**Exercise 12 - Molecular Evidence for Whale Evolution**

**Lab Activity:**

In comparing amino acids between species one at a time, you may notice that this method, while accurate and effective, is rather time consuming.

The new method of doing things is to utilize the vast amount of information available on the Internet.

Both of the sites you will use today access information available on the National Center for Biotechnology Information website.

**National Center for Biotechnology Information**


The National Center for Biotechnology Information is a website sponsored by the federal government. The goal of the site is to advance science and health by providing access to biomedical and genomic information.

**Part I – Finding Sequences**

1. Open the Internet and type the NCBI homepage into your browser.


2. The aim of our investigation today is to compare the cytochrome b sequences among different mammal groups. In the box next to “Search,” click on the dropdown menu and select the “Protein” Database. In the box next to “for” type the phrase “CYTB Mammalia” and click on the “Search” button (CYTB is one of the server’s abbreviations for cytochrome b).

3. Clicking on this page takes you to the results page. Each result lists a hyperlink to the protein as well as the scientific, Latin name of the organism from which the protein was obtained.

4. As you scroll through the results, you will notice that there are upwards of 2,000 pages of entries for this particular protein.

   **Look at the information provided underneath each entry.**

   **Approximately how many amino acids make up a complete, mammalian cytochrome b protein?**

   ____________

5. As you click through the result pages, you may notice there are proteins that are fragments and are much smaller in size than the complete proteins. You want to be careful NOT to select these organisms in your investigation. All protein samples you investigate should be the full size and listed as CYTB proteins.
6. To access each individual organism, you must click on the hyperlink for the organism.

The first organism to come up in this example is *Herpestes javanicus*. Clicking on the blue hyperlink tells us that this organism is commonly known as:

7. This organism page has a great deal of information. In addition to the organism’s taxonomy, it provides links to research conducted on the protein, and, important for our investigation, a copy of the protein sequence for the organism is found at the bottom of the page.

8. ```
```
9. The mongoose, while an interesting subject for investigation, is not a species that we want to investigate in full detail today. The topic of our investigation, you may recall is to focus on the evolution of whales. Click “Back” in your browser to return to the mammal sequence page.

Once on the page, you can narrow the search even further by searching the protein database for “CYTB Cetacea,” (the mammalian order to which whales belong).

10. Among the first couple of hits identified is *Megaptera novaeangliae*. By clicking on the blue hyperlink, you can see this species is the humpback whale, a species we observed during earlier class sessions. The information provided is organized in the exact same way as the page you viewed earlier.

   Our interest is in the amino acid sequence information. Although, as you saw earlier, the amino acid sequence is listed at the bottom of the page, this format will be difficult for us to deal with when we conduct our analysis. The easier format can be found by clicking on the “Display Settings” link found at the top of the page, and then applying the “FASTA” settings.

11. On the FASTA sequence page, use your mouse to **select** and **copy** the sequence. This is shown for you below.

12. After you select and copy the information, open a Microsoft Word document and **paste** this information into your Word document.

13. **Save** your Word Document and modify your sequences so that they can be interpreted. To do so, you must remove any blank spaces from the headings so that the computer does not mistake letters for amino acids. In other words.....
The sequence given for the Humpback Whale in FASTA format looks like this:

```
>gi|62184339|ref|YP_220731.1| cytochrome b [Megaptera novaeangliae]
MTNIRKTHPMKIINDTFIDLTPSNISSWNNFGSSLGLCLIMQILTGLFLAMHYT
PDITTAFFSVTHICRDRVNYGWIRYHANGASMFICLYAHMRGRGLYGGYAFRET
WNIGVILLFTVMATAFVGVYVLWGQMSFGATVITNLSSAIPYITTLEWIGGF
SVDKATLTRFPFHFIPFIITALAIHVHILHETGSNPTGIPSMDIKIFPHYY
TIKDTLGALLLILITLLMLTLTAPDLLLGDPDNYTPANPLSTPAHIKEWYLFAYAI
LRSPINKLGGVLALLLSILILAFIPMLHTSKQRSMMFRPSQFLFWMLVADLLLT
WIGGQPVEHPYMIVGQLASILYFLILVLMPTMSLIEKLMKW
```

If you tried to enter this into a sequencing program, all the letters would be interpreted as amino acids, and you would not be able to accurately compare species. To avoid this problem, you must modify the information you obtained. Thus, the Humpback whale should be entered as:

```
>Humpback.Whale
MTNIRKTHPMKIINDTFIDLTPSNISSWNNFGSSLGLCLIMQILTGLFLAMHYT
PDITTAFFSVTHICRDRVNYGWIRYHANGASMFICLYAHMRGRGLYGGYAFRET
WNIGVILLFTVMATAFVGVYVLWGQMSFGATVITNLSSAIPYITTLEWIGGF
SVDKATLTRFPFHFIPFIITALAIHVHILHETGSNPTGIPSMDIKIFPHYY
TIKDTLGALLLILITLLMLTLTAPDLLLGDPDNYTPANPLSTPAHIKEWYLFAYAI
LRSPINKLGGVLALLLSILILAFIPMLHTSKQRSMMFRPSQFLFWMLVADLLLT
WIGGQPVEHPYMIVGQLASILYFLILVLMPTMSLIEKLMKW
```

The greater than (>) symbol indicates that what comes next is not part of the amino acid sequence. For a two or more word named organism, you must put a period in between words in the species name. For example, if you sequence a Humpback Whale, you must modify its name to read as:

```
>Humpback.Whale
```

If you fail to do so, the program will begin to read the w-h-a-l-e (in humpback whale)... as amino acids!!!

14. Try out the sequencing for yourself. Use the program to find cytochrome b sequences for the following whales, marine mammals and possible land relations of whales. Find each organism’s sequence by searching the protein database using the abbreviation of the protein (CYTB) and the scientific name of the organism in quotation marks.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey Whale</td>
<td><em>Eschrichtius robustus</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Humpback Whale</td>
<td><em>Megaptera novaeangliae</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Minke Whale</td>
<td><em>Balaenoptera acutorostrata</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Northern Right Whale</td>
<td><em>Eubalaena glacialis</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Southern Right Whale</td>
<td><em>Eubalaena australis</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Sperm Whale</td>
<td><em>Physeter catodon</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Killer Whale</td>
<td><em>Orcinus orca</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Narwhal</td>
<td><em>Monodon monoceros</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Beluga Whale</td>
<td><em>Delphinapterus leucas</em></td>
<td>Cetacea</td>
</tr>
</tbody>
</table>

Double check your spelling for each scientific name, and make sure that you select a full copy of the cytochrome b protein (it should be approximately 378 amino acids in length).
<table>
<thead>
<tr>
<th>Animal</th>
<th>Scientific Name</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottlenose Dolphin</td>
<td><em>Tursiops truncatus</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Spotted Dolphin</td>
<td><em>Stenella frontalis</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Pacific White Sided</td>
<td><em>Lagenorhynchus obliquidens</em></td>
<td>Cetacea</td>
</tr>
<tr>
<td>Dolphin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harbor Seal</td>
<td><em>Phoca vitulina</em></td>
<td>Carnivora</td>
</tr>
<tr>
<td>Atlantic Walrus</td>
<td><em>Odobenus rosmarus</em></td>
<td>Carnivora</td>
</tr>
<tr>
<td>California Sea Lion</td>
<td><em>Zalophus californianus</em></td>
<td>Carnivora</td>
</tr>
<tr>
<td>Polar Bear</td>
<td><em>Ursus maritimus</em></td>
<td>Carnivora</td>
</tr>
<tr>
<td>Caribbean Manatee</td>
<td><em>Trichechus manatus</em></td>
<td>Sirenia</td>
</tr>
<tr>
<td>Hippopotamus</td>
<td><em>Hippopotamus amphibius</em></td>
<td>Artiodactyla</td>
</tr>
</tbody>
</table>

After modifying all of your sequences, be sure to **save your Word Document**!!!

**Part II – Sequence Alignments**

15. A feature of the NCBI webpage is the **Constraint Based Multiple Alignment Tool (COBALT)**. COBALT serves to use the resources of NCBI to compare sequences and put each species into a progressive multiple alignment. From there, a simple phylogenetic tree can be constructed from this alignment.

![Image of COBALT tool](http://www.ncbi.nlm.nih.gov/tools/cobalt/)

16. The COBALT page asks you to enter protein accession, gis, or FASTA sequences. We have already compiled this information in the first part of this exercise.

Return to your Word document that contains your cytochrome sequences. **Select** all of your sequences, **Copy** them and **Paste** them into the box where it indicates you should paste sequences.

17. The alignment itself takes several moments to run (more so today because we are all on the site at the same time). Once it has completed, it will show you the analysis that it ran between all species. The information provided will include information on things like number of amino acids in the protein and information about the similarities and differences that occur in the sequences.

18. You can get the program to construct a phylogenetic tree by clicking on the “Phylogenetic Tree” hyperlink in the top right hand corner of the page.
A phylogenetic tree shows the evolutionary relationship among various species that are believed to have a common ancestor. These trees also take into consideration evolutionary time through the distances between sequences (or the “leaves” of the tree).

Analysis:

In the space below, copy the phylogram you created in today’s class. (Note: the right whales have been joined on this phylogram so as to be consistent with the one you developed in earlier class sessions)

Prior to conducting this exercise, which organism(s) on the list would you have predicted to be the closest relatives to modern whales and dolphins?

______________________________

According to this molecular phylogeny, which organism is the closest relative to modern whales?

______________________________

What is surprising to you about the organism that is the closest genetic relatives to whales?

________________________________________________
The sequences you analyzed today were amino acid sequences. Would you expect to get the same results if you compared the DNA of these organisms instead of amino acids? Explain your response.

Based upon the result of this analysis, are whales a monophyletic group or a polyphyletic group? Justify your response.

Sequences

>Blue.Whale
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLIVQILTGLFLAMHYTDPDTAFASSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW

>Humpback.Whale
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLIMQILTGLFLAMHYTDPDTAFASSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW

>Sperm.Whale
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLIMQILTGLFLAMHYTDPDTAFASSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW

>Killer.Whale
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLVQILITGLFLAMHYTSDTLFAFSSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW

>Dugong
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLVQILITGLFLAMHYTSDTLFAFSSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW

>Caribbean.Manatee
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLVQILITGLFLAMHYTSDTLFAFSSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW

>Harbor.Seal
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLVQILITGLFLAMHYTSDTLFAFSSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW

>California.Sea.Lion
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLVQILITGLFLAMHYTSDTLFAFSSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW

>Walrus
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLVQILITGLFLAMHYTSDTLFAFSSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW

>Sea.Otter
MTNIRKTHLMLKINNAFIDLTPNSISSWNFGSLLGCLVQILITGLFLAMHYTSDTLFAFSSVTHIC RDVNYGVWRLYHANGAFMFLCIALHYGHGGLYSHAFRETWINIGIVLVTVMATAVFGYFLVGQMFSG WGAQTVNLSALAIYGTTLVEWINGGSVDKATLTFRAFHNIFLFIIMALAIYHLIHLHETSNPTG IPSDMDKIPPHYYTKIDGALLLLIITLMHTFAFDLGDPDNYTPANLSPAHHKPEWYFLFAAI LRSIPNKGGVLALLLSILILAPIMLHTSKSQRMMERFPSQFQFLFWVLADDLTTLWIGQFVEHPYIV GQLASILYFLLLILMTASLIEKLNKLMW
Polar Bear

MTNRKTHPLAKINNSFDLPTSNASONWFGSSLGVCILILQILTGLF
AMHYSDDTTAFASSVTHIC
RDVNYGWIRYVMHANGASMSGFICLFLHVGRGLYGSYTFLTWI
GIVIIIILTTMAFMGILVLPWQGQMSF
WGAIVTNILSAIPYTGLLEVWIGGFSVDKATLRFFAFHFLFPII
LATAALAVHLLFLEHTSGSN
IPSDSFKHPHYITIKDLIGAILLLILALVLFSDLPDGPP
ANPLFTPHIKPEWILFYFAI
LRSIPNKLGGVLAALIALILALPHTLSQKRMFRPSLQCLF
WAVDLILLTWIGQPVEHFPII
GQASILYFLTILLILMPVAGIENNLLKW

Eurasian Wolf

MTNRKTHPLAKVNVNFSFIDLPAPSASONWFGSSLGVCILILQ
ILTGLFLAMHYSDDTAFASSVTHIC
RDVNYGWIRYVMHANGASMSGFICLFLHVGRGLYGSYTFLTWI
GIVIIIILTTMAFMGILVLPWQGQMSF
WGAIVTNILSAIPYTGLLEVWIGGFSVDKATLRFFAFHFLFPII
LATAALAVHLLFLEHTSGSN
IPSDSFKHPHYITIKDLIGAILLLILALVLFSDLPDGPP
ANPLFTPHIKPEWILFYFAI
LRSIPNKLGGVLAALIALILALPHTLSQKRMFRPSLQCLF
WAVDLILLTWIGQPVEHFPII
GQASILYFLTILLILMPVAGIENNLLKW

Dog

MTNRKTHPLAKVNVNFSFIDLPAPSASONWFGSSLGVCILILQ
ILTGLFLAMHYSDDTAFASSVTHIC
RDVNYGWIRYVMHANGASMSGFICLFLHVGRGLYGSYTFLTWI
GIVIIIILTTMAFMGILVLPWQGQMSF
WGAIVTNILSAIPYTGLLEVWIGGFSVDKATLRFFAFHFLFPII
LATAALAVHLLFLEHTSGSN
IPSDSFKHPHYITIKDLIGAILLLILALVLFSDLPDGPP
ANPLFTPHIKPEWILFYFAI
LRSIPNKLGGVLAALIALILALPHTLSQKRMFRPSLQCLF
WAVDLILLTWIGQPVEHFPII
GQASILYFLTILLILMPVAGIENNLLKW

Hippopotamus

MTNRKSHPLKINDAFVDPAPSASONWFGSSLGVCILILQILT
GLFAMHYSDDTAFASSVTHIC
RDVNYGWIRYVMHANGASMSGFICLFLHVGRGLYGSYTFLTWI
GIVIIIILTTMAFMGILVLPWQGQMSF
WGAIVTNILSAIPYTGLLEVWIGGFSVDKATLRFFAFHFLFPI
LATAALAVHLLFLEHTSGSN
IPSDSFKHPHYITIKDLIGAILLLILALVLFSDLPDGPP
ANPLFTPHIKPEWILFYFAI
LRSIPNKLGGVLAALIALILALPHTLSQKRMFRPSLQCLF
WAVDLILLTWIGQPVEHFPII
GQASILYFLTILLILMPVAGIENNLLKW

Cow

MTNRKSHPLKIVNNDLFDLAPSASONWFGSSLGVCILILQIL
TGFLAMHYSDDTAFASSVTHIC
RDVNYGWIRYVMHANGASMSGFICLFLHVGRGLYGSYTFLTWI
GIVIIIILTTMAFMGILVLPWQGQMSF
WGAIVTNILSAIPYTGLLEVWIGGFSVDKATLRFFAFHFLFPI
LATAALAVHLLFLEHTSGSN
IPSDSFKHPHYITIKDLIGAILLLILALVLFSDLPDGPP
ANPLFTPHIKPEWILFYFAI
LRSIPNKLGGVLAALIALILALPHTLSQKRMFRPSLQCLF
WAVDLILLTWIGQPVEHFPII
GQASILYFLTILLILMPVAGIENNLLKW

Horse

MTNRKSHPLKINNSFDLAPSASONWFGSSLGVCILILQILT
GLFAMHYSDDTAFASSVTHIC
RDVNYGWIRYVMHANGASMSGFICLFLHVGRGLYGSYTFLTWI
GIVIIIILTTMAFMGILVLPWQGQMSF
WGAIVTNILSAIPYTGLLEVWIGGFSVDKATLRFFAFHFLFPI
LATAALAVHLLFLEHTSGSN
IPSDSFKHPHYITIKDLIGAILLLILALVLFSDLPDGPP
ANPLFTPHIKPEWILFYFAI
LRSIPNKLGGVLAALIALILALPHTLSQKRMFRPSLQCLF
WAVDLILLTWIGQPVEHFPII
GQASILYFLTILLILMPVAGIENNLLKW

Rhinoceros

MTNRKSHPLKINNSFDLAPSASONWFGSSLGVCILILQILT
GLFAMHYSDDTAFASSVTHIC
RDVNYGWIRYVMHANGASMSGFICLFLHVGRGLYGSYTFLTWI
GIVIIIILTTMAFMGILVLPWQGQMSF
WGAIVTNILSAIPYTGLLEVWIGGFSVDKATLRFFAFHFLFPI
LATAALAVHLLFLEHTSGSN
IPSDSFKHPHYITIKDLIGAILLLILALVLFSDLPDGPP
ANPLFTPHIKPEWILFYFAI
LRSIPNKLGGVLAALIALILALPHTLSQKRMFRPSLQCLF
WAVDLILLTWIGQPVEHFPII
GQASILYFLTILLILMPVAGIENNLLKW

Indian Elephant

MTNRKSHPLKINNSFDLAPSASONWFGSSLGVCILILQILT
GLFAMHYSDDTAFASSVTHIC
RDVNYGWIRYVMHANGASMSGFICLFLHVGRGLYGSYTFLTWI
GIVIIIILTTMAFMGILVLPWQGQMSF
WGAIVTNILSAIPYTGLLEVWIGGFSVDKATLRFFAFHFLFPI
LATAALAVHLLFLEHTSGSN
IPSDSFKHPHYITIKDLIGAILLLILALVLFSDLPDGPP
ANPLFTPHIKPEWILFYFAI
LRSIPNKLGGVLAALIALILALPHTLSQKRMFRPSLQCLF
WAVDLILLTWIGQPVEHFPII
GQASILYFLTILLILMPVAGIENNLLKW

African Elephant

MTNRKSHPLKINNSFDLAPSASONWFGSSLGVCILILQILT
GLFAMHYSDDTAFASSVTHIC
RDVNYGWIRYVMHANGASMSGFICLFLHVGRGLYGSYTFLTWI
GIVIIIILTTMAFMGILVLPWQGQMSF
WGAIVTNILSAIPYTGLLEVWIGGFSVDKATLRFFAFHFLFPI
LATAALAVHLLFLEHTSGSN
IPSDSFKHPHYITIKDLIGAILLLILALVLFSDLPDGPP
ANPLFTPHIKPEWILFYFAI
LRSIPNKLGGVLAALIALILALPHTLSQKRMFRPSLQCLF
WAVDLILLTWIGQPVEHFPII
GQASILYFLTILLILMPVAGIENNLLKW