

Data Charts: Investigating Evolutionary Questions Using Online Databases

Part 1 Tables and Questions

1.1) What other morphological features could be used to compare bats to birds and mammals?

1.2) Write an explanation based on the data table to explain if bats are more closely related to birds or to mammals.

Table 2: List of species used for Part 1

Species	Common Name	Scientific Name	Black HBB Code
Bat Species #1			
Bat Species #2			
Bird Species #1			
Bird Species #2			
Mammal species #1			
Mammal species #2			

Table 3: Distance matrix for Part 1 (No need to fill in the X'd boxes; this just repeats information)

	Bat #1	Bat #2	Bird #1	Bird #2	Mammal #1	Mammal #2
Bat #1	100%					
Bat #2	XXXX	100%				
Bird #1	XXXX	XXXX	100%			
Bird #2	XXXX	XXXX	XXXX	100%		
Mammal #1	XXXX	XXXX	XXXX	XXXX	100%	
Mammal #2	XXXX	XXXX	XXXX	XXXX	XXXX	100%

1.3) Which two species in the above table have the most similar beta-hemoglobin chains? Explain using the data.

1.4) Which two species in the above table have the least similar beta-hemoglobin chains? Explain using the data.

1.5) For bat #1, make a list of species that have the most similar beta-hemoglobin sequence to the least similar including the % identity.

1.6) For bat #2, make a list of species that have the most similar beta-hemoglobin sequence to the least similar including the % identity.

1.7) Does this information seem consistent with the hypothesis that bats are mammals?

1.8) Using all the data from Part 1, write a final conclusion statement based on evidence about whether bats are more closely related to other mammals than to birds.

1.9) Draw the phylogenetic tree of the six species you selected. Include the common name rather than the HBB code. Lines and placement of the branches should be identical to the website. Write a summary statement about the relationships between the species.

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Part 2 Tables and Questions

2.1) What are some examples of perissodactyl mammals (at least 3)?

2.2) What are some examples of artiodactyl mammals (at least 3)?

2.3) What are some morphological distinctions (differences) between perissodactyls and artiodactyls?

Table 4: Species used for Part 2

Species	Common Name	Scientific Name	Black HBB Code
Whale Species			
Fish Species			
Odd-toed mammal #1			
Odd-toed mammal #2			
Even-toed mammal #1			
Even-toed mammal #2			

Table 5: Distance matrix for Part 2 (No need to fill in the X'd boxes; this just repeats information)

	Whale Species	Fish Species	Odd-toed mammal #1	Odd-toed mammal #2	Even-toed mammal #1	Even-toed mammal #2
Whale Species	100%					
Fish Species	XXXX	100%				
Odd-toed mammal #1	XXXX	XXXX	100%			
Odd-toed mammal #2	XXXX	XXXX	XXXX	100%		
Even-toed mammal #1	XXXX	XXXX	XXXX	XXXX	100%	
Even-toed mammal #2	XXXX	XXXX	XXXX	XXXX	XXXX	100%

2.4) Is the whale hemoglobin more similar to the fish hemoglobin, or to the mammal hemoglobin? Explain using the data.

2.5) Is the whale hemoglobin more similar to the hemoglobin of odd-toed mammals or even-toed mammals? Explain using the data.

- 2.6) A. Was the hemoglobin of the whale much more similar to the hemoglobin of mammals of one type of foot than the other or just a little more similar?
- B. With this in mind, what problems do you see with using your answer to 2.5 to conclude from which type of four-footed mammal whales evolved?
- 2.7) The graduate student's advisor suggested that she examine published paleontological and molecular studies to see what other researchers have concluded about the closest relatives of whales. Examine the articles referenced in the directions, and determine whether your conclusion is the same as their conclusions regarding the feet of the ancestors of whales. If your conclusion is different, propose some reasons why.
- 2.8) Draw the phylogenetic tree of the six species you selected. Include the common name rather than the HBB code. Lines and placement of the branches should be identical to the website.

Part 3 Tables and Questions

Table 6: Results of a BLAST search on the crocodile beta-hemoglobin sequence

Similarity	Species name & name of protein
First most similar (do not use crocodile)	
Second most similar	
Third most similar	
Fourth most similar	
Fifth most similar	
Sixth most similar	
Seventh most similar	
Eighth most similar	
Ninth most similar	
Tenth most similar	

3.1) Define monophyletic, paraphyletic, and polyphyletic.

3.2) A. Were any of the species listed birds?

B. One unusual reptile is the tuatara, whose scientific name is *Sphenodon punctatus*. How similar is the tuatara to the crocodile?

3.3) Does the tuatara appear in your list of ten? If not, how far down on the BLAST search list does it occur, fifteenth, twentieth, ect? (Hint: *Sphenodon punctatus* is abbreviated as "sphpu" in the NCBI blast search list.)

3.4) Most importantly, which species are more similar to the crocodile? (birds or other reptiles)

Many phylogenetic systematists believe that the names of taxa should include ALL the relatives of the most recent common ancestor of that group (in technical terms, they believe that the group should be “monophyletic”). If Reptilia is monophyletic, then all reptiles should be more closely related to the crocodile than any other non-reptilian group. If any other non-reptile is more closely related than a reptile, then the group is paraphyletic.

3.5) Do the molecular data suggest that Reptilia is paraphyletic or monophyletic? Explain.

3.6) How important and of what use is it that the taxonomy and classification of organisms reflect the evolutionary relationships of organisms?