PHYLOGENY TREES

Introduction

Phylogeny trees (or cladograms) are branching diagrams used to show the evolutionary relationships between species. The tree is arranged into groups of species called clades, with each clade consisting of an ancestral organism and all of its evolutionary descendants. Each branch point (node) within the phylogeny tree represents a point of divergence from a shared ancestor. The fewer nodes between two groups the more closely related they are expected to be.

Aim

To use molecular sequences of various species and an online alignment tool to generate a cladogram

Method

1. Go to Clustal Omega website: https://www.ebi.ac.uk/jdispatcher/msa/clustalo
2. Input the sequences listed on the next page (download the pdf of this activity to copy and paste)
3. Ensure the sequence type is set to 'Protein' (sequences derived from haemoglobin alpha chain)
4. Label each sequence with a mathematical right bracket and the species name (>Name)
5. After submitting the data, select 'Guide Tree' to view results (adjust the spacings for visual clarity)

Results

Paste or sketch a copy of the phylogeny tree in the space below

Discussion

1. Identify all the species in the tree that would belong to a primate clade

2. Suggest a species that could represent the secret sequence and justify your decision

3. Explain why molecular sequences are considered more reliable than structural characteristics for determining evolutionary relationships via phylogeny trees

4. Suggest how the time since evolutionary divergence could be estimated from sequence data

Amino Acid Sequences (Haemoglobin Alpha Subunit)

Goldfish	MSLSDPDKAVVKALWAKIGSRADEIGAEALGRMLTVYPQTKTYFSHWSDLSPGSGPVKKHGKTIMGAVG DAVSKIDDLVGALSSLSELHAFNVRIDPANFKILALNVIVVIGMHFPGDFTPEVHMSVDKFFQNLALALSDK
Sheep	MVLSAADKSNVKAAWDKVGGNAGAYGAEALERMFLSFPTTKTYFPHFDLSHGSAQVKGHGEKVAAALTK AVGHLDDLPGTLSDLSDLHAHKLRVDPVNFKLLSHTLLVTLACHLPNDFTPAVHASLDKFLANVSTVLTSK
Duck	MVLSAADKTNVKGVFSKIGGHAEEYGAETLERMFIAYPQTKTYFPHFDLSHGSAQIKAHGKKVAAALVEAV NHVDDIAGALSKLSDLHAQKLRVDPVNFKFLGHCFLVVVAIHHPAALTPEVHASLDKFMCAVGAVLTAK
Horse	MVLSAADKTNVKAAWSKVGGHAGEFGAEALERMFLGFPTTKTYFPHFDLSHGSAQVKAHGKKVGDALTL AVGHLDDLPGALSNLSDLHAHKLRVDPVNFKLLSHCLLSTLAVHLPNDFTPAVHASLDKFLSSVSTVLTSK
Chicken	MVLSAADKNNVKGIFTKIAGHAEEYGAETLERMFTTYPPTKTYFPHFDLSHGSAQIKGHGKKVVAALIEAA NHIDDIAGTLSKLSDLHAHKLRVDPVNFKLLGQCFLVVVAIHHPAALTPEVHASLDKFLCAVGTVLTAK
Frog	MHLTADDKKHIKAIWPSVAAHGDKYGGEALHRMFMCAPKTKTYFPDFDFSEHSKHILAHGKKVSDALNE ACNHLDNIAGCLSKLSDLHAYDLRVDPGNFPLLAHQILVVVAIHFPKQFDPATHKALDKFLVSVSNVLTSK
Tortoise	MVLTAGDKANVKTVWSKVGSHLEEYGSETLERLFIVYPSTKTYFPHFDLHHDSAQVRAHGRKVLSALGEAV NHIDDIPGALSKLSDLHAQTLRVDPVNFKLLNLCFVVVVGRHHPTILTPEVHVSLDKFLSAVATALTSK
Bat	MVLSPADKTNVKAAWDKVGGHAGDYGAEALERMFLSFPTTKTYFPHFSDLSHGSAQVKAHGKKVGDAL NNAVGHMDDLPTALSALSDLHAHKLRVDPVNFKLLSHCLLVTLACHHPAEFTPAVHASLDKFLANVSTVLV
Macaque	MVLSPADKSNVKAAWGKVGGHAGEYGAEALERMFLSFPTTKTYFPHFDLSHGSAQVKGHGKKVADALTL AVGHVDDMPNALSALSDLHAHKLRVDPVNFKLLSHCLLVTLAAHLPAEFTPAVHASLDKFLASVSTVLTSK
Zebra	MVLSAADKTNVKAAWSKVGGNAGEFGAEALERMFLGFPTTKTYFPHFDLSHGSAQVKAHGKKVGDALT LAVGHLDDLPGALSNLSDLHAHKLRVDPVNFKLLSHCLLSTLAVHLPNDFTPAVHASLDKFLSTVSTVLTSK
Cow	MVLSAADKGNVKAAWGKVGGHAAEYGAEALERMFLSFPTTKTYFPHFDLSHGSAQVKGHGAKVAAALT KAVEHLDDLPGALSELSDLHAHKLRVDPVNFKLLSHSLLVTLASHLPSDFTPAVHASLDKFLANVSTVLTSK
Lemur	VLSPADKTNVKTAWNAVGGQAGEHGAEALERMFLSFPTTKTYFPHFDLSHGSGQVKAHGKKVADALTNA VSHLDDMPGALSALSDLHAHKLRVDPVNFKLLSHCLLVTLASHHPAEFTPAVHASLDKFFAAVSTVLTSK
Shark	STSTSTSDYSAADRAELAALSKVLAQNAEAFGAEALARMFTVYAATKSYFKDYKDFTAAAPSIKAHGAKVVT ALAKACDHLDDLKTHLHKLATFHGSELKVDPANFQYLSYCLEVALAVHLTEFSPETHCALDKFLTNVCHELSS
Gorilla	VLSPADKTNVKAAWGKVGAHAGDYGAEALERMFLSFPTTKTYFPHFDLSHGSAQVKGHGKKVADALTNA VAHVDDMPNALSALSDLHAHKLRVDPVNFKLLSHCLLVTLAAHLPAEFTPAVHASLDKFLASVSTVLTSK
Elephant	VLSDNDKTNVKATWSKVGDHASDYVAEALERMFFSFPTTKTYFPHFDLGHGSGQVKAHGKKVGEALTQA VGHLDDLPSALSALSDLHAHKLRVDPVNFKLLSHCLLVTLSSHQPTEFTPEVHASLDKFLSNVSTVLTSK
Walrus	VLSGEDKNNIKTAWGKIGGHAAEYGAEALERMFVVYPTTKTYFPHFDVSHGSGQVKAHGKKVADALTTAV GHLDDLPGALSALSDLHAHKLRVDPVNFKLLSHCLLVTLANHIPADFTPAVHASLDKFLASVSTVLTSK
Lion	MVLSSADKNNVKACWGKIGSHAGEYGAEALERTFCSFPTTKTYFPHFDLSHGSAQVQAHGQKVADALTK AVVHINDLPNALSDLSDLHAYKLRVDPVNFKFLSHCLLVTLACHHPEEFTPAVHASLDKFFSAVSTVLTSK
Cat	VLSAADKSNVKACWGKIGSHAGEYGAEALERTFCSFPTTKTYFPHFDLSHGSAQVKAHGQKVADALTQAV AHMDDLPTAMSALSDLHAYKLRVDPVNFKFLSHCLLVTLACHHPAEFTPAVHASLDKFFSAVSTVLTSK
Wolf	VLSPADKTNIKSTWDKIGGHAGDYGGEALDRTFQSFPTTKTYFPHFDLSPGSAQVKAHGKKVADALTTAVA HLDDLPGALSALSDLHAYKLRVDPVNFKLLSHCLLVTLACHHPTEFTPAVHASLDKFFTAVSTVLTSK
Human	MVLSPADKTNVKAAWGKVGAHAGEYGAEALERMFLSFPTTKTYFPHFDLSHGSAQVKGHGKKVADALTN AVAHVDDMPNALSALSDLHAHKLRVDPVNFKLLSHCLLVTLAAHLPAEFTPAVHASLDKFLASVSTVLTSK
Secret	VLSGTDKTNVKSIFSKIGGQADDYGAEALERMFVTYPQTKTYFPHFDVSPGSAQVKAHGKKVAGGLSEAA NHIDDIATSLSKLSDLHAQKLRVDPVNFKLLGQCFLVVVAIHNPSALTPEAHASLDKFLCAVGLVLTAK