNNKKSSRRVVVVAAAADDEEGGGG
 Inicios = ---M---------------M---------------M---------------------------
  Base1  = TTTTTTTTTTTTTTTTCCCCCCCCCCCCCCCCAAAAAAAAAAAAAAAAGGGGGGGGGGGGGGGG
  Base2  = TTTTCCCCAAAAGGGGTTTTCCCCAAAAGGGGTTTTCCCCAAAAGGGGTTTTCCCCAAAAGGGG
  Base3  = TCAGTCAGTCAGTCAGTCAGTCAGTCAGTCAGTCAGTCAGTCAGTCAGTCAGTCAGTCAG
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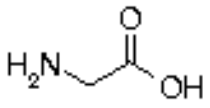

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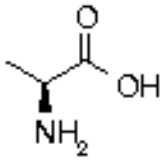

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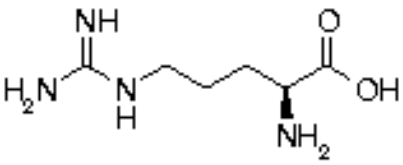

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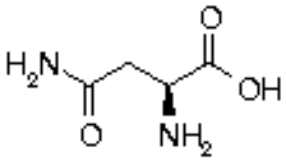

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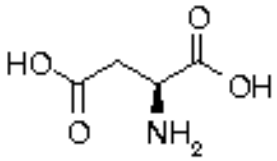

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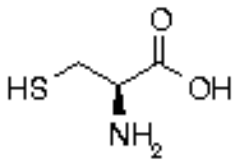

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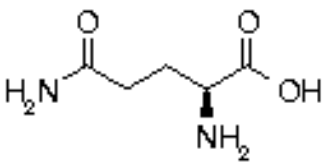

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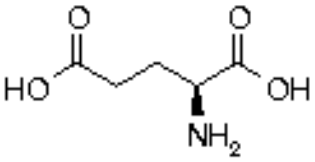

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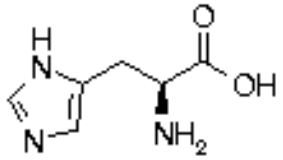

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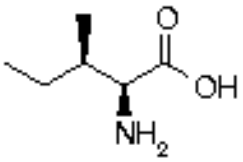

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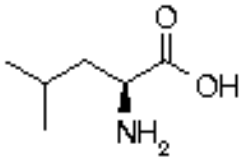

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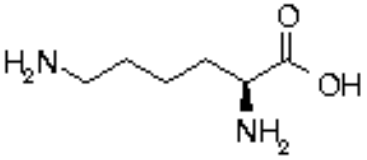

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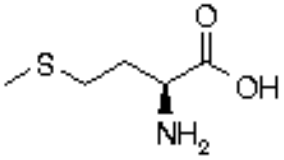

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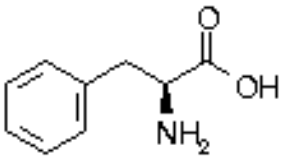

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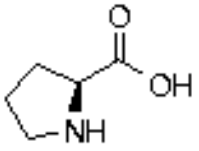

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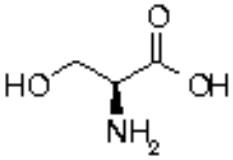

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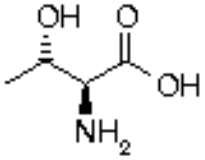

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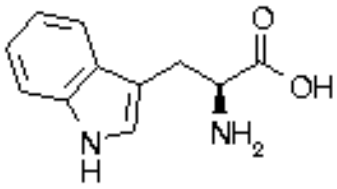

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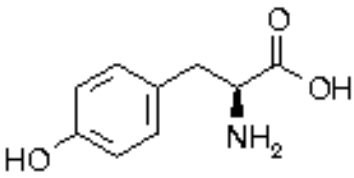

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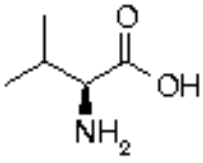

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