

Name \_\_\_\_\_

Date \_\_\_\_\_

TABLES FOR DATA ENTRY, QUESTIONS: Investigating Evolutionary Questions Using Online Databases

**PART I TABLES AND QUESTIONS**

1.1) What morphological features do bats share with mammals? With birds? Fill in **Table 1**.

**TABLE 1: Morphological comparison of birds, bats, and other non-bat**

<b>Feature</b>	<b>Birds</b>	<b>Bats</b>	<b>Other mammals</b>
Presence of hair			
Presence of feathers			
Presence of mammary glands			
Presence of wings			
Homeothermy			
Four chambers in heart			

1.2) (other morphological features to compare?): \_\_\_\_\_

\_\_\_\_\_

1.3) (bats more similar to birds, or to mammals?) \_\_\_\_\_

**TABLE 2: A list of the species used for Part I**

<b>Species</b>	<b>Common Name</b>	<b>Scientific Name</b>
Bat species #1		
Bat species #2		
Bird species #1		
Bird species #2		
Mammal species #1		
Mammal species #2		

**TABLE 3: The distance matrix for Part I** (No need to fill 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	XXXXXX	100%

ANSWER THE FOLLOWING QUESTIONS (based on Table 3):

3.1) Which two species in the above table have the most similar beta-hemoglobin chains?

\_\_\_\_\_

3.2) Which two species in the above table have the *least* similar beta-hemoglobin chains?

\_\_\_\_\_

3.3) For **bat #1**, make a list of species that have the *most* similar beta-hemoglobin sequence to the *least* similar:

- a. (most similar): \_\_\_\_\_ % identity
- b. \_\_\_\_\_ % identity
- c. \_\_\_\_\_ % identity
- d. \_\_\_\_\_ % identity
- e. (least similar): \_\_\_\_\_ % identity

3.4) For **bat #2**, make a list of species that have the *most* similar beta-hemoglobin sequence to the *least* similar:

- a. (most similar): \_\_\_\_\_ % identity
- b. \_\_\_\_\_ % identity
- c. \_\_\_\_\_ % identity
- d. \_\_\_\_\_ % identity
- e. (least similar): \_\_\_\_\_ % identity

3.5) Does this information seem consistent with the hypothesis that bats are mammals? \_\_\_\_\_

3.6) Are bats more closely related to other mammals than to birds? \_\_\_\_\_ Why do you say this?

**PART II DATA TABLES and QUESTIONS (from Procedure)**

**TABLE 4: Species used for Part II**

Species	Common Name	Scientific Name
Whale species		
Fish species		
Odd-toed mammal #1		
Odd-toed mammal #2		
Even-toed mammal #1		
Even-toed mammal #2		

4.1) Examples of perissodactyls (at least 3) \_\_\_\_\_

4.2) Examples of artiodactyls (at least 3) \_\_\_\_\_

4.3) Morphological distinctions (differences) between perissodactyls and artiodactyls:

\_\_\_\_\_

\_\_\_\_\_

**TABLE 5: Distance matrix for Part II (No need to fill 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%

5.1) Is the whale hemoglobin more similar to the fish hemoglobin, or to the mammal hemoglobin? \_\_\_\_\_  
 (Are you convinced that whales are not fish!? \_\_\_\_\_ Why?)

5.2) Is the whale hemoglobin more similar to the hemoglobin of odd-toed mammals or even-toed mammals?

5.3.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?

(Continue to next page)

5.3.b) With this in mind, what problems do you see with using your answer to 5.2 to conclude from which type of four-footed mammal whales evolved?

Return to the second paragraph under the **Procedure** for Part II.

5.4) If your conclusion is different, propose some reasons why.

### PART III DATA TABLE 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	

6.1) Were any of those species birds? \_\_\_\_\_

6.2) One unusual reptile is the tuatara, whose scientific name is *Sphenodon punctatus*. How similar is the tuatara to the crocodile?  
\_\_\_\_\_

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

6.4) 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.

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

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**PART IV: QUESTIONS (if assigned):**

IV-1) What animal came up that was most similar and that you recognized? Go look up your unknown animal in a textbook or at the library.

IV-2) What type of animal was it? \_\_\_\_\_

IV-3) Did the BLAST search help you predict what type of animal it was? \_\_\_\_\_

IV-4) How important and of what use is it that the taxonomy and classification of organisms reflect the evolutionary relationships of organisms?

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